

No. 2

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INSTITUTO NACIONAL DE RECURSOS HIDRAULICOS (INDRHI)
THE DOMINICAN REPUBLIC

**THE FEASIBILITY STUDY
ON
THE LIMON DEL YUNA AREA AGRICULTURAL
DEVELOPMENT PROJECT**

FINAL REPORT

VOLUME I: MAIN REPORT

NOVIEMBRE 1995

**PACIFIC CONSULTANTS INTERNATIONAL
KOKUSAI KOGYO CO., LTD.**

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The following foreign exchange rate is applied in the study:
US\$1.00=RD\$12.87 (as of March 1995)

PREFACE

In response to a request from the Government of the Dominican Republic , the Government of Japan decided to conduct a feasibility study on the Limon del Yuna Agricultural Development Project and entrusted the Study to Japan International Cooperation Agency (JICA).

JICA sent to the Dominican Republic a team headed by Mr. Takashi Fujita, Pacific Consultants International, three times from August 1994 to September 1995.

The team held discussions with the officials concerned of the Government of the Dominican Republic, and conducted the field survey at the study area. After returning to Japan, further studies were made by the Study team and the present report was prepared.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Dominican Republic for their close cooperation extended to the team.

November, 1995



Kimio Fujita

President

Japan International Cooperation Agency

November, 1995

Mr. Kimio Fujita
President,
Japan International Cooperation Agency,
Tokyo, Japan

Dear Mr. Fujita

Letter of Transmittal

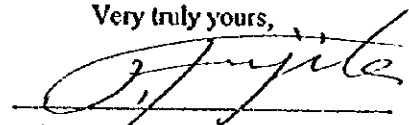
We are pleased to submit you the final report of the Feasibility Study on the Limon del Yuna Area Agricultural Development Project. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above mentioned project. The comments made by the officials concerned of the Government of Dominican Republic during discussions on the draft final report which were held in Santo Domingo and Tokyo are also taken into account in redacting this report.

The Project is concluded to be feasible judging from both economic and financial point of the view, and the implementation of the Project will contribute highly to the improvement of living standards of the farmers in the area and also to the development of the area. Furthermore, because the Project corresponds to the phase III of the AGLIPO Agricultural Development Project to which the Government of Japan has been rendering technical and financial cooperation since 1980 and the phase II of the AGLIPO Project is to be implemented in 1995, the inhabitants in the area is eagerly anticipating the realization of the last AGLIPO Project.

In view of the importance of the Agricultural development in the area, we recommend that the Government of the Dominican Republic puts the utmost priority to implementation of this Project.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Agriculture, Forestry and Fisheries and the Embassy of Japan in the Dominican Republic. We also wish to express our deep gratitude to the officials concerned of the Government of the Dominican Republic for their close cooperation and assistance extended to us during our field study.

Very truly yours,



Takashi Fujita

Team Leader

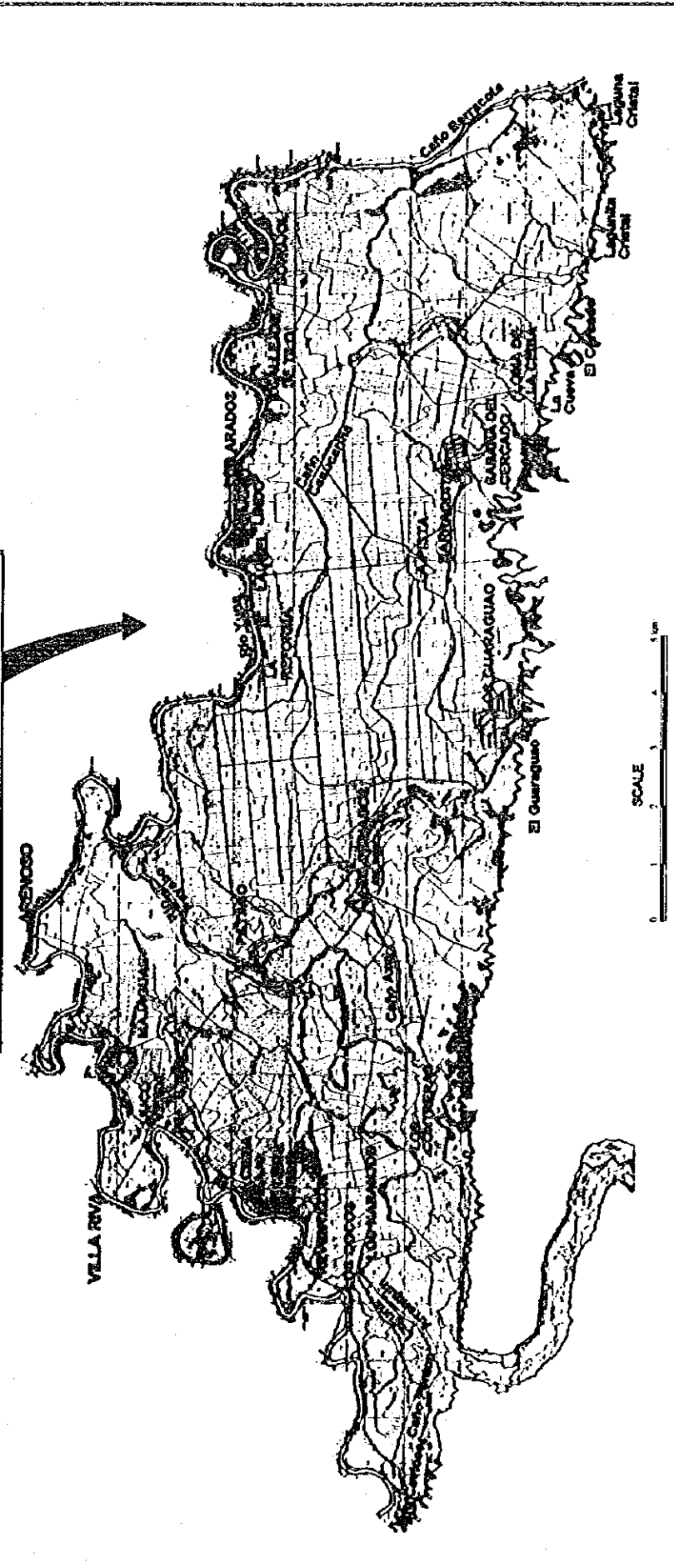
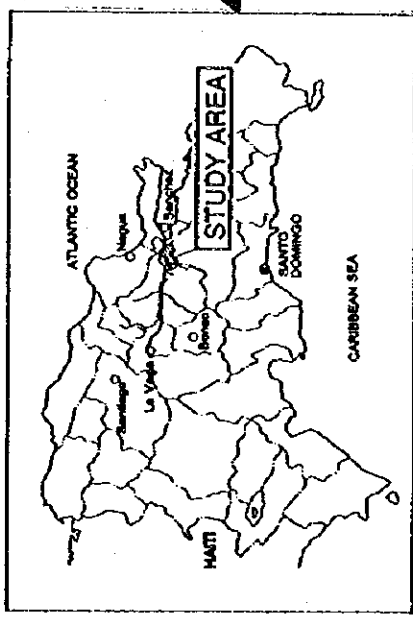
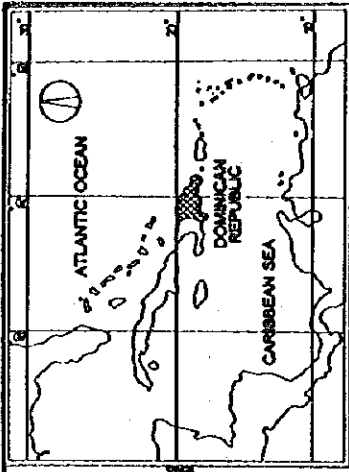
Feasibility Study Team on the

Limon del Yuna Agricultural

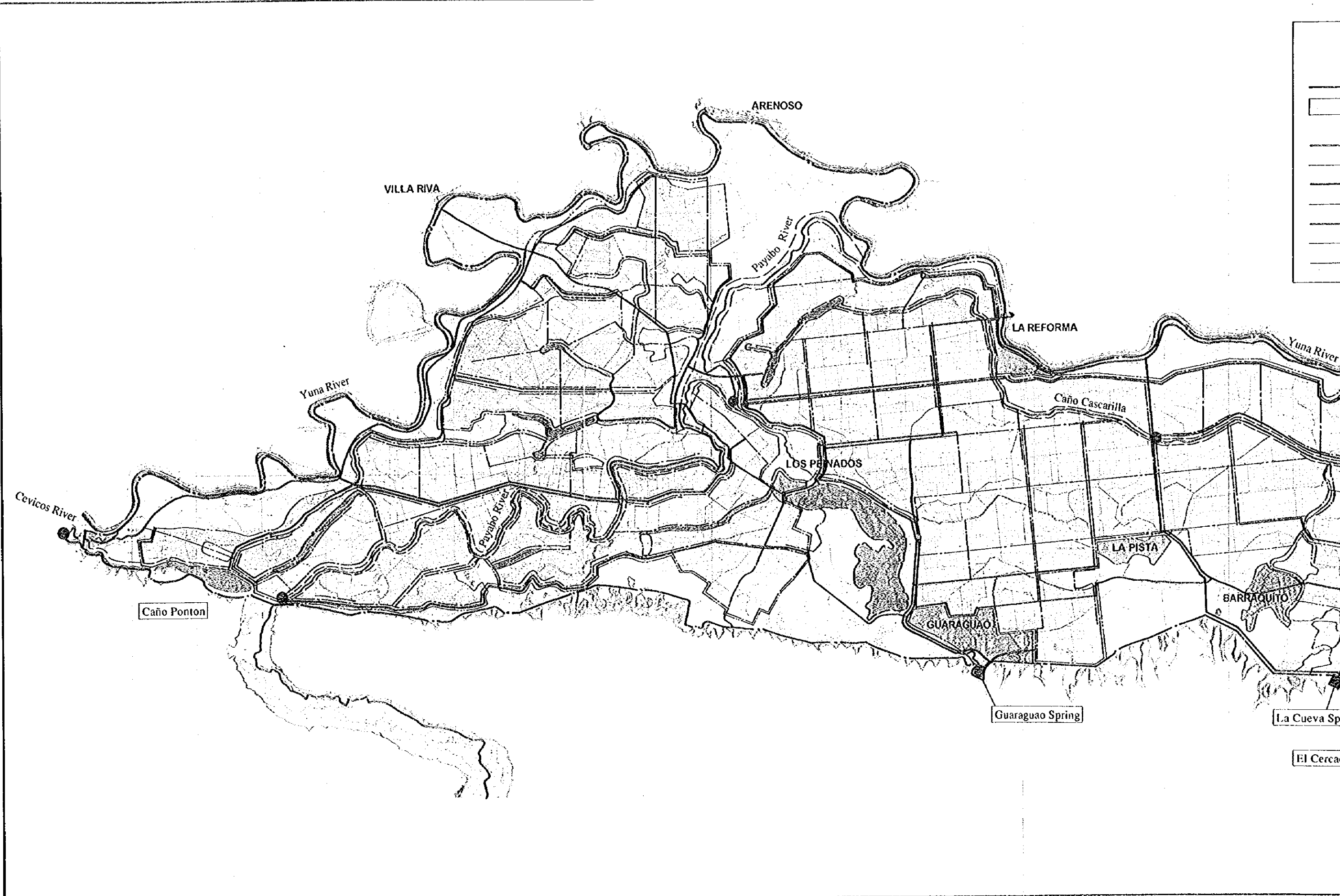
Development Project

Pacific Consultants International/

Kokusai Kogyo Inc.



LOCATION MAP



ARENOSO

VILLA RIVA

Payabo River

LA REFORMA

Yuna River

Caño Cascarilla

Yuna River

LOS PENADOS

Payabo River

LA PISTA

Cevicos River

Caño Ponton

BARRAQUITO

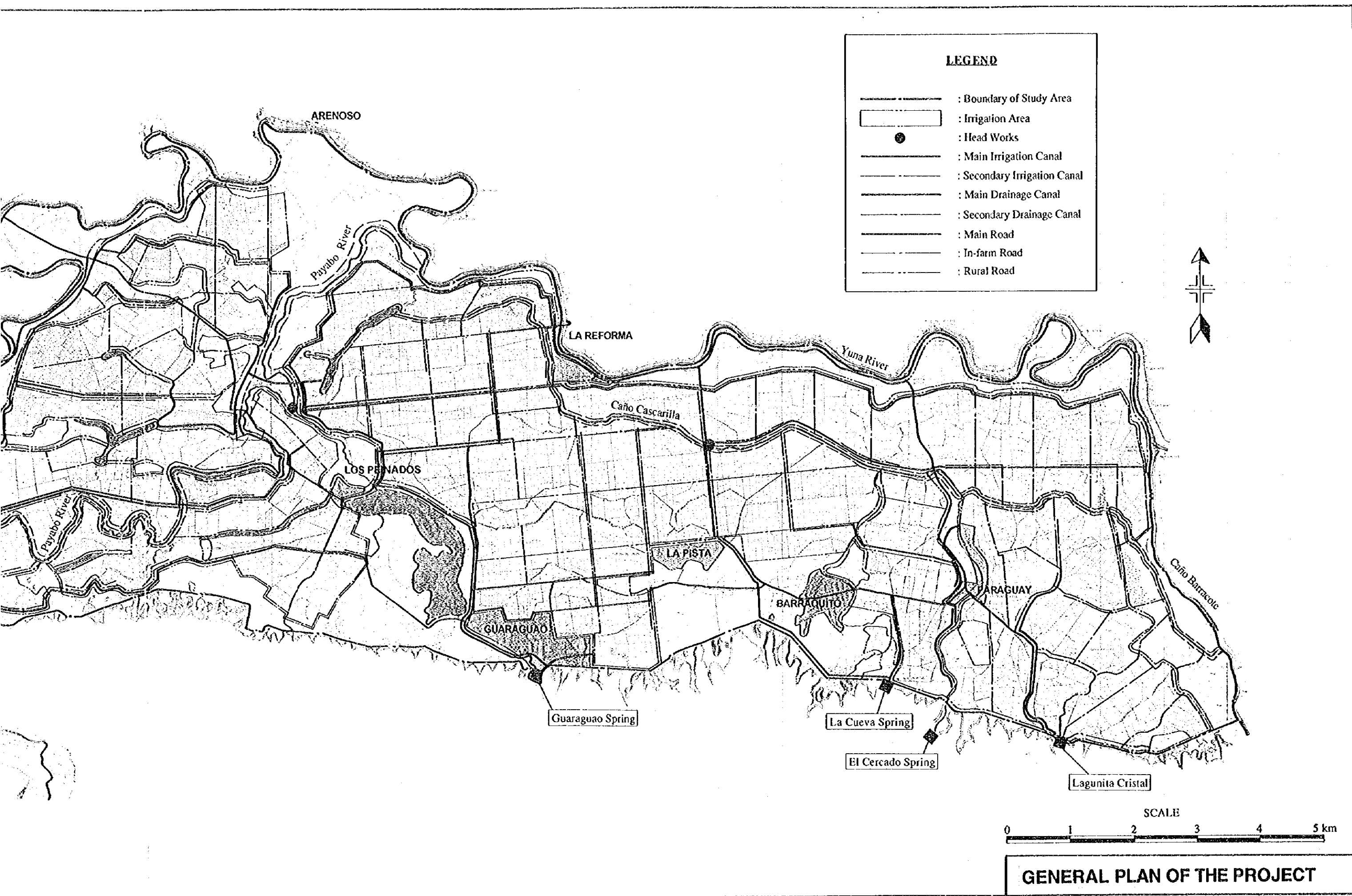
GUARAGUAO

Guaraguo Spring

La Cueva Sp

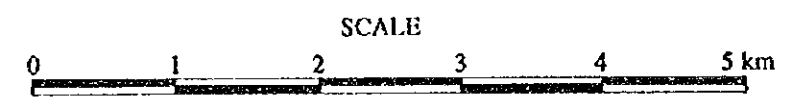
El Cerca





LEGEND

- : Boundary of Study Area
- ▭ : Irrigation Area
- : Head Works
- : Main Irrigation Canal
- - - : Secondary Irrigation Canal
- : Main Drainage Canal
- - - : Secondary Drainage Canal
- : Main Road
- - - : In-farm Road
- · · : Rural Road

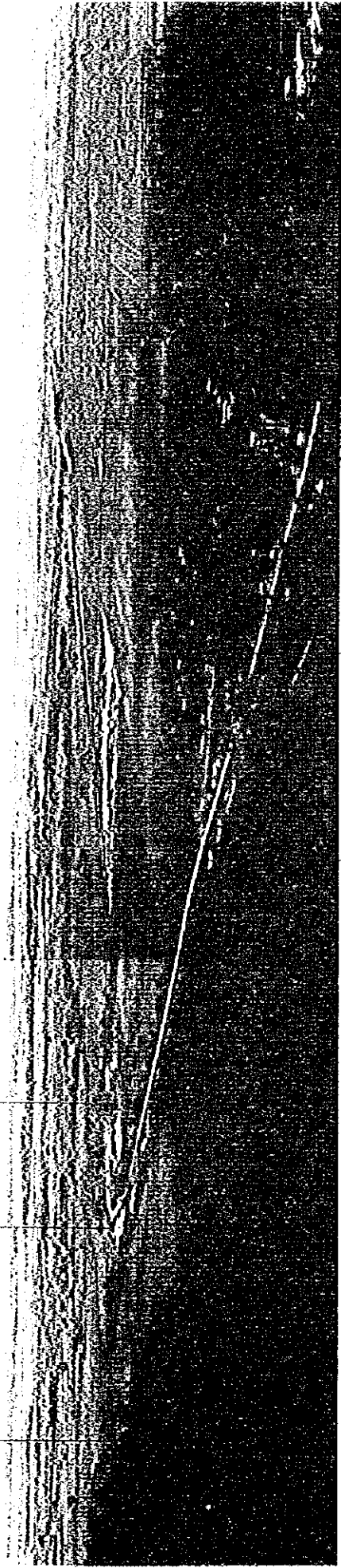


GENERAL PLAN OF THE PROJECT

Mt. Los Haitises

Site of Reservoir

Rice Mill (FALY)

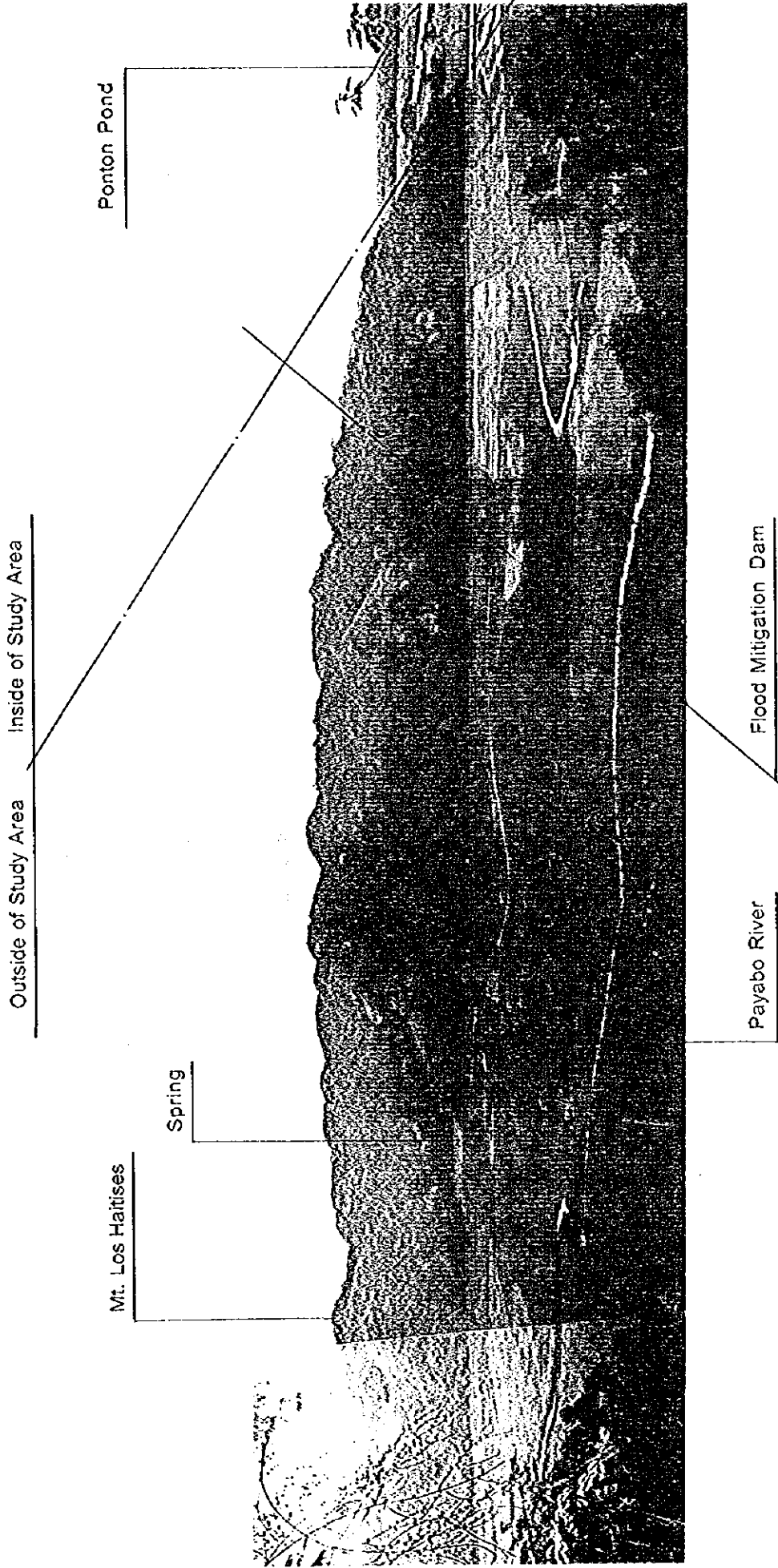


Main Road

Main Irrigation Canal

Settlement of Guaraguao

Central Study Area

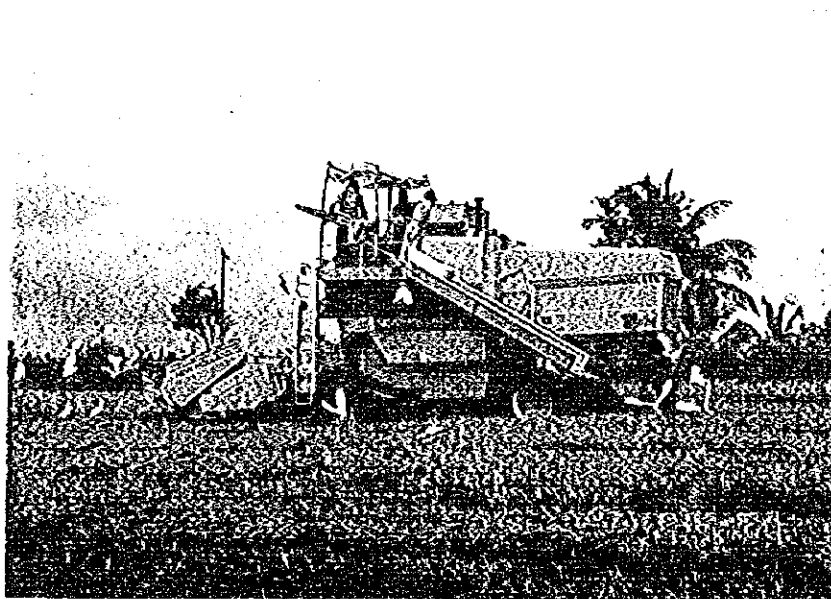


Upper Stream of Payabo River, Western Side of Study Area



Paddy Field preparation
by draft cattle

Settlers generally use either cultivator or draft cattle for plowing and large scale land owners use tractors for rotary tilling and leveling



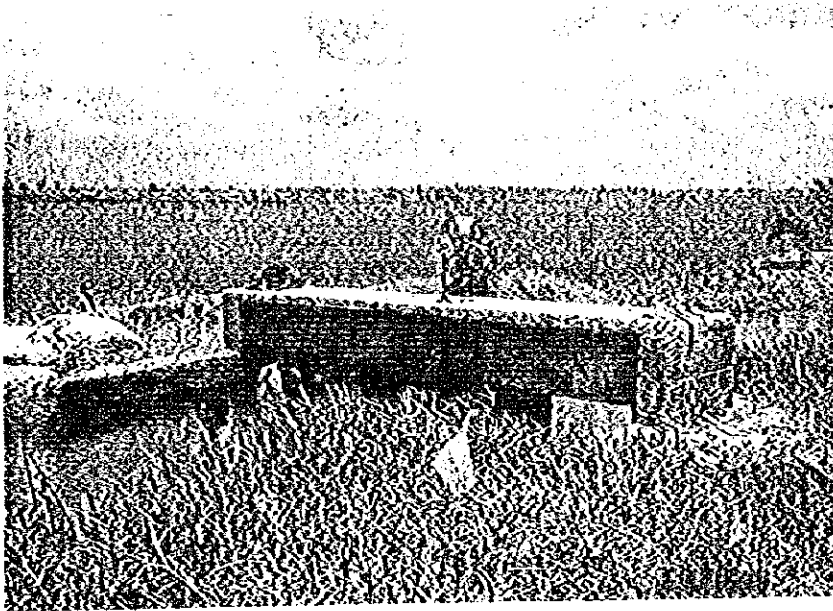
Harvesting scene by
combine harvester

More than 95% of the area's entire paddy fields are harvested using combine harvesters from either the Federation Agrarian of Limon del Yuna



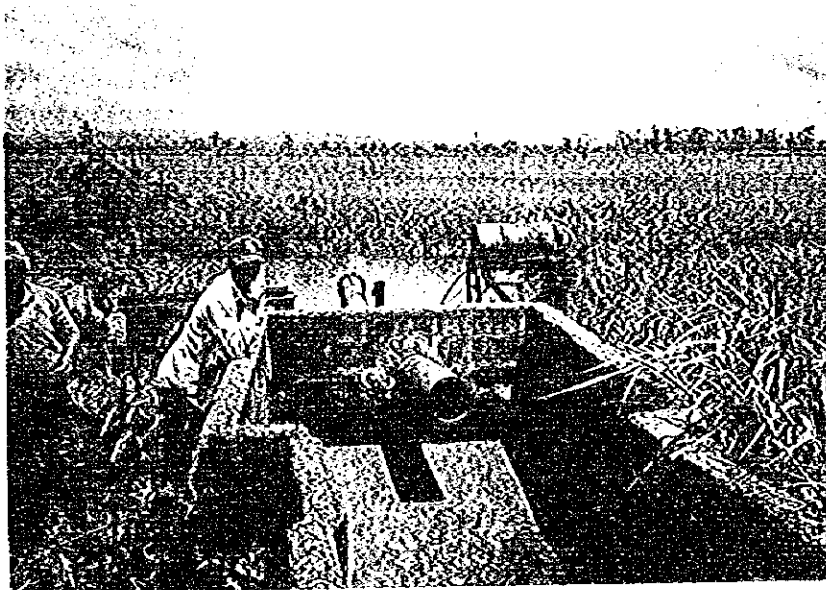
Rice mill (at Guaraguao)

A total of 18 rice mills are installed within the Study area. Of these rice mills, rice mill of Guaraguao has been operated by the Limon del Yuna Agricultural Federation (FALY) which was controlled by the settler's association, since 1992.



Typical diversion works

Sluice gate does not already function and sandbag is alternatively utilized. Irrigation canal is planned to be lined and diversion work is also to be newly constructed.



Pumping Station (D=12") under control of Dominican Agrarian Institute (IAD)

The facility is too old and badly maintained. This facility will be withdrawn in the future.



Spring(at Lagunita Cristal)

Quantity of Lagunita Cristal Spring is next to the Guaraguao in the Study area. Water-Gauge donated from JICA was installed beside the spring. Surroundings of the spring will be improved in the future.

**THE FEASIBILITY STUDY
ON
THE LIMON DEL YUNA AREA
AGRICULTURAL DEVELOPMENT PROJECT**

PROFILE OF THE DEVELOPMENT PROJECT

1. Name of the Project	Limon del Yuna Area Agricultural Development Project					
2. Country	Dominican Republic					
3. Project Area	Villa Riva City (Province of Duarte) & Sanchez City (Province of Simons)					
4. Purpose of the Project	This project area forms part of the AGLIPO Project area (approx. 25,000 ha); the AGLIPO is an abbreviation of the three sectors (Aguacate-Guayabo, Limon del Yuna and El Pozo) which are located lower basin of the Yuna river, the second largest river of the country. This area is considered as the optimum zone for rice production being endowed with favorable climatic, soil and topographic conditions, so rice culture has been predominant for various decades. Poor field drainage at swampy lands and inconsistent supply of irrigation water are identified as the leading issues which call for urgent measures to their improvement. In response to the Dominican Government request for developing the AGLIPO area as the country's major rice production area, the Government of Japan has provided both technical and financial assistance to the area and this project constitutes the phase III of the AGLIPO area development project.					
5. Land Use	Category	Paddy Field	Upland	Wetland	Others	Total
	Actual (ha)	6,680	490	2,180	100	2,550
	With project (ha)	6,650	390	1,670	70	3,220
	With project	8,820 ha				12,000
6. Irrigable Area	Directly beneficial farmer: 2,220 Indirectly beneficial non-farmer: 118					
7. Beneficiaries	Indirectly beneficial farmer: 476					
8. Major Construction Works	<ul style="list-style-type: none"> - Intake facilities <ul style="list-style-type: none"> Diversion weir: 4 (Payabo river); 2, Cevicos river; 1 & Cascarnilla canal; 1 Intake works at springs: 3 in 4 springs Spillway: 1 (Cabo Ponton) Reservoir: 1 (Middle stream of the Guaraguao river) Pumping station (small scale within the area): 3 (head: 3m, discharge: 3-8 m³/s, use of return flow) - Irrigation system <ul style="list-style-type: none"> Main canal: 96,550 m (14.5 m/ha, concrete lining) Secondary canal: 68,860 m (10.4 m/ha, concrete lining) Tertiary canal: 217,230 m (32.7 m/ha, earth type) Diversion works: 271 (To be placed at diversion point of canals) Road intersection works: 59 (Concrete pipe) River intersection works (siphon): 1 (at Payabo river, concrete pipe and concrete lining) Intake of return flow: 7 - Drainage system <ul style="list-style-type: none"> Main canal: 8,940 m (1.3 m/ha, earth type) Secondary canal: 71,960 m (10.8 m/ha, earth type) Tertiary canal: 180,810 m (39.4 m/ha, earth type) Wasteway: 8 (Equipped with gate with flap) Road intersection works: 53 (Concrete pipe) River intersection works (siphon): 1 (at Payabo river, double-lane box culvert) - Flood mitigation works <ul style="list-style-type: none"> Improvement works of the Payabo river: 22,500 m (Q = 20 - 100 m³/s) Improvement works of Cascarnilla canal: 19,000 m (Q = 35 - 40 m³/s) - Road improvement works <ul style="list-style-type: none"> Trunk road: 63,950 m (5.3 m/ha, Total width: 8 m, Effective width: 6m) Lateral road: 167,200m (25.1m/ha, Total width: 8m, Effective width: 6m) In-farm road: 8,800 m (0.7 m/ha) - O/M office: 1 (162 m²) 					

9. Implementation Organization	Implementation agency: INDRHI Participating agencies: IAD (The project area is within IAD's agrarian reform project area and the project proceeds to re-distribute state lands, so IAD's participation is indispensable) SEA (To be responsible for extension services) Water users' association (Junta de Regantes) (To be responsible for O/M of irrigation works)								
10. Project Implementation Calendar	Year in order	1	2	3	4	5	6	7	
11. Project Cost	Loan Arrangement								
	Detailed Design								
Construction	Construction								
	O/M Services								
12. O/M Plan	- Construction works (RDS x 1000)							5,000	
	a. Preparatory works:	9,003							18,675
	b. Water intake works:	20,691							5,000
	c. Irrigation system:	123,227							54,813
	d. Drainage system:	32,802							38,360
	e. Flood mitigation works:	22,014							42,010
	f. Road works:	89,391							463,967
	g. Office for O/M services:	2,992							(In US\$ 15.4 million, US\$1-RDS1247)
Sub-total	300,120							Loan R: RDS 156 million (US\$ 12.8 million) Foreign: RDS 508 million (US\$ 23.9 million)	
13. Project Evaluation	Water Code which contemplated to turn over responsibilities for O/M of irrigation system from INDRHI to Junta de Regantes is being discussed at the National Congress for approval.								
	Demarcation of Responsibilities							INDRHI	
14. Related Projects	Water distribution to paddy fields							Nucleo	
	O/M of tertiary canals							Junta de Regantes	
	Collection of water charge							Assoc.	
	Settlement of disputes							Junta	
	Election of representative to Association								
	O/M of secondary canals								
	Settlement of disputes among nucleos								
	Election of representative to Junta								
	O/M of main canals								
	Representative of the project								
	O/M of intake facilities								
	Management of watershed								
	O/M machinery							Backhoe: 3, Dump truck: 3 Motor grader: 1, Pick-up: 1 Truck: 3	
	Annual O/M budget (RDS)							5,649,000	
Water charge (RDS)							175 (Actual), 304 (with project)		
13. Project Evaluation	Incremental agricultural output:							Economic Internal Rate of Return (EIRR): 14.7%	
	Avoidance of loss in agricultural loss:							Sensitivity analysis: Decrease of yield by 10% EIRR=13.3%, Increase of cost by 10% EIRR=13.4%	
	Total incremental benefits:								
	RDS 104,669 thousand								
14. Related Projects	JICA: 1980 - 1981: Feasibility Study for AGLIPO (El Pozo) Area Agricultural Development Project								
	OECE: 1986 - 1990 AGLIPO Agricultural Development Project (Loan amount: Japanese Yen 8,625 million)								
	JICA: 1985 - 1986 Feasibility Study for Aguacate-Guayabo Area Agricultural Development Project								
	OECE: 1995 - AGLIPO II Agricultural Development Project (Loan amount: Japanese Yen 9,013 million)								

SUMMARY

SUMMARY

1. BACKGROUND AND OBJECTIVE OF THE STUDY

The Limon del Yuna area is one of three sectors that form the AGLIPO area. In response to the request of the Dominican Government for developing this AGLIPO area as major rice production area of the country, the Government of Japan has rendered both technical and financial assistance to the area since 1980.

1.1 BACKGROUND OF THE STUDY

1.1.1 Agricultural Development at AGLIPO Area

The AGLIPO area is an abbreviation for the three sectors: Aguacate-Guayabo, Limon del Yuna and El Pozo. This area is considered as an optimum zone for rice production with favorable climatic, soil and topographic conditions, so rice culture has been predominant since various decades ago. The Government of the Dominican Republic has promoted rice production in the area, and for that purpose agrarian reform projects were implemented there; at the El Pozo sector since 1962; at the Limon del Yuna sector since 1967; and at the Aguacate-Guayabo sector since 1969. The area constitutes part of the agricultural zone extended over lower basin of the Yuna river, and in view of the fact that no large city is located nearby nor tourism resources to invite abundant tourist are found, no practical proposal may be prepared in this Limon del Yuna area but to develop for agricultural purpose in view of ameliorating living standard of local population and activating economic performance.

The Government of the Dominican Republic, aiming at increasing rice production at AGLIPO area, requested the Government of Japan to carry out a technical cooperation for the feasibility study of the AGLIPO area agricultural development project in May 1979. In response to the above-mentioned request and within the context of the prioritization among three sectors, the Government of Japan agreed to implement the feasibility study on agricultural development of El Pozo area as the phase I of the AGLIPO project from 1980 to 1982; this feasibility study was followed by implementation of construction works during 1984-1990 with a loan of the Government of Japan. As the next phase (phase II) of the AGLIPO project, the Aguacate-Guayabo area was taken up and another feasibility study on this area was conducted from 1985 to 1986; it is expected that this area would be put into implementation with a loan of the Government of Japan in 1995.

If an irrigation and drainage system will be improved as proposed, an increased rice production of the area will contribute to offset three-quarter parts of the deficit in national demand of rice in the coming year of 2015.

1.1.2 The Limon del Yuna Area

The Limon del Yuna area is found over the plain land with an extension of 120 km² which is located on the right margin of the Yuna River, the second largest river of the country. This area is suffered from stagnated agricultural production due to physical deterioration of existing irrigation works, under-development of canal network, deficiency of drainage network, absence of flood mitigation measures, and degradation of roads function, although the level of

infrastructures is considered to be the highest among the three sectors constituting the AGLIPO area. With an eye to overcoming this situation, the Government of the Dominican Republic requested the Government of Japan a technical cooperation for formulating an agricultural development project in Limon del Yuna area as the phase III of the AGLIPO project in May 1989. In response to this request, the Government of Japan dispatched a preliminary survey mission to conclude the S/W for the Study in August 1993.

1.2 OBJECTIVE OF THE STUDY AND THE STUDY AREA

The objective of the Study is to formulate the Limon del Yuna area agricultural development project and to evaluate it from technical, economic and social points of view.

The Study area is extended over the downstream plain on the right margin of the Yuna river with an approximate area of 120 km² and is limited by the Yuna river to the north, by the Los Haitises Range to the south, by the Barracote river to the east, and by the Cevicos river to the west.

2. NATIONAL SOCIO-ECONOMIC BACKGROUND

Agriculture is the mainstay to sustain Dominican economy and promotion for rice production is one of the most important agricultural policies of the country. Shortage in supply of rice in the coming future is predicted judging from growth trend of national population, so increase of rice production is an issue of great importance.

2.1 AGRICULTURAL SECTOR WITHIN CONTEXT OF THE NATIONAL ECONOMY

In the Dominican Republic the trade balance has been consistently negative and the amount of the deficit has increased recently due to correlated effect of the decline of exports in value terms and the expansion of imports. The shrinkage of exports stemmed from the continuous depression of such traditional exports as sugar, coffee and cacao in the international markets

Agricultural exports contribute greatly to generating foreign exchange of the country; in 1993, the total value of foreign exchange was US\$ 511.5 million, of which US\$ 185.9 (36.3%) million was covered by four traditional agricultural exports (sugar, coffee, cacao and tobacco).

2.2 AGRICULTURAL DEVELOPMENT POLICIES

One of the critical constraints on the agricultural development in the country is the limited area of irrigated lands. It is registered that the physical area for irrigated lands accounts for 248 thousand ha, which is equal to approximately 10% of the total arable lands of the country and almost half of potentially irrigable lands. And, within these irrigated areas, it is reported that the efficiency of water conveyance does not reach 40%, calculated in terms of conduction, operation and application to farmlands (PLAN NACIONAL DE ORDENAMIENTO DE LOS RECURSOS HIDRAULICOS, OEA-INDRHI).

Under the circumstances cited above, the attention of the governmental policies shall be paid to making investment in new irrigation works, maintenance and effective use of existing infrastructure, and more rational use of water resources.

Another important trend relevant to irrigation system of the country is to turn over the responsibilities and undertakings of irrigation works from INDRHI to water users' association. The background for promoting this turn-over policy is that, in spite of the government effort to invest in irrigation projects, the benefits generated by these projects were not as high as those expected at planning stage, and that this deficient generation of benefits is mainly caused by inadequate operation and maintenance of completed irrigation works.

2.3 RICE PRODUCTION WITHIN THE AGRICULTURAL SECTOR

With an eye attaining activation of the agricultural sector the Government of the Dominican Republic has laid emphasis on such policies as: development of alternative industry on behalf of the sugar-related industry, exemption of tax from imported agricultural inputs and machinery, expansion of arable land by means of rehabilitation and construction of irrigation system. An increase of agricultural production with consolidation of irrigation system is also considered as one of the most important agricultural development policies within the Investment and Actin Programme of the Public Sector 1992-1996. For the last decade the production of rice has been unstable, increased and decreased year by year; the output in 1993 (320 thousand tons) was decreased by 10% in comparison with that of ten years ago (358 thousand tons in 1984). Thus increase in rice production is the pressing task in terms of elevating self-sufficiency rate of the grain and saving of foreign exchange.

3. FACT FINDING ON THE STUDY AREA

The Study area is endowed with agro-climatological conditions and water resources suitable for rice cultivation and approximately 32,500 tons of paddy is produced yearly. Major constraints on rice cultivation are frequent attack of flooding, inconsistent supply of irrigation water, and inadequate provision of institutional supporting services to farmers. Thus, development plan to ease these constraints is highly anticipated.

3.1 GENERAL ASPECTS

The Study area is located in the north east of the Dominican Republic. This area lies on wide alluvial delta formed by the Yuna River and its major portion is featured by the flat physiognomy with an altitude ranging from 3 to 17 meters above sea level.

The great majority of the Study area belongs to Villa Riva municipality, the Province of Duarte, meanwhile one small village situated at the confluence of the Yuna River with the Barracote Canal belongs to Sánchez municipality, the Province of Samaná. These two provinces together with the provinces of Salcedo, Sánchez Ramírez and María Trinidad Sánchez form Cibao Oriental Sub-region which occupies 11% of the national territory.

The Limon del Yuna area has been developed with the implementation of IAD's agrarian reform project which started in 1969. A total of 2,676 households are identified within the Study area, of which 2,100 households are beneficiaries of the agrarian reform project and the remaining 576 households are owners of private land. This agrarian reform project area accounts for 64 % of the total Study area and persons benefited by the project and their family member represent almost 80 %.

3.2 CLIMATIC CONDITION AND HYDROLOGICAL STUDY

3.2.1 Climatic Condition in the Study Area

Processing data recorded at the Barraquito station, the climate of the Study area is summarized as follows:

- Annual rainfall 2,070 mm
- Mean temperature 26 °C
- Maximum temperature 33 °C
- Minimum temperature 18 °C
- Relative humidity 83 %
- Evaporation 1,460 mm/year
- Wind velocity 1.1 m/sec

The most rainy month falls on May, which is followed by August and November, while the least rainy month comes to be January, February and March. With respect to performance of temperature there is such a small difference as less than 15 % between the annual and monthly average. In the same manner, the relative humidity present few variation all the year around.

3.2.2 Rainfall

Approximately 1,700 mm of average annual rainfall was estimated in the catchment area of the Yuna river and around 2,000 mm was estimated for the Payabo river basin.

3.2.3 Discharge of the Yuna river

After completion of the Rincon dam (in 1978) and the Hatillo dam (in 1982), the annual average and annual minimum discharges of the Yuna river within the Study area have increased by 30% and 100%, respectively.

3.2.4 Discharge of the Payabo river

Discharges of the Payabo river at the entrance point to the Study area are observed to be 9.5 m³/s (average discharge) and 1.0 m³/s (minimum discharge), subject to the return period of 1/5.

3.3 TOPOGRAPHY AND GEOLOGY

3.3.1 Topography

The area is surrounded by mountains more than two thousand meters high; to the north the Septentrional mountain range and to the south the Central and Oriental mountain ranges. These mountains gradually ascend from west to the east. In the vicinity of the Study area these mountains are only in the range of 100-300 m. The Study area itself is lying on a low alluvial plain about 5 - 20 meters above sea level, situated between the said mountains and formed from the deposits of the Yuna river, Payabo river, and Cevicos river which flow eastward. The south of the Study area is bordered by the Los Haitises mountains where a karstic foundation region is found. A precipice originated by fault developments separates these two areas.

3.3.2 Geology

Tertiary volcanic rocks distributed in the upstream area of the Yuna river, limestone that form the Los Haitises mountains, and the metamorphic rocks of the northern area all constitute the basement rock layer of the study area. Overlying this basement rock is a layer of Quaternary diluvial thin gravel, sands and clay, which in turn is overlain by alluvial sediments of the Yuna and Payabo rivers. The alluvial sediments are from the Holocene epoch and mainly consist of clay and sand.

3.3.3 Geo-technical Investigations

The following investigations were carried out in the course of the field survey. As indicated in the geological profile, the ground foundation in the Study area is divided into 8 layers.

Geological Period	Epoch	Symbol	Soil Quality	Thickness of Layer (m)	N-Value	Average N-Value
Quaternary	Alluvium	Bs	Gravelly Clay	0.8		
			Clay	-	3 - 17	8
		Ac	Sandy Clay	0.5		
		As	Clay-Sandy Silt	2.0-18.0	2 - 20	5
		Ag	Sand	3.0	10 - 41	27<
			Gravel	2.0-4.0	37 - 50<	50<
	Diluvium	Dc	Clay	-	13 - 50<	28
		Ds	Sand-Clayey Sand	3.0-4.0	42 - 50<	50<
		Dg	Gravel	-	50<	
Tertiary	Pliocene	Tc	Clay	-		46

3.4 SOIL SURVEY AND SOIL CLASSIFICATION

3.4.1 Soil Survey

Almost two decades has passed since FAO completed their survey, and as a result of the Phase I field works, it was confirmed that there was no substantial transformation of soils between those distributed at the time of FAO survey and those existing at present. However, in some places, an additional sedimentation composed of relatively new soil materials such as clay and silt that would have been brought in by flood for many years and the drying tendency of the meadow soils by artificial drainage were observed and new soil map was prepared.

3.4.2 Land Capability Classification

The soil series newly created in the present survey were assessed their capability for irrigation use in accordance with Aren's classification system: Class 1 having no limitation and being suitable for irrigation to produce the high yield of all sorts of crops that suit to the local climate; Class 2 having some limitations of soil, topography and drainage and being suitable for irrigation to produce the high yield of limited sorts of crops; Class 3 having severe deficiency of soil, topography and drainage and being suitable for irrigation to produce moderate yield; Class 4 having greater limitation of soil, topography, drainage, economy and flood and being unsuitable for irrigation to produce most of crops with exception of rice and hygrophytes; Class 5 being unsuitable for irrigation though additional survey is required for final decision.

The soils of classes 1 and 2 are found in the districts between the Yuna river and the Payabo river in the west part and on the bank of the Yuna river in the parts from north to northeast, the soils of class 3 in the parts of central south and of east, the soils of Class 4 in three parts of northwest, center and southeast, and the soils of Class 5 in the coastal section of the Barracote river in the southeast part and in the central east part.

3.5 LAND USE AND LAND TENURE

3.5.1 Present Land Use

Present land use in the Limon del Yuna area is summarized as follows:

Land Use Category	Area (ha)	%
1. Arable Land	9,350	77.9
1.1 Paddy field	6,680	55.7
1.2 Upland	490	4.1
1.3 Pasture	2,180	18.2
2. Forest	1,410	11.8
3. Wetland	80	0.7
4. Wasteland	20	0.2
5. Pond	60	0.5
6. River	130	1.1
7. Settlement	290	2.4
8. Others	660	5.5
Total	12,000	100.0

The category of forest comprises lands occupied by cacao and coconut palm trees, uplands, bush, and so on, thus an approximation of this extension is somewhat difficult. In general, uplands are taken into account only when their parcel exceeds 10 ha, thus an actual extension of uplands including those dispersed throughout forests may be twice as large as that presented in the above table

3.5.2 Grade of Development of Paddy Fields

Existing paddy fields may be classified into the following three categories by their parcels, namely:

Category A - Completely consolidated parcels:	2,570 ha (38%)
Category B - Fairly consolidated parcels:	1,800 ha (27%)
Category C - Parcel without consideration:	2,310 ha (35%)

3.5.3 Land Tenure

The territory of the Study area is composed of state lands (8,600 ha) and private lands (3,400 ha) and it is supposed that 70% of lands within the Study area are administrated by IAD. More private lands are found at the sector along the Yuna river and at La Ceiba de los Pajaros. The proportion of farm land by size is: smaller than 2 ha (7.0 %), 2 - 4 ha (77.2 %), 4 - 6 ha (4.2 %), larger than 6 ha (11.6 %). It is reported that there are six large land owners with holding more than 1,000 tareas (63 ha) and these land owners cover 16,000 tareas (1,000 ha) of lands.

3.6 AGRICULTURAL PRODUCTION

3.6.1 Rice Production

Paddy fields of the Study area account for 6,680 hectares — IAD settlements make up 4,380 hectares and privately owned lands 2,300 hectares. From information obtained on agricultural credit given to farmers and a survey on farmers' socio-economic condition and the field reconnaissance survey, the total area of land cultivated in the Study Area each year is estimated to be 9,500 hectares; 6,000 hectares undergoes first cropping of which 3,500 hectares has a second cropping. The yield per hectare as calculated by quadrat sampling and assumptions obtained from investigations was 3.9 tons/ha for the first crop and 2.6 tons/ha for the second crop. Consequently, it is broadly calculated that the Study Area produces 32,500 tons of rice yearly.

(1) Cropping system

The fundamental rice cropping system in Limon del Yuna is as follows:

First cropping:	Seeding in nursery in December Transplanting in January - March Harvesting in May - July
Second cropping:	Seeding in nursery in May - July Transplanting in June - August Harvesting in October - December

The weather in the area is not an impediment to year around, so rice planting activities as the monthly temperature suits this cultivation practice. Rather, it is influenced by the availability of irrigation water and the availability of funds.

The rice cultivation practice that predominates is transplanting; transplanting of rice seedlings is carried out on 80% of the fields while direct seeding is carried out on the remaining 20%.

(2) Varieties

Juma 57 and Isa 40 each make up about 90% and 10% of the entire rice grown in Limon del Yuna. Yield in the second cropping is between 20 - 50 % lower (average 35 %) than the first cropping.

(3) Paddy yield and land classification

Surveys were carried out in both cropping seasons. Lands were classified in the Study area for rice production, based on the quadrat sampling yield survey and the proposals by the technical personnel from the IAD and SEA whose estimates were based on years of experience.

3.6.2 Crops and Livestock Production Value

The crops and livestock production value was roughly estimated as summarized in the following table. Values for paddy, livestock products and perennial crops represented 66%, 16% and 13%,

respectively. The value for annual upland crops was around 2%, which coincides with the proportion of the output.

Crops	Output (Ton)	Price (RD\$/ton)	Value (RD\$)	%
Paddy	32,500	4,500	146,250,000	68.61
Cacao	335	10,753	3,602,255	1.69
Plantain	3,904	4,965	19,383,360	9.09
Coconut	2,500	2,344	5,860,000	2.75
Sub-total (Perennial crops)			28,845,615	13.53
Maize	100	4,007	400,700	0.19
Sweet potato	255	2,618	667,590	0.31
Cassava	255	3,450	879,750	0.41
Haricot bean	16	18,656	298,496	0.14
Vegetables*	189	4,323	817,047	0.38
Sub-total (Annual upland crops)			3,063,583	1.44
Milk**	5,428	3,730	20,246,440	9.50
Beef (Heifer and steer)***	3,161	3,253	10,282,733	4.82
Beef (Cow)***	1,090	4,115	4,485,350	2.10
Sub-total (Livestock products)			35,014,523	16.43
Total			213,173,721	100.00

Note: * Represented by pumpkin, cucumber and sweet pepper

** Output (kl), Price (RD\$/kl)

*** Output (head), Price (RD\$/head)

3.6.3 Production Cost

The production cost for paddy cultivation is calculated to be RD\$ 15,094/ha. This production cost is broken down in respective category of cost as follows: fertilizers and agro-chemicals (28.7%), manpower (28.5%), contract work (aerial fumigation and harvest) (11.8%), land preparation by machinery and animal (13.5%), seed (8.1%), interest and commission of agricultural credit (8.3%), and water charge (1.1%). The production cost for paddy prevailed in the Dominican Republic is almost twice as high as that in Argentine, Colombia and Ecuador.

3.6.4 Farming Balance Sheet

According to BAGRICOLA's cost-benefit analysis on crops, paddy is a promising crop with expected net return around RD\$ 7,000/ha. Nevertheless, the Study team's survey has revealed that farmers in the area attained far lower net return of paddy cultivation attributable to depressed productivity affected by inconsistent supply of irrigation water, poor drainage, inundation, etc.; even at lands with 1st-class capability the attained net return was as few as RD\$ 1,500/ha on average - about 20% of the BAGRICOLA's target; balance sheet at lands with 2nd and 3rd-class capabilities resulted in deficit as a consequence of income-cost analysis.

3.7 MARKETING AND PROCESSING OF AGRO-PRODUCTS

3.7.1 Marketing of Rice

In the Dominican Republic, up to 1987 INESPRES had played a vital role within the marketing channel of rice, purchasing paddy directly from farmers on the basis of the supporting price established every harvest season of the year. At present, purchase of paddy from farmers is made exclusively by private rice mills including cooperatives and middlemen. 57% of the paddy harvested in the Study area are processed at rice mills within the area. It is estimated, that about 17% of the paddy produced in the Study area is destined for self-consumption of farmers and their family members.

As of January, 1995, one "fanega" (120 kg) of paddy is sold in the range of RD\$ 540-560 (equivalent to RD\$ 4,500-4,670 per ton) in the Study area. The farm-gate price of paddy in the country is kept in higher level in comparison with that of other countries; the prevailing farm-gate price of RD\$ 540/fanega, equivalent to RD\$ 4,500/ton for paddy or RD\$ 7,500/ton (US\$ 582.75/ton) for milled rice is roughly calculated to be twice as high as the FOB price of the Thai rice (US\$ 296/ton, as of December 1994).

3.7.2 Processing and Storage Facilities

A total of 18 rice mills are installed within the Study area. Apart from these 18 rice mills, one large-scale mill with drier is found in Villa Riva and another one with similar installation in Arenoso. An integrated milling capacity of rice mills in the Study area reaches 13.73 tons per hour (calculated paddy basis), and if included rice mills in Villa Riva and Arenoso, the same capacity is to be elevated to 20.16 tons per hour. Referring to the information registered at INDRHI's regional office, the peak harvest month in the Limon del Yuna area come to November when approximately 5.5 thousand tons of paddy are harvested. For processing 5.5 tons of paddy a month, an integrated capacity of 27.5 tons/hour ($5500 \div 25 \div 8 = 27.5$) is required for rice mills. This calculation draws the conclusion that the existing facilities in the Study area can not comply with processing of the whole of the paddy to be harvested within the area at the peak harvest season.

3.8 INSTITUTIONAL SUPPORTING SYSTEM AND RURAL ORGANIZATION

3.8.1 Responsible Institutions for the Supporting Services

In the Study area, the following governmental agencies: Ministry of Agriculture (SEA), Dominican Agrarian Institute (IAD), National Institute of Hydraulic Resources (INDRHI), Agricultural Bank (BAGRICOLA), Agricultural Materials Sales Center (CVMA) and Rice Research Center (CEDIA), are rendering institutional services to increase and stabilize agricultural production as well as to ameliorate living standard of farmers. These institutional services, nevertheless, have not produced anticipated benefits due to budgetary shortage, inappropriate provision of irrigation and drainage system at farm level, poor functioning of farmers' organization, etc.

3.8.2 Agricultural Extension Services

Extension services of agricultural technology is currently provided by SEA's sub-regional offices and IAD's project office. Major constraint related with extension services is lack of transportation which limits the frequency of visiting farmers to render services. In addition, deficient office equipment prevents officers to engage adequately in collection and administration of data and information. Another aspect of problem concerning with extension services is that, even if the coverage area of these two institutions coincides, there is no substantial coordination between them in relation with exchange of opinions on method and information of the services, and thus no efficient services realized.

3.8.3 Operation and Maintenance System of Irrigation and Drainage Facilities

The irrigation and drainage facilities in the Study area represented by intake works, trunk and lateral canals, diversion works and gates are operated and maintained under responsibility of INDRHI's Lower Yuna District Office and Limon del Yuna Project Office.

The equipment in these offices are used for excavation of canals, but their physical deterioration has prevented from functioning well. Furthermore, deficient personnel engaged in O/M services results in inadequate level of the services, and as a consequence, water users' dissatisfaction has widespread.

3.8.4 Water Charge

Because the Government had subsidized greatly the O/M of irrigation system, the proportion of the total amount of water charge collected form water users against the total expense incurred for the O/M services had been below 20% up to 1989. From 1990 on, however, within the context of the structural reform policies, new pricing system of water charge called "factor de cobre (collection factor)" was introduced, and with putting this new system into force, the said proportion had been raised remarkably. In spite of this improvement, the proportion still remains around 70%, and this situation is explained by the fact that there are not a few water users who do not perform their duty to pay water charge.

3.8.5 Establishment of Water Users' Association

The privatization policy which pretends to transfer functions and responsibilities of public sector to private sector is in progress in the Dominican Republic, and in line with this policy, some portion of INDRHI's responsibilities and undertakings relevant to operation and maintenance of irrigation system is being turned over to water users' association (Junta de Regantes). The importance of this turnover policy was confirmed by the resolution promulgated by the National Agricultural Council- the top ranking organization to determine government's agricultural policy; in the article 1 of the said resolution, the Resolution No. 4/95, it was declared as "the highest priority of the INDRHI's irrigation policy shall be laid on conforming "Junta de Regantes" and decentralizing gradually the operation of irrigation system to them, which will contribute to better utilization of water resources and to raising agricultural productivity of the country".

In advance to the legislation at the Congress, the trend to turn over INDRHI's irrigation system is accelerated and autonomous operation and maintenance of irrigation system by "Junta de Regantes" has been realized at 7 irrigation projects all over the country. "Junta de Regantes" has not been established in the Study area, but is now in operation in the AGLIPO project area.

3.8.6 Agricultural Credit

In realizing rice production, farmers in the Study area depend on finance provided by BAGRICOLA, commercial banks, agricultural federations, rice mills, etc. Beneficiaries of the agrarian reform project who do not possess mortgage for the loan have no access to agricultural credit except for that of BAGRICOLA. In getting loan from BAGRICOLA, farmers without mortgage are requested to be a member of any organization subject to IAD's coordination to the matter. On the other hand, private farmers need to be investigated their financial capability to repay loan by bank's officer under the guideline of BAGRICOLA or commercial banks.

The debtors of BAGRICOLA are not necessarily satisfied with the bank's finance and their complains may be summarized as follows:

- They are burdened with higher rate of interest and other levies,
- The interval between application and disbursement of loan is too prolonged,
- The standard for approval of loan is relatively strict,
- The loan term is too short.

3.8.7 Rural Organization

In the Study area, there are three types of rural organization formed by farmers: association, cooperative and federation. From 1973 on, settlers of IAD's project are obliged to affiliate themselves with any of these organizations.

3.9 IRRIGATION AND DRAINAGE SYSTEM

3.9.1 General Description

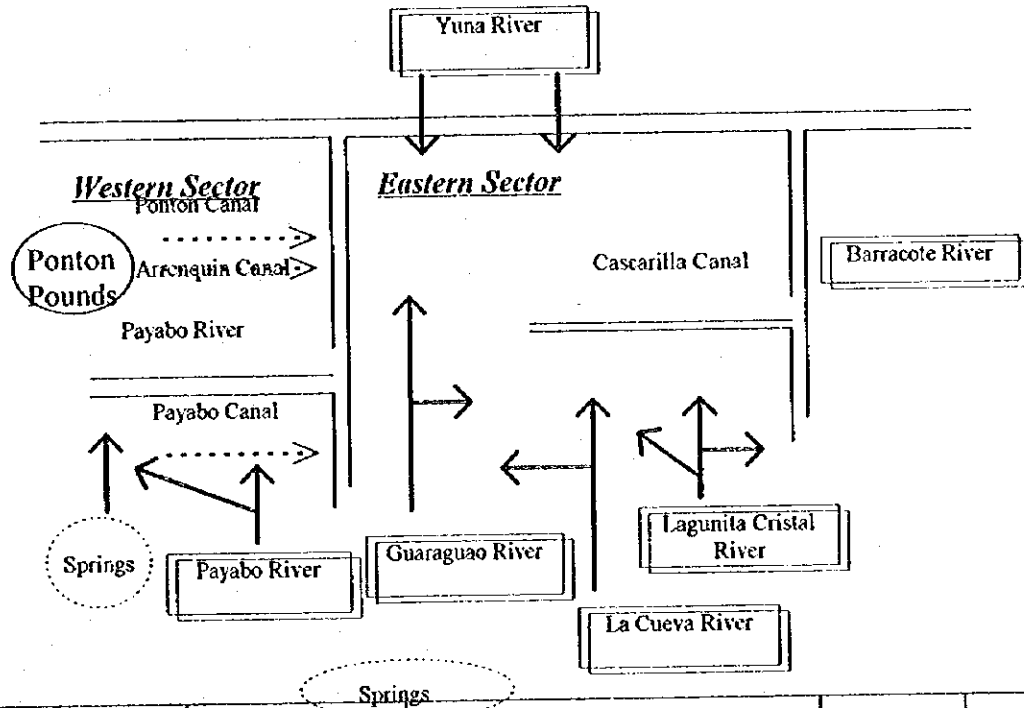
Irrigation and drainage network in the Study area is divided into two major sectors (western and eastern) by the Payabo river and its tributary, the Guaraguao river; the western sector has a total irrigated area of 2,540 ha benefited by the Payabo river and the major portion of paddy fields situated there are not properly prepared, meanwhile paddy fields of the eastern sector, which account for 4,140 ha in total, have attained considerable grade of consolidation benefited by irrigation water supplied from springs; within the eastern sector there are some privately owned paddy fields which are irrigated taking water from the Yuna river by means of pumping system and these paddy fields are not adequately consolidated. In so far as drainage system is concerned, most of excess water is discharged into the Payabo river in the western sector and into the Cascarilla canal in the eastern sector.

3.9.2 Irrigation Blocks

Sources of irrigation water in the Study area are classified into three systems:

- Payabo river (Western sector);
- Springs water (Eastern sector);
- Yuna river (Eastern sector)

These three systems are illustrated as follows:



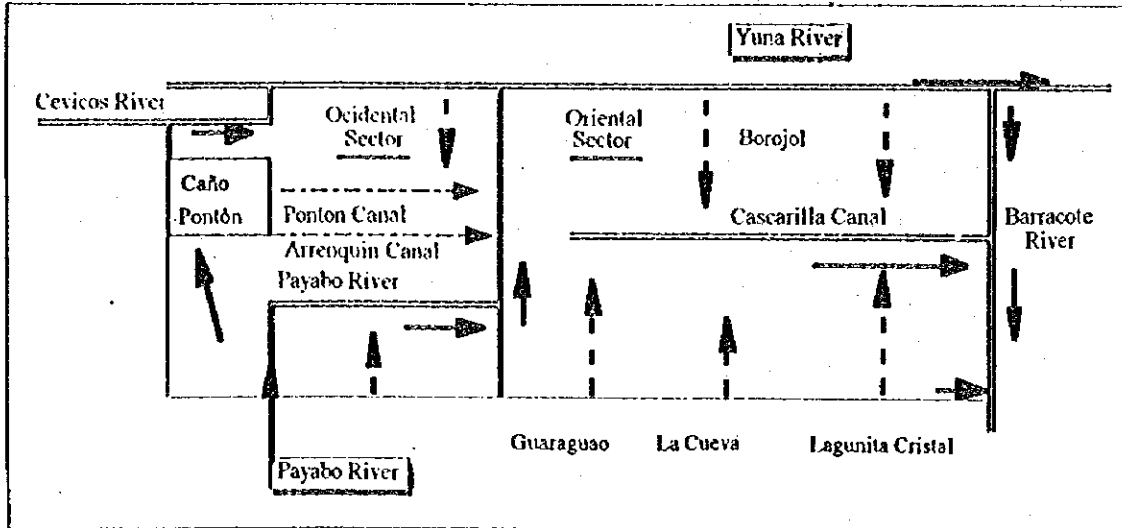
Sources of Irrigation Water	Payabo River		Springs			Yuna River	Total
	Ponton	Payabo	Guaraguao	La Cueva	Lagnita Cristal	Borojol	
Irrigated area (ha)	1,910	630	2,280	330	770	760	6,680
Pumping irrigation (ha)	980	240	460	30	0	760	2,470

Within the Study area, close to 40% of paddy fields rely irrigation water on pumping system, and this situation is explained in the following manner:

- Water level of irrigation source is lower than elevation of paddy field: 1,070 ha
- Pumping system was contemplated at the planning stage of irrigation system: 600 ha
- Pumping system was introduced to compensate shortage of water: 800 ha

3.9.3 Drainage System

Drainage system in the Study area are divided into two sectors; eastern and western. Major portion of excess water are drained into the Payabo river in the western sector and into the Cascarilla canal in the eastern sector, meanwhile some of them are discharged into the Cevicos river in the western sector and into the Barracote river in the eastern sector.



Payabo River

The Payabo river flows from southwest to northeast within the Study area and joints with the Yuna river. The Payabo river has more than 300 km² of the catchment area, 1/3,000 of average river bed slope, 4-5 m width of river section, and 10 m³/s of flowing capacity. This river is subjected to overflow at high water level stage inundating lands around the river 2-3 days.

Cascarilla Drainage Canal

The Cascarilla canal runs from west to east along the Yuna river and is connected with the Barracote river. The canal has an average slope of 1/2,000 and catchment area of about 60 km². This canal has been excavated various times after construction and has enough canal section to permit passage of large amount of discharge. Some lands around lower reach of the canal are often inundated.

3.10 FLOODING DAMAGE

The Yuna river, which flows to the north of the Study area and is the second largest river of the country in terms of catchment area, has not brought flooding damages over the Study area since 1979 when overflow of river water was taken place with attack of the cyclone "David".

3.10.1 Actual Situation of Flooding Damage

(1) Payabo river

The Payabo river constitutes an important source of irrigation water in the area and serves as the main drainage canal at the western sector of the area. This river runs from southwest to northeast of the Study area flows into the Yuna river. The Payabo river has a catchment area of about 340 km² at the entrance to the Study area. However, due to smaller cross section (4-5 m) and inflow of backwater from the Yuna river caused by lower river bed elevation (around 2 m.a.s.l.), overflow of river water is sometimes taken place producing flooding damages over surrounding lands.

Especially, the narrow topography with 10 km long and 800 m wide formed by land covering the foot of the southern mountain area is transformed into river at the time of flooding stage. The run-off discharge is estimated at 300 m³/s (five-year-return period) and at 360 m³/s (ten-year-return period). According to the interview survey on farmers conducted in the course of the field works, inundation remains 2 or 3 days with the maximum submergence depth of 1.5 m. Under the circumstances, land use in this section is limited.

(2) Cascarilla canal

Different from the western sector, the eastern sector is not affected by remarkable flooding because no extensive catchment area is located at back area. It is informed that flooding damage takes place only at lands around the end of the Cascarilla canal.

3.10.2 Flooding Area

Flooding in the Study area is stemmed from: 1) backwater produced by high water level of the Yuna and Barracote rivers, 2) Overflow from the Payabo river, and 3) rainfall within the area. High water level of the Yuna and Barracote rivers does not occur simultaneously, so flooding analysis under influence of these two river should be made independently. It is revealed as a consequence of the flooding analysis that the effect of rainfall is less meaningful than the former two factors.

(1) Inundation over the basin of the Payabo river

The inundated area with submergence deeper than 30 cm and for the period of 24 hours and more is as given below. The backwater of the Yuna river has mayor effect on inundation of the area, meanwhile flooding within area may be meaningless.

Inundation caused by backwater of the Yuna river

Return Period	Elevation of Submergence level (masl)	Maximum Submergence Depth (m)	Inundated Area (ha)	
			In Total	Paddy Field
1/2	10.53	1.53	1,260	577
1/5	11.27	2.28	1,680	778
1/10	11.65	2.65	2,660	1,768

Inundation caused by the Payabo river

Return Period	Elevation of Submergence level (masl)	Maximum Submergence Depth (m)	Inundated Area (ha)	
			In Total	Paddy Field
1/2		0.99	49	49
1/5		1.12	207	146
1/10		1.21	236	152

(2) Inundation over the basin of the Cascarilla canal

Inundated area caused by backwater of the Barracote river with submergence deeper than 30 cm and for more than 24 hours is as follows. This inundation is less serious than that caused by the Payabo river.

Inundation caused by backwater of the Barracote river

Return Period	Elevation of Submergence level (masl)	Maximum Submergence Depth (m)	Inundated Area (ha)	
			In Total	Paddy Field
1/2	2.03	0.03	290	49
1/5	2.75	0.75	550	187
1/10	3.16	1.16	900	528

3.11 ROADS

Main roads connecting principle villages are relatively well maintained. However, these roads, being constructed within wetlands, have been gradually subsided since their construction. As a consequence, the level of some sections of these roads becomes lower than that of the paddy fields producing frequently puddle on their surface.

Farm roads are insufficient in terms of length and they are in precarious condition; besides some roads are considered to have never been maintained since construction.

Presently, there is only one bridge over the Yuna river (constructed at La Reforma) to unit the Study area with other areas , although construction of new bridge to connect Villa Riva with La Ceiba de los Pajaros is underway (it is envisaged that this construction works will complete in 1995).

3.12 ENVIRONMENT

3.12.1 Rules, Regulations and Guidelines, and EIA Practice

There are no general laws and ordinances on environmental issues in the Dominican Republic at present. However, an environmental protection bill has been to Congress, and Article 220 of this bill covers the environmental impact assessment (EIA) system.

This Article 220 of the bill on "Protection and Environments Quality Law" stipulates the implementation of EIA on any project with possible environmental impacts. The enactment of the bill will impose the implementation of EIA on large scale agricultural development projects.

3.12.2 Social Environment

The population of the area is a mixture of indigenous people and immigrants. There are no conflicts between the two as a lot of the immigrants come from neighboring areas. The population is predominantly indigenous, albeit the presence of Haitian settlers in the area to be submerged for the construction of a flood control dam at the Payabo river; these settlers migrated to the area to work in sugar cane plantations. This minority group will not impede the implementation of the project as they have assimilated to the ways of the local people.

Exclusive of Fastac (Alpla-Cypermethrin) and several others, the agrochemical used in the area contain low fish toxins, are not residue-prone agrochemical in crop and are less likely to result in biological magnification. Further, these chemicals can be hardly considered as environmental pollutants as their application is kept in small doses.

3.12.3 Natural Environment

There are no endangered species in the area as the wetlands (ponds, swamps and marshes) do not fall under the category stipulated in the Ramsar Treaty. However, these areas are famous as either habitats of snapping turtles or landing areas of migratory birds.

The area has a low-lying topography and a geology made up of humid soil, clay and marine sediments. Soil quality is predominantly clayey.

Forests only cover a very small part of the project area, which is mostly made up of paddy fields or grasslands. The whole area is covered with vegetation and free from soil erosion problems.

3.12.4 Water Quality

According with the result of water samples analysis, all water resources within the Study area are apt for use as irrigation water and the survey results proved that agrochemical use has very little impact on the environment.

4. CONSTRAINTS AND POTENTIALS ON DEVELOPMENT

Due to various physical, institutional and economic constraints on development, agricultural activities of the Study area have been stagnated, and proposal to relax these constraints varies in terms of methodology and required investment. The Study area, on the other hand, is endowed land and water resources suited for agricultural development and with rational utilization of these potentials may be converted into area of "High and stable agricultural productivity" bringing about activation of local economy.

4.1 CONSTRAINTS ON DEVELOPMENT

The Study area was developed as a large-scale agrarian reform project area about thirty years ago with intensive investment on construction of irrigation and drainage works. Since then the area has expected to become a leading rice productive area of the country. Nevertheless, due to the various factors, the Study area is actually suffered from inferior and inconsistent agricultural productivity and, as a consequence, its agricultural activity represented by paddy cultivation is stagnated. To overcome this bottleneck and to attain target development anticipated at the time of project planning, drastic measures to reform these socio-economic and physical conditions of the Study area is highly required.

Constraints affecting the development of the Study area are epitomized as follows (See Fig 4.1).

(1) Physical factors

The Study area is subject to frequent attack of river flooding and flat land topography of the area causes poor drainage and leaves farmlands inundated for longer period. Water resources to be available for irrigation purpose are not abundant. And, the great majority of lands in the area has been developed, so there is very little virgin land that may be put in farmland.

(2) Institutional factors

Inadequate operation and maintenance of irrigation/drainage works has prevented from distributing irrigation water effectively and improving poor drainage. On the other hand, unsatisfactory institutional services in the field of agricultural credit and extension of crop farming technology is associated with low cropping intensity as well as deterioration of agricultural productivity. Inactive farmers' organization results in dull performance of rural society. In addition, limited farm size distributed beneficiaries of agrarian reform discourages them to expand farming activity.

(3) Economic factors

Under-development of rice processing business within the area disproportionate with paddy production declines to activate local economy through raising value-added of agro-products, accelerating marketing and creating new job opportunity. Inactive farmers' organization cited above is also contribute to hinder competition in such activities as sale of agricultural inputs and rent of agricultural machinery, which constitutes one of elements to raise production cost of crop and animal husbandry.

These constraints could be classified according with methodology and difficulty for easing them as well as necessary investment in the following manner.

Those which require support at national level:

- Inadequate credit services of the BAGRICOLA
- Lack of budgetary allocation for extension service and operation and maintenance of irrigation works
- Difficulty in acquisition of improved seed
- Limited farm size
- Elevated price of agricultural inputs

Those which may be eased by strengthening existing organization or institutional supporting services

- Lack of financial resources to farmers
- Inappropriate system for O/M of irrigation/drainage works and roads
- Deficiency of agricultural machinery
- Absence of proper extension services to farmers; unsatisfactory services to educate farmers in forming organization

Those which require medium sum of investment to be financed by the central government

- Absent of O/M works
- Under-development of road network

Those which require large sum of investment together with sophisticated technology

- Insufficiency of irrigation water and substitution of pumping system
- Flooding damage

4.2 POTENTIALS ON DEVELOPMENT

As explained in the previous section, the Study area is at present under-developed to have been affected by various constraints, but these constraints may be eased if strengthening of institutional services to support farmers and rational use of physical resources are realized. And, as a consequence, an anticipated development of the Study area may come true. Potentials attributable to development of the Study area are as follows.

4.2.1 Institutional Aspect

Irrigation and drainage facilities are already installed in the Study area, so investment required for development of the area can be reduced in comparison with development project without such facilities. In so far as operation and maintenance of irrigation works is concerned, turn-over of irrigation works from INDRHI to water users' associations (Junta de Regantes) is in progress in other irrigation project areas under the privatization policy of the Dominican Government, the proposal to form water uses' association to entrust the association O/M of irrigation works within the Study area may be facilitated without serious obstacles. Besides, the existence of farmers'

organizations, even though they are actually out of function, can promote improvement in marketing and crop cultivation by strengthening their activity.

4.2.2 Land Resources

Clay and similar property soils, which are distributed extensively over the alluvial plain formed by flooding of the Yuna river, are optimum resources for cultivating rice. It is observed that there are some poorly drained lands which are evaluated to be less capable to use for irrigation purpose and some farmlands which are suffered from low productivity affected by poor land drainage, they may be switched to better productive lands putting drainage improvement works into force.

Although it is not probable to convert large amount of virgin land into arable land, the existing grazing lands which occupy considerable portion of the Study area may be used as land of more intensive use. Thus land resources present higher adaptability for agricultural development.

4.2.3 Water Resources

Water resources available to irrigate farmlands in the Study are not necessarily abundant, but their rational use will enable to expand irrigable area. Apart from actually available water resources, irrigation water can be taken newly from the Cevicos river in the western sector and from the El Cercado spring in the eastern sector. Although intake method is limited to pumping system, flow of the Yuna river is another resource to be assessed its possibility to use for irrigation purpose. In addition, the use of return flow and construction of reservoir are proposals which are worth while to be studied.

4.3 DEVELOPMENT STRATEGIES

4.3.1 Principles on Formulating Development Plan

In formulating agricultural development plan of the area, the higher priority shall be given to promoting paddy production taking account of the Study area's climatological conditions, land and water resources potentials, prevailing farming practice and socio-economic circumstances, and future forecast for supply and demand of rice at the national level.

In line with this principal, an expansion of cultivated area of paddy is envisaged within the agricultural development plan in accordance with the following basic concepts.

Principles on land use plan

As estimated in the analysis of present land use, the total sum of arable lands in the Study area accounts for 9,350 ha, and the present Study pretends to expand paddy field as much as possible after alienating the following lands.

- a. Actual paddy fields alongside the Yuna river which are irrigated by pump (If farmers in these lands desire to continue planting paddy, they will have opportunity in doing it in other paddy fields to be re-distributed)
- b. Uplands with smaller farm size without being irrigated by gravity (Cristal village)

c. Large private farmland which is administrated under intensive farming system for production of plantain

d. Rough grazing lands not suitable for conversion into paddy field

With alienating these lands, the maximum extension of paddy fields will become 8,680 ha in total.

4.3.2 Development Strategies

The Limon del Yuna Area Agricultural Development Project to be formulated in conformity with the strategies mentioned below aims at reforming the Study area as an area which will enjoy an enhancement of the situation supported by "Higher and More Sustainable Agricultural Production" (Refer to Fig. 4.2).

1. In planning irrigation system priority will given to gravity intake and distribution system from standpoints of saving construction and O/M cost and convenience in O/M services, while pumping irrigation will be evaluated its possibility only when this system excels the gravity system in expected cost-benefit ratio.
2. Drainage improvement plan will have an objective to serve enhancement of land productivity in paddy fields and grazing lands which are suffered from poor drainage being located near the mountain, to the south of the Study area.
3. Flood related measures will be delineated in such manner as to mitigate damages to agricultural production as small as possible. Necessary civil works will be designed after studying the relation between construction cost and expected benefit.
4. Roads development planning will be made as follows: trunk roads will be touched only to improve their surface unevenness; secondary roads will be improved in such grade as to permit access of heavy machinery and vehicles.
5. Marketing and processing plan of agro-products shall be proposed in due compliance with agricultural production plan.
6. So far as farmers organization is concerned, proposal will be made to form newly an organization affiliated by beneficiaries of irrigation system (water users' association) and to strengthen existing farmers' organization (cooperatives).
7. Recommendations will be provided with respect to strengthening institutional services to farmers (agricultural credit and transfer and extension of cropping technology).
8. In planning infrastructures considerations shall be made in alleviating negative effect of their development on environmental issues.

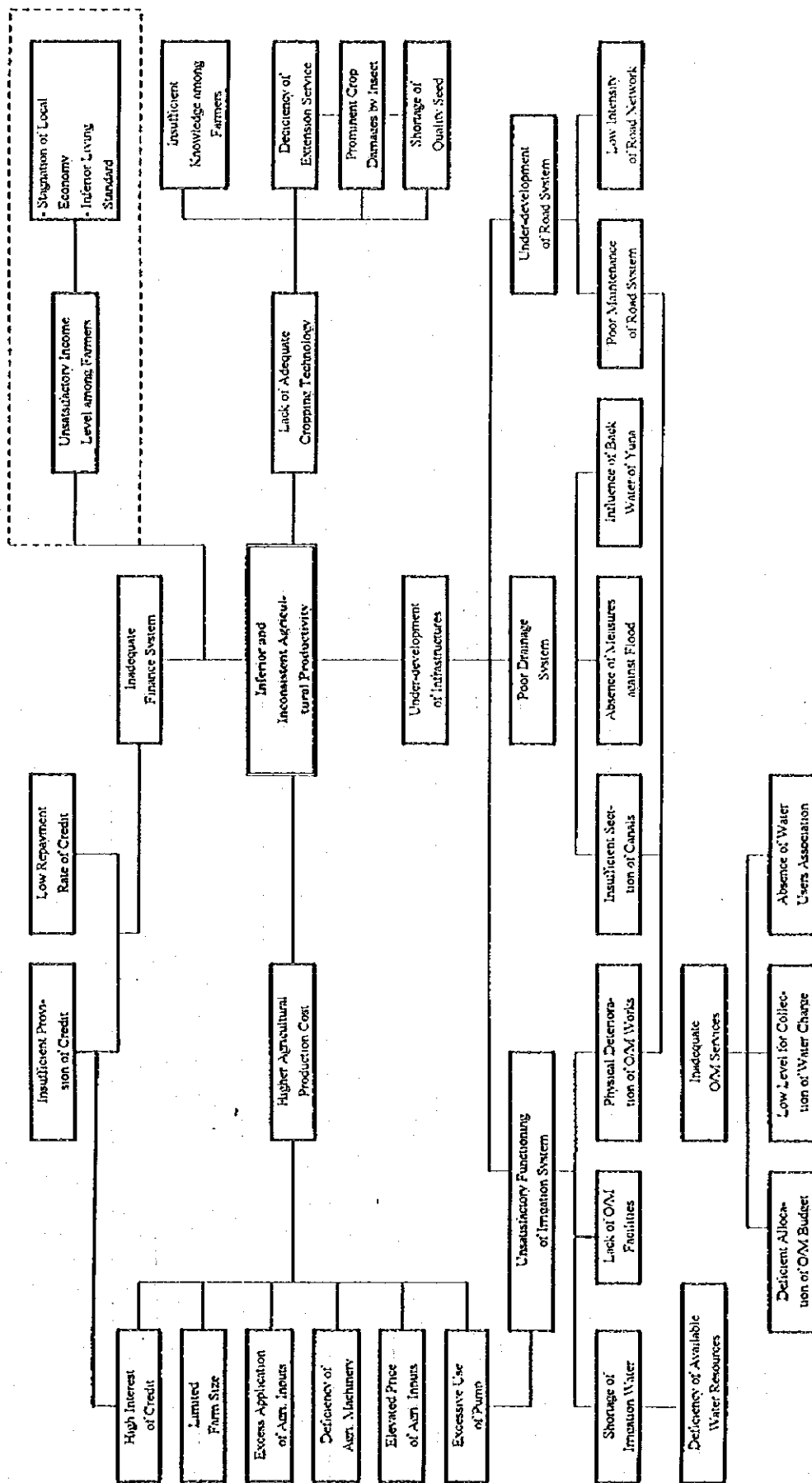


Fig. 4.1 Prevailing Constraints on Development

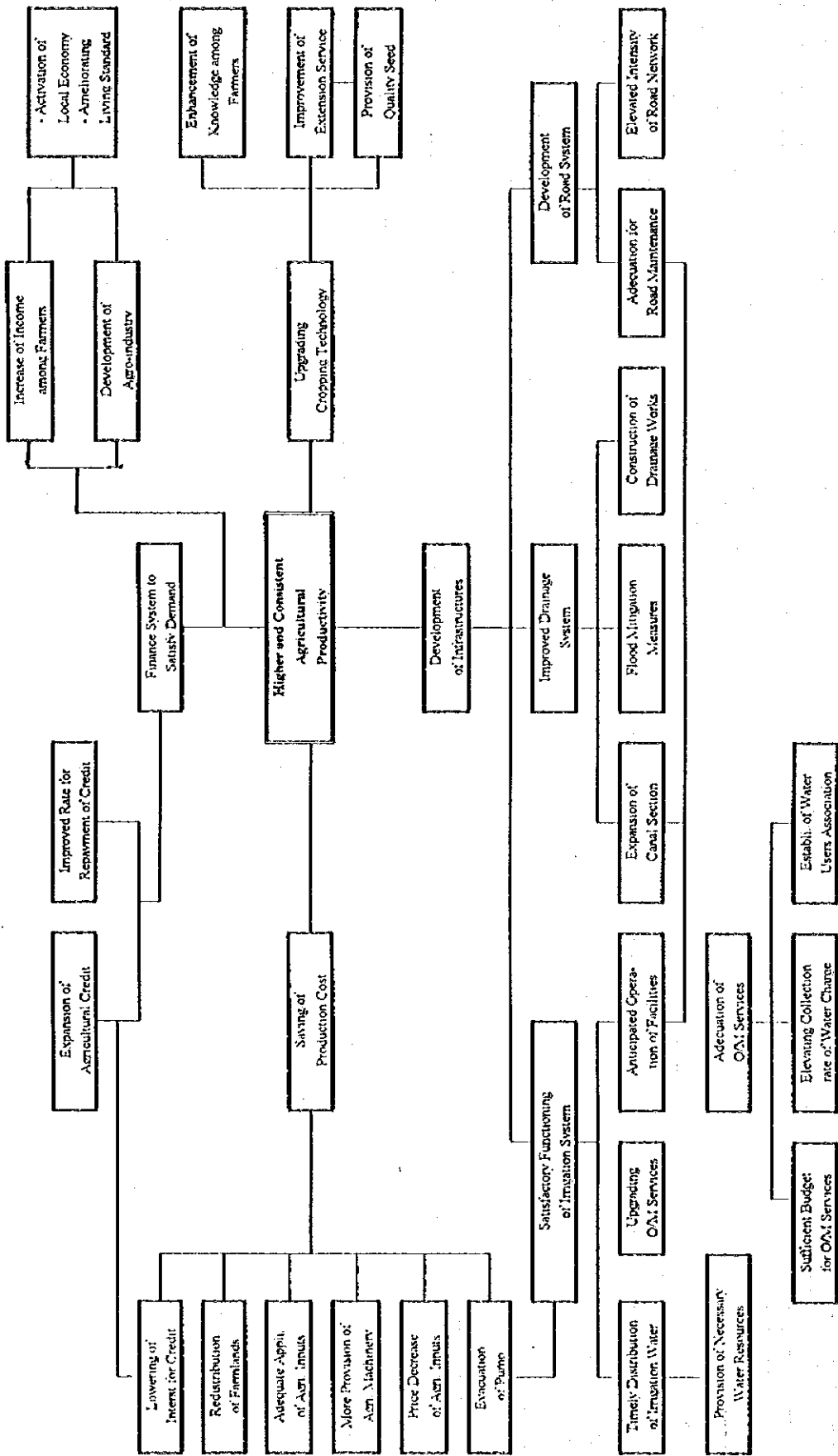


Fig. 4.2 Development Targets of the Study Area

5. FORMULATION OF THE DEVELOPMENT PROJECT

The development objectives for the present project are presented in line with the development strategies, and three alternative plans to comply with these objectives have been incorporated formulating independently infrastructures and agricultural production and farming system development plans as well as institutional services strengthening plans.

5.1 OBJECTIVES OF THE PROJECT

The only practical proposal for the area to attain anticipated growth shall be encouragement of the agricultural sector and the following targets in relation with the development of the area are presented.

- To take part in the development of the AGLIPO area attributable to realization of high-productive agricultural zone
- To establish farming system to promise farmers with consistent crop yield and satisfactory income
- To strengthen rural organization to contribute to rationalization of farming, marketing, and operation and maintenance of irrigation/drainage system
- To ameliorate living standard if farmers and to encourage performance of local economy

To attain the said targets, measures shall be taken in conformity with the development strategies.

5.2 ALTERNATIVE PLANS ON DEVELOPMENT

5.2.1 Premises on Presentation of Alternative Plans

In principle, alternatives plans have been prepared in two categories taking the following premised into consideration.

(1) Deficiency of irrigation water

Actual paddy fields have been expanded beyond potential irrigable area by gravity and, as a consequence, more paddy fields tend to rely on pumping system to take water for irrigation purpose. The first cropping period of paddy is not faced with shortage of water, meanwhile to supply constantly irrigation water for the second cropping period, renovation of existing irrigation system is indispensable.

(2) Support to small farmers

27 years have passed since the beginning of the agrarian reform project and during the course of this period, division of farmlands which have been distributed to settlers is taken into effect. At present, there are very little virgin land which may be available for

distribution of farmers. The land tenure study has disclosed that there are about 100 farms, which are inferior to 2 ha in size (1.6 ha on average). It is supposed that a minimum farm size to promise farmers with desirable living standards would be around 3 ha; so as to eradicate farmers with farmland holding smaller than 3 ha from the Study area, it is necessary to dispose about 200 ha of land, and in this context, it is advisable to comprise large farms in the development plan.

(3) Electric supply system

The electric supply system in the Dominican Republic has been confronted with the serious problem that constitutes a bottleneck in operation of pumping system at irrigation project areas. Therefore, special attention should be paid in inclusion of pumping system in planning irrigation system.

(4) Improvement of irrigation/drainage system to facilitate organization of water users' association

As a measure to realize an effective and rational use of water resources as well as to attain consistent agricultural production, turn-over policy in control and responsibilities of irrigation system from INDRHI to water users' association (Junta de Regantes) is in progress throughout the country. To follow this policy within the Study area, an improvement of existing infrastructures that permit anticipated functioning of the said association is of necessity.

(5) Different conditions from standpoint of land tenure

Farming conditions are different between (A) Agrarian reform project area and (B) Private lands located alongside the Yuna river, so consideration is to be made for respective category of land tenure.

A. Agrarian reform project area:

In this project area, during the course of 30 years after completion of infrastructures for paddy cultivation, various distortions have been identified.

B. Private lands

Endowed with land fertility, farmers in these lands enjoy higher production of paddy pumping water from the Yuna river, but no systematic infrastructure has been provided in this sector up to date.

The above considerations lead to the suggestion that the agrarian reform project area should be reconstructed with rehabilitation of deteriorated structures and provision of new system after examining the transformation of installations between the initial stage of the project and actual the present, whereas private lands area should be provided necessary infrastructures.

5.2.2 Alternative Plans

The present agricultural development plan will be formulated aiming at increasing rice production, and, in this context, attaining an expansion of the cultivated area of paddy together with improvement of productivity is a key factor for the success of the project. Alternative plans to expand cultivated area of paddy may be classified into two categories by utilization proposal of water resources: one is to limit intake method to gravity system (Alternative Plan A) and the other is to allow pumping system in addition to gravity system (Alternative Plan B) ; the latter plan is further divided into two sub-categories (Alternative Plan B-1 and Alternative Plan B-2) according with inclusion or exclusion of large farms. Thus three Alternative Plans are formulated in this Study.

Alternative Plan A:

In this plan water will be taken from water sources exclusively by gravity without relying on pumping system. As a consequence, an expansion of actual paddy fields is not envisaged in this plan. Nevertheless, some uplands and grazing lands which are easily accessible to irrigation water will be converted into paddy fields. Exceptionally, installation of small-scaled pumps will be realized in view of rational water use by taking return flow.

Alternative Plan B-1

This plan pretend to expand double cropping fields of paddy as much as possible with maximum utilization of available water resources employing not only gravity system but also pumping system.

Alternative Plan B-2

This Plan aims to exclude large farms which are located apart from the irrigation blocks from the irrigable area without affecting general planning of the irrigation system.

5.3 LAND USE PLAN (DEVELOPMENT AREA)

The improvement of irrigation and drainage system contemplated in the present agricultural development project will bring the shift of land use from the actual situation into more intensive way and the total area of 8,820 ha is defined as development area of the present agricultural development project.

5.4 AGRICULTURAL PRODUCTION AND FARMING SYSTEM DEVELOPMENT PLAN

5.4.1 Cropping Area

The implementation of irrigation and drainage system development project sacrifices some portion of arable lands for construction/expansion of canals and other related structure, so the net area of arable

lands in "With project" situation will be reduced in comparison of that in "Without project" situation. Nevertheless, with improving cropping intensity, the cultivated area "With Project" situation will increase by 30% for the Alternative A, by 39% for the Alternative B-1, and by 37 % for the Alternative B-2 in comparison with the "Without Project" situation. Thus, the cultivated area for respective alternative of the "With Project" situation will become as given below.

Crops	Without Project			Alternative Plan A		Alternative Plan B-1		Alternative Plan B-2	
	1st Crop	2do Crop	Total	Total	Balance	Total	Balance	Total	Balance
Paddy	6,000	3,500	9,500	13,300	3,800	15,720	6,220	15,140	5,640
Uplands	65	65	130	340	210	220	90	220	90
Pasture	1,840	-	1,840	1,330	- 510	0	- 1,840	360	- 1,480
Total	7,905	3,565	11,470	14,970	3,500	15,940	4,470	15,720	4,250

5.4.2 Yield Prospect and target Production of Paddy

Stable irrigation water supply, improvement of drainage condition and newly introduced technology resulting from the implementation of the Project, may bring about the yields projected in the table below.

Class	Current Yield		Projected Yield	
	1st crop.	2nd crop.	1st crop.	2nd crop.
Class 1	4.5 t/ha	3.1 t/ha	6.0 t/ha	5.0 t/ha
Class 2	4.0	2.6	5.5	4.6
Class 3	2.5	1.6	5.5	4.6
Weighted average	3.9	2.6	5.7	4.8

The table below sums up the measurement of the paddy fields in each class by alternative.

Class	Actual Area	Alternative A	Alternative B-1	Alternative B-2
Class 1	2,450 ha	2,500 ha	2,800 ha	2,510 ha
Class 2	3,080	3,050	3,400	3,400
Class 3	1,150	1,100	1,660	1,660
Total	6,680	6,650	7,860	7,570

An annual cropping area and production for respective alternative of "With" project situation are as shown below.

Alternative Plan	Without Project			With Project			Incremental Output (ton/year)
	Cultivated Area (ha/year)	Unit Yield (ton/ha)	Output (ton/year)	Cultivated Area (ha/year)	Unit Yield (ton/ha)	Output (ton/year)	
A	9,500	3.42	32,500	13,300	5.22	69,415	36,915
B-1				15,720	5.21	81,906	49,406
B-2				15,140	5.20	78,716	46,216

With project implementation, it is anticipated that the output of paddy will be increased by 214% for the Alternative Plan A, by 252% for the Alternative Plan B-1, and by 242% for the Alternative Plan B-2.

5.4.3 Farm Economy

The implementation of the present agricultural project will enable farmers in the development area to realize double cropping of paddy a year owing to consistent supply of irrigation water, improvement of drainage condition and mitigation of flood damage. As a consequence of this betterment, cropping intensity of paddy will be elevated from 142% to 200% a year, and unit yield of the same crop will attain higher level from 3.42 ton/ha to 5.20 ton/ha. The proposed production cost of paddy will have a slight increase from RD\$ 15,095 ("Without project") to RD\$ 15,720 ("With project").

Taking above-mentioned discussion into account, the net return of paddy farming for both "Without" and "With" project situations with regard to average farmer is estimated in the following manner.

	"Without" Project	"With" Project
Paddy field (ha)	4.5	4.5
Cultivated area (ha/year)	6.4	9.0
Unit yield (ton/ha)	3.42	5.20
Production (ton/year)	21.9	46.8
Farm-gate price (RD\$/ton)	4,500	4,500
Gross return (RD\$/year)	98,550	210,600
Production cost (RD\$/ha)	15,095	15,720
Production cost (RD\$/year)	96,608	141,480
Net return (RD\$/year)	1,942	55,170
Net return (RD\$/ha)	303	6,130

5.5 AGRO-PRODUCTS MARKETING AND PROCESSING PLAN

5.5.1 Principal in Formulating the Plan

The agro-products marketing and processing plan shall be formulated for attaining the following objectives:

- To reconcile the interest of farmers by promoting their participation in marketing process and to strengthen farmers' organization endowing it with substantial function.
- To develop agro-industry within the area so as to generate more job opportunity among local inhabitants.

For realizing above-mentioned objectives, the following institutional services to be rendered by governmental organizations are prerequisite for effective implementation of the plan.

- Financial arrangement for construction of facilities and operation of initial capital.

- Technical advise on proper operation of the facilities and production of improved milled rice.
- Educational campaign and training to strengthen farmers' organization.

5.5.2 General Description of the Plan

The agro-products marketing and processing plan contemplates to construct rice processing facilities equipped with innovated machinery within the Study area which permits to cope with proposed increase in paddy production and to produced improved quality of milled rice. The facilities will be administrated and operated by farmers' organization to comply with the objectives of this plan.

5.6 IRRIGATION AND DRAINAGE PLAN

5.6.1 Irrigation Plan

Taking into consideration of the actual irrigation network as well as available water resources, the irrigation network for the Alternative Plans A and B have been proposed as follows.

(1) Alternative Plan A

Irrigable Blocks	Source of Water	Irrigable Area (ha)		Intake Volume (m ³ /s)	Available Return flow (m ³ /s)
		Total	Return Flow		
Payabo	Payabo River	730	59	0.712	0.170
Ponton	Payabo River				
	Cevicos River				
	Springs	1630	275	1.438	0.227
Guaraguao-1	Springs	1632	327	1.385	0.227
Guaraguao-2	Reservoir	258	-	0.274	0.082
La Cueva	Springs	380	-	0.403	
El Cercado	Springs	270	-	0.286	
Lagnita Cristal	Springs	880	-	0.934	
Borojol	Return flow				
	Reservoir	870	870	-	0.923
Total		6650	1531	5.432	1.629

(2) Alternative Plan B

Irrigation Blocks	Source of Water	Irrigable Area (ha)		Intake Volume (m ³ /s)	Available Return flow (m ³ /s)
		Total	Return Flow		
Payabo	Payabo River Springs	1180	60	1.188	0.064
Ponton	Yuna River Cevicos River	1890	287	1.702	0.304
Guaraguao	Springs Yuna River	2350	336	2.137	0.356
La Cueva	Springs	380	-	0.403	
El Cercado	Springs	270	-	0.286	
Lagnita Cristal	Springs	880	-	0.934	
Borojol	Return flow Yuna River	910	768	-	0.966
Total		7860	1451	6.650	1.690

The Alternative Plan B envisages the following aspects which are different from the Alternative Plan A.

- a. Intake of water from the Yuna river by means of pumping system is considered. Irrigable area and intake volume proposed for this pumping system are:

Blocks	Irrigable Area (ha)	Intake Volume (m ³ /s)
Ponton	697	0.740
Guaraguao	709	0.752
Borojol	142	0.151
Total	1,548	1.643

- b. Construction of a reservoir is not included; this alternative pretends to cover proposed land for this infrastructure into paddy field (approximately 100 ha).

5.6.3 Drainage Plan

The great majority of excess water within the Study area is drained into the Payabo river and the Cascarilla Canal. These two systems function as a main drainage canal which connects with the remainder of the drainage systems within the Study area. The existing main drainage system which is connected with the Payabo river and the Cascarilla canal will be improved to function adequately as secondary canal system and, to complete the drainage network throughout the development area, small drainage system will be jointed with these secondary system.

The submergence analysis has disclosed that even intensive rainfall is taken place no serious damage due to flooding of paddy fields would be brought about over agricultural production. This means that flooding caused by intensive rainfall is within limit of allowable submergence. Nevertheless, in view of the fact that some drainage systems pass through populated area, the cross-section of drainage canals will be designed with in a diameter which enables to drain 24-hour-rainfall within 24 hours under 5-year-return period. On the other hand, a drainage system

which makes it possible to function drainage of excess water constantly will be provided at poor drainage lands located at the foot of the Los Haitises.

5.7 FLOOD MITIGATION PLAN

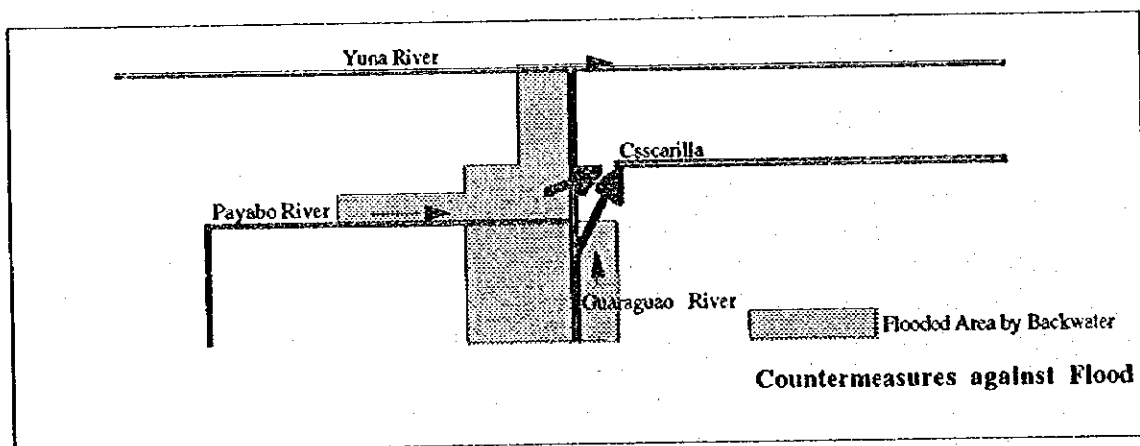
Flooding within the Study area is caused by backwater stemmed from flooding of the Yuna river and the Barracote river as well as by overflow of the Payabo river. For controlling overflow of the Payabo river, it is necessary to take two measures: (1) to regulate backwater coming from the Yuna river and (2) to alleviate flood at the head of the stream of the Payabo river, meanwhile flooding of the Cascarilla canal can be mitigated by taking action against backwater of the Barracote river. The flood mitigation plan in this development study is delineated subject to the following allowable submergence.

Allowable submergence: Submergence deeper than 30 cm should take place within 24 hours provided that this depth should not exceed 80 cm taking the height of paddy plant

5.7.1 Measures to Control Backwater of the Yuna River

Backwater of the Yuna river may be controlled by means of elevating crest of embankment of the Payabo river higher than the flood water level. This proposal shall contribute to improvement of flowing capacity of the Payabo river by 20 m³/s.

With elevation of embankment overflow of river water can be prevented, but this measure will result in increasing river water level, which will make it impossible to discharge excess water of paddy fields situated both margins of the river. For solving this problem proposal will be made to divert surface water of the paddy fields cited above to the Cascarilla canal. The connection of the Payabo river with the Cascarilla canal will be made at two sections as illustrated below.



5.7.2 Measures to Mitigate Flooding at Upper Stream of the Payabo River

As measures against flooding the following two proposals have been presented.

A. Expansion of section for drainage river.

The flooding discharge can be diverted to the Payabo river as well as to the Cevicos river and the flowing capacity of these two systems is estimated with regard to various cases of submergence depth. The result of this estimation disclosed that, except for some sections of the lower basin of the Guaraguao river, submergence depth could be kept within allowable depth if the flowing capacity of drainage systems are to be strengthened up to 20 m³/s.

B. Flood mitigation dam

The construction of a dam aiming at mitigating flooding damage will have remarkable effect; decreasing peak discharge by 34% the maximum allowable submergence can be elevated to 71% and with decrease of the same by 85% no land covering the whole development area will be inundated deeper than 30 cm. The definite constrain on development of this proposal is extremely elevated construction cost against tangible benefit of it, which leads to the conclusion that the construction of a flood mitigation dam is not economically feasible.

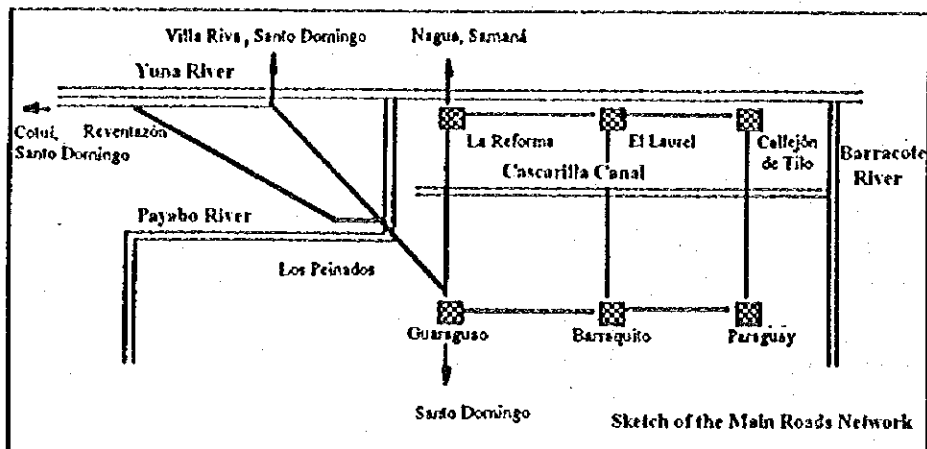
As a consequence of the above consideration, proposal for expansion of river section was adopted as a measure to mitigate flooding damage.

5.7.3 Measures against Backwater Flowing into the Cascarilla Canal

The flood water level of the Cascarilla canal is estimated to be 2.75 m under the return period of 1/5, so damages on agricultural production caused by inundation may be evaded if paddy is not planted at lands lower than 2 m.a.s.l. in view of the fact that the maximum submergence depth is 0.75 m. It is recommended to install a roller gate with flap at the connection of the canal with drainage canal so that return flow from the canal into paddy fields should not be taken place.

5.8 ROAD PLAN

Main roads serve as 1) an access among major villages within the Study area and connecting the Study area with other areas of the country. The rough sketch of the improved main road network is as illustrated below. Lateral and in-farm roads will be jointed with these main roads. Total width for main and lateral roads is designed to be 8m and 6 m, respectively.



5.9 FACILITIES PLAN

The project's facilities shall consist of, but not limited to, the following facilities:

Categories	Unit	Alternative Plan A	Alternative Plan B-1	Alternative Plan B-2
1. Intake facilities				
- Diversion weir	No.	4	4	4
- Intake works at springs	No.	8	8	8
- Spillway	No.	1	1	1
- Reservoir	No.	1	-	-
- Pumping station				
* at Yuna river	No.	-	2	2
* within the area	No.	3	3	3
2. Irrigation system				
- Main canal	m	96,550	102,500	102,100
- Secondary canal	m	68,860	70,480	68,520
- Tertiary canal	m	217,230	260,600	254,980
- Diversion works	No.	271	315	301
- Road intersection works	No.	59	67	64
- River intersection works	No.	1	1	1
- Intake of return flow	No.	7	7	7
3. Drainage system				
- Main canal	m	8,940	10,160	8,460
- Secondary canal	m	71,960	78,690	76,720
- Tertiary canal	m	180,810	215,480	210,240
- Wasteway	No.	8	10	10
- Road intersection works	No.	53	59	57
- River intersection works	No.	1	1	1

4. Flood mitigation works				
- Improvement works of Payabo river	m	22,500	22,500	22,500
- Improvement works of Cascarilla canal	m	19,000	19,000	19,000
5. Road improvement works				
- Trunk road	m	63,950	63,780	63,780
- Lateral roads	m	167,200	189,350	180,920
- In-farm road	m	8,800	8,800	8,800
- Bridge	No.	2	2	2
6. Office for O/M services	No.	1	1	1

5.10 INSTITUTIONAL SERVICES AND RURAL ORGANIZATION DEVELOPMENT PLAN

5.10.1 Transfer and Extension of Cropping Technology

Recommendations on improvement of transfer and extension of cropping technology are:

1. To establish an experimental farm administrated and operated by CEDIA within or in the vicinity of the Study area so that farmers in the area may be more accessible to innovated cropping technologies.
2. To establish a joint-committee participated by SEA, IAD, INDRHI, CEDIA and BAGRICOLA so as to exchange technical issues, views and problems related to crop and livestock production between concerned technical staff of each organization. It is advised that this joint-committee should prepare extension service programs in view of rendering effective services.

5.10.2 Agricultural Credit

The problems related with agricultural credit services are not specific ones coherent to the Study area but are in common all over the country; these problems are closely associated with agricultural policies of the central government, so political decision is required to solve them. Under the circumstances, recommendations will be made as explained below.

1. To strengthen manpower and expand available amount of credit at BAGRICOLA's branch offices near the Study area so as to satisfy increased demand with implementation of the project.
2. BAGRICOLA's credit for settlers is not rendered individually but through associations or cooperatives organized by farmers; to train and educate leaders of these organizations so that their member farmers may become more sensible in management and repayment of their debt.

Arenoso branch office); to diversify coverage of the credit to other crops and to other purposes than crop production such as purchase of agricultural machinery, equipment and vehicle, etc.

4. To create special line of credit applied for farmers' organizations; this credit, in turn, shall be provided to members of the organization who fail to get credit from BAGRICOLA.

5.10.3 Rural Organization Development Plan

(1) Farmers' organization

Farmers' organizations strengthening plan shall have objectives to realize economic independence of these organizations by means of providing them with substantial economic base and to promote cultivating cooperativism among members of the organizations, and as a measure to attain these objectives, proposal is made to entrust administration and operation of six rice processing facilities contemplated in the "Marketing and Processing Plan of Agro-products" to five cooperatives and one federation existing in the Study area. The medium and long term target of this plan is to expand activities of organizations after attaining the said economic independence in such fields as sale of agricultural inputs, rent of agricultural machinery, credit, sale of subsistence commodities, etc. and to return benefits of the organizations to their affiliated members so that enhancement of farmers' living standard may come true.

(2) Water users' association

It is proposed to establish water users' association within the area. The structure of this association and responsibilities respective level of the same are as explained hereinafter.

a. Nucleos de Regantes:

The unit shall be responsible for distribution of water from final gate to paddy fields, O/M of irrigation and drainage canals, collection of water charge, coordination for organization among water users as well as for settlement of disputes among members. Representative of each "nucleos" shall participate in "Asociacion de Regantes"

b. Asociacion de Regantes:

This is an organization to be formed for each water intake unit and shall take charge in O/M of lateral irrigation and drainage canals and in settlement of disputes among "nucleos". Representative of each "asociacion" shall participate in "Junta de Regantes".

c. Junta de Regantes:

This is the highest level of water users' association and shall be responsible for O/M of whole irrigation and drainage system to cover the irrigation project area. President of this unit will be selected among members by vote of all affiliated members.

6. PROJECT IMPLEMENTATION AND OPERATION

6.1 PROJECT EXECUTING AGENCY

INDRHI is the governmental agency of the Dominican Republic in charge of execution of irrigation and drainage project, therefore INDRHI is qualified to be the executing agency of the Project because major components of the present project are irrigation and drainage facilities. Because the project area belongs to IAD's agrarian reform area and it is envisaged that new settlers will be introduced within the development area. It is thus essential that IAD would participate during the implementation stage of the project. IAD shall be in charge of establishing lands distribution plan and its execution.

6.2 PROJECT IMPLEMENTATION SCHEDULE

As project preparatory period which comprises such activities as finance arrangement and employment of the Consultant 24 months will be taken, and the the project is scheduled to be implemented in 54 months, of which 14 months is allocated to detailed design services, 36 months to construction works, and 4 months for operation and maintenance works. The project implementation schedule is summarized in the figure below.

Components	Year in Order						
	1	2	3	4	5	6	7
Loan arrangement	_____						
Detailed design			_____				
Construction works							
- Preparator works				_____			
- Roads				_____			
- Drainage system					_____		
- Irrigation system						_____	
- Other works							_____
O/M services	_____						

6.3 PROJECT COST ESTIMATION

Unit: RD\$ x 1000

Category	Alternative Plan A			Alternative Plan B-1			Alternative Plan B-2		
	Local P.	Foreign P.	Total	Local P.	Foreign P.	Total	Local P.	Foreign P.	Total
1. Construction works	109,150	190,970	300,120	121,238	242,929	364,167	118,882	234,603	353,485
2. Land Acquisition	5,000	0	5,000	5,000	0	5,000	5,000	0	5,000
3. O/M machinery	0	18,673	18,673	0	18,673	18,673	0	18,673	18,673
4. General expenses	5,000	0	5,000	5,000	0	5,000	5,000	0	5,000
5. Consulting services	9,506	45,307	54,813	9,506	45,307	54,813	9,506	45,307	54,813
Sub-total (1-5)	128,656	254,950	383,606	140,744	306,909	447,653	138,388	298,583	436,971
6. Physical contingency	12,865	25,495	38,360	14,074	30,691	44,765	13,839	29,858	43,697
Sub-total (1-6)	141,521	280,445	421,966	154,818	337,600	492,418	152,227	328,441	480,668
7. Price escalation	12,347	27,683	42,011	15,758	33,980	49,738	15,486	32,987	48,473
Total (1-7)	153,868	308,108	463,977	170,576	371,580	542,156	167,713	361,428	529,141

6.4 OPERATION AND MAINTENANCE

(1) Proposal for operation and maintenance of irrigation system

In case of the present project, in view of the fact that sources of irrigation water are dispersed and intake works proposed for each source are relatively small in scale, it is recommended that Junta de Regantes should take charge of all facilities including intake facilities and main canals. INDRHI, on the other hand, shall be responsible for such water intake facilities as reservoir and pumping station as well as drainage system. For providing O/M services, offices for INDRHI and "Junta de Regantes" shall be established within the Study area; it is advised that for close communication and coordination between these two organizations, these office should be located in the same site.

(2) O/M cost

Annual operation and maintenance cost for project's facilities together with training services to Junta de Regantes is estimated independently for INDRHI and Junta de Regantes in the following manner.

Unit: RD\$

	INDRHI		Junta de Regantes	
	Alternative A	Alternative B	Alternative A	Alternative B
General O/M services	304,000	341,000	2,713,000	3,128,000
Office expense	541,000	541,000	2,692,000	2,692,000
Training	-	-	40,000	40,000
O/M of pump	-	999,000	204,000	204,000
Total	845,000	1,881,000	5,649,000	6,064,000

(3) Water Charge

Water charges to be imposed on beneficiaries of irrigation/drainage system "With" project are established as follows:

Irrigable Area	Alternative Plan A	Alternative Plan B
Up to 10 ha	RD\$ 394/ha	RD\$ 404/ha
Larger than 10 ha	RD\$ 788/ha	RD\$ 808/ha

7. PROJECT EVALUATION

7.1 COMPONENT OF THE COSTS AND BENEFITS OF THE PROJECT

The costs and benefits of the project which are subject to project evaluation shall consist of the following components.

Unit: RD\$ x 1000

Cost Items	Alternative A	Alternative B-1	Alternative B-2
Construction Works	300,120	364,167	353,484
Acquisition of Machinery	18,673	18,673	18,673
General Administration	5,000	5,000	5,000
Consulting Services	54,813	54,813	54,813
Physical Contingency	37,861	44,265	43,197
Total of Investment Cost	416,467	486,918	475,167
O/M Cost (Year)	3,871	4,503	4,503

Unit RD\$ x 1000

Items	Alternative A	Alternative B-1	Alternative B-2
Incremental Net Return of Agricultural Production	102,264	111,876	108,780
Avoidance of Loss in Agricultural Production	2,405	2,405	2,405
Total	104,669	114,281	111,185

7.2 VALUATION OF PROJECT'S COSTS AND BENEFITS AT ECONOMIC PRICE

7.2.1 Farm-gate Price

For the purpose of valuing economic price, crops and livestock products which are contemplated in both "With" and "Without" project situation are divided into two categories: traded items and non-traded items; the economic farm-gate price (economic import/export parity price) for the former is valued at border prices and that for the latter is obtained multiplying financial (market) price by conversion factor for consumer goods.

7.2.2 Production Cost

The financial production costs was converted to economic cost by means of elimination of direct transfer items and adjustment for price distortions in traded commodities and non-traded commodities by multiplying financial price with conversion factor.

7.2.3 Project Benefits

On the basis of the economic farm-gate price and production cost, the benefits of the project (incremental net return of agricultural production and avoidance of loss in agricultural production) at economic price is estimated in the following manner.

Unit RD\$ x 1000

Items	Alternative A	Alternative B-1	Alternative B-2
Incremental Net Return of Agricultural Production	66,597	74,517	73,443
Avoidance of Loss in Agricultural Production	1,678	1,678	1,678
Total	68,275	76,195	75,121

7.2.4 Project Costs

The project costs valued at market price are broken down into: traded commodities, non-traded commodities, skilled labor cost, unskilled labor cost and indirect cost and market prices for each component are converted into economic prices in accordance with necessary adjustments. Economic costs for initial investment and operation and maintenance cost are thus obtained as follows:

Unit: RD\$ x 1000

Cost Items	Alternative A	Alternative B-1	Alternative B-2
Construction Works	249,100	302,259	293,392
Acquisition of Machinery	17,179	17,179	17,179
General Administration	4,350	4,350	4,350
Consulting Services	53,168	53,168	53,168
Physical Contingency	32,380	37,696	36,809
Total of Investment Cost	356,177	414,652	404,898
O/M Cost (Year)	3,067	3,826	3,826

7.3 ECONOMIC ANALYSIS

7.3.1 Economic Internal Rate of Return (EIRR)

The annual inflow (benefits) and outflow (costs) of the project at economic price have been determined as mentioned before and, as a consequence, the annual incremental net benefit (annual benefit minus annual cost) is incorporated to cover the whole project life, which is set as 50 years for the project under consideration. On the basis of annual flow (cash flow) of the incremental net benefits, the economic internal rate of return (EIRR) is estimated to be 14,7% for the Alternative Plan A, 14.1% for the Alternative Plan B-1, and 14.2 % for the Alternative Plan B-2. Any of these rates exceeds the discount rate of 12 % which was set by the Central Bank and considered as the opportunity cost of the capital in the Dominican Republic. Therefore, all of three Alternatives have been justified from economic point of view.

7.3.2 Sensitivity Analysis

On the basis of the following assumptions on key factors of the project, sensitivity analysis was carried out.

- Unit yield of paddy is declined by 10% (Case 1)
- Project cost is escalated by 10% (Case 2)
- Combination of the Case 1 and the Case 2 (Case 3)
- Completion of construction works is delayed by 2 years (Case 4)

Project's EIRR was affected for respective assumption in the following manner:

Assumptions	EIRR (%)		
	Alternative 1	Alternative B-1	Alternative B-2
Case 1	13.3	12.7	12.9
Case 2	13.4	12.8	13.1
Case 3	12.1	11.9	11.7
Case 4	13.0	12.5	12.7

The above analysis disclosed that the profitability of the project is more sensible to the delay of completion of construction works than decline of unit yield and escalation of project cost.

7.4 FINANCIAL ANALYSIS

7.4.1 Profit-and-loss Analysis at Model Farms

At level of farmers, the implementation of the present project will bring both positive and negative effects; the former is represented by expansion of cultivated area and enhancement of land productivity and the latter is expressed in the form of rise in water charge and reduction of arable land. Under the circumstances, so as to quantify these effects profit-and-loss analysis at farm level was made by establishment of various model farms in accordance with land tenure, farm size, crop, and, cultivated area. A total of 6 model farms have been established with following characteristics:

Model Farms	Land Tenure	Farm Size (ha)		Crops		Cultivate Area (ha)	
		Without	With	Without	With	Without ^{1/}	With ^{2/}
A	IAD	3.8	3.8	Paddy	Paddy	4.9	6.8
B	IAD	1.6	3.0 ^{3/}	Paddy	Paddy	2.1	5.4
C	IAD	9.0	9.0	Pasture	Paddy	9.0	16.2
D	Private	5.8	5.8	Upland	Paddy	2.0	6.8
E	Private	40.0	30.0 ^{4/}	Paddy	Paddy	47.0	51.0
F	Private	180.0	135.0 ^{4/}	Pasture	Paddy	180.0	243.0

Note: With - With Project, Without - Without Project

1/ - Farm size x 0.9 (proportion of net irrigable area) x 1.4 (actual cropping intensity)

2/ - Farm size x 0.85 (proportion of net irrigable area) x 2.0 (proposed cropping intensity)

3/ - With assumption that redistribution of land should be made

4/ - With assumption that one-quarter of land should be expropriated according with "Quota Part" law

In relation with above model farms profit-and-loss analysis under both "With" and "Without" projects is made on the basis of market price and the result of the same is summarized in the table below.

Net Return (RD\$/year)	Model Farm					
	A	B	C	D	E	F
Without Project	1,446	620	16,458	11,620	13,865	929,160
With Project	49,545	39,344	115,550	49,545	355,432	1,757,453
Increased Net Return	48,099	38,725	69,092	37,925	341,567	828,293

7.5 PROJECT'S INDIRECT BENEFITS

As mentioned before, the implementation of the present project will produce such direct benefits as incremental agricultural production owing to improvement of irrigation and drainage conditions and avoidance in agricultural loss to be brought by flood mitigation. And, apart from

these direct benefits, it is anticipated that the project would accompany indirect benefits to be explained hereinafter.

(1) Contribution to development of agro-industry both within and out of the Study area and to encouragement of local economic activities

An annual production of paddy is expected to increase from 32,000 ton/year to 70,000-80,000 ton/year, and this incremental production will encourage to promote development of rice processing industry as well as elevating operation efficiency of existing plants. Simultaneously, in parallel with expansion of cultivated area of paddy, demand for fertilizers, agro-chemicals, and agricultural machinery services will increase, which contributes to make local commercial activities prosperous. With development of these agro-industrial and commercial activities, activation of regional economy will come true.

(2) Promotion for strengthening rural organization

The present agricultural development plan proposes to develop rice processing facilities to be administrated and operated by farmers' organization within the Study area. With realization of this proposal, the existing farmers' organization, which have no substantial function nor activity at present, will be provided opportunity for conducting fruitful economic activity. Furthermore, with achievement of successful administration of rice processing facilities, farmers' organizations will become capable of expanding their activities to such fields as sale of agricultural inputs, rent of agricultural machinery, and credit services, and benefits to be produced through farmers' organization will be returned to members of the organizations.

Besides above-mentioned cooperative organizations, improvement of irrigation/drainage system will facilitate formation of water users' association within the Study area. Thus, implementation of the present project is highly beneficial in terms of strengthening rural organization.

(3) Creation of opportunity for employment

Expansion of cultivated area of paddy also promises to provide more job opportunity of farm labor and development of agro-industry will take local inhabitants into new employment. Furthermore, implementation of construction works will create wide variety of employment, although it is a short-term basis.

(4) Contribution to self-sufficiency of rice

In the Dominican Republic, rice has been imported for eight years of the last decade and it is predicted that there will be a deficit of 200 thousand tons of rice for the coming year of 2015 if the country's population would grow following actual trend. The Limon del Yuna Agricultural Development Project envisages to increase rice output by 70,000 tons per year, so implementation of this project contributes to offset one-third of national deficit of rice.

(5) Saving of fuel

The prevailing poorly functioning irrigation system forces farmers to rely considerable portion of irrigation water on pumping system and farmers bear a cost of RD\$ 3,647,000 (total annual amount in the Study area) for operation and maintenance of pumping irrigation system in addition to water charge payable to INDRHI. Enhancement of gravity irrigation system discourages farmers to use pumps and, as a consequence, saving of fuel required for operation of pumps will be realized.

8. CONCLUSION AND RECOMMENDATIONS

8.1 CONCLUSION

The three alternative plans have been evaluated in connection with the following parameters.

Parameters	Alternative Plan A	Alternative Plan B-1	Alternative Plan B-2
Development area of paddy fields	6,650 ha	7,860 ha: to be expanded by 1,210 ha in comparison with Plan A	7,570 ha: to be expanded by 920 ha in comparison with Plan A
Increased in output of rice	36,915 ton	49,406 ton (1.34 times the Plan A)	46,216 ton (1.25 times the Plan B)
EIRR	14.7%	14.1%	14.2%
Re-distribution of farmland	Possible to expand size of farmland	Possible to expand size of farmland	Possible to expand size of farmland
New Settlement	Not viable	A total of 400 families may be newly settled	A total of 300 families may be newly settles
Intake method of irrigation water	The great majority of irrigation water will be taken by gravity	Greater portion of expanded development area will rely on pumping system	Greater portion of expanded development area will rely on pumping system

Although the Alternative Plans B-1 and B-2 will have more development area, it is recommended to adopt the Alternative Plan A due to the following justifications.

- (1). The Alternative Plan a is the most economically feasible plan among three alternative plans anticipating the highest value of EIRR.
- (2). The investment cost for the Alternative A is less than the other two plans.
- (3). About 200 ha of farmlands which are necessary for distributing to farmers cultivating smaller lands is also contemplated in Alternative A.

- (4). The major components of the present development project is rehabilitation of existing structures and in this context, even if the plan does not envisage new settlement, it is not against the objective of the project. The issue for expansion of farmlands cultivated by beneficiaries of the agrarian reform project should be discussed as a matter of the AGLIPO area in general.
- (5). Even though the pumping system proposed in the Alternative B is not large scaled one and consumption of energy in this system will not be large enough, attention should be paid to the passive attitude of the Dominican Government in employment of pumping irrigation system.

8.2 RECOMMENDATIONS

(1). Earlier commencement of the project

It is advised that the project should be commenced as early as possible due to the reasons as mentioned hereinafter:

- As the Limon del Yuna project has been put to the final stage of development among three areas of the AGLIPO project, so farmers in this area are anxious for earlier implementation of development project.
- The AGLIPO II project shall be commenced in 1995. If the Limon del Yuna project should be implemented in parallel with the AGLIPO II project, it would contribute to 1) alleviating farmers' dissatisfaction on the final development of the area, and 2) INDRHI's rational project implementation.
- An improvement of paddy productivity would not be realized if the prevailing whimsical method for maintenance of irrigation system is to be continued.
- There is no practical proposal but for agricultural purpose in development of the area.
- It is very timely to develop the area in this moment, because the Dominican Government is promoting to establish water users' association at irrigation project areas.

(2). Construction of Rice Mill

The construction of rice mill is alienated from components of this project to be developed under the present project, because this kind of development works has different characteristics from that of public works for agricultural infrastructures. Nevertheless, the development of agro-industry is highly anticipated not only to comply with increase of paddy production but also to strengthen rural organization and, as a consequence, to activate local economic performance. In this connection, it is advisable that the development of rice milling facilities should be put into force in line with the implementation of the present project. Furthermore, to realize this development, it is suggested that special line of credit should be incorporated.

(3) **Establishment of Exhibition Farm**

One of the factors which are associated with inferior level of productivity of paddy in the Study area is an absence of adequate transfer network of technologies developed at CEDIA. Bearing this situation in mind, it is proposed to establish an exhibition farm so that farmers in the area may become more accessible to learning appropriate cropping technology.

(4) **Agricultural Credit**

The planted area of paddy "With" project will increase by 30-40% in comparison with the actual situation and it is supposed that demand for credit also expands in accordance with increase of planted area. The great majority of farmers in the area are economically handicapped settlers with little financial resources, so rendering credit services for these farmers is essential for sowing crops. Under the circumstances, it is recommended that public financing institutions should strengthen their organization both their financing capacity and manpower.

(5) **Promotion of Rural Organization**

The present project proposes to construct rice milling facilities and operate and administrate them by farmers' organization. This proposal will serve to activate the existing cooperatives and associations which have not virtual performance at present. In addition, if these rice milling facilities would be operated and administrated generating anticipated return, farmers' organization may expand their activities to such fields as sale of agricultural inputs, lease of agricultural machinery, provision of agricultural credits, etc., produced benefits will be distributed to members of cooperatives and associations.

Besides farmers' organization, an improvement of irrigation and drainage facilities will constitute an incentive to form water users' association within the Study area, which in turn will contribute to promoting rural organization.

(6) **Monitoring and Control of Environmental Aspects**

In the moment no serious environmental problem is identified in the Study area. But it is foreseen that the dosage of agro-chemicals would be increased in parallel with an expansion of cropping area of paddy with implementation of the present project and, as a consequence, degradation of environment would be brought if farmers would not follow recommended practice for use of agro-chemicals. Under the circumstances, it is essential that an environmental education and instruction to farmers should be carried out by concerned institutions and the environmental monitoring and control system should be established within "Junta de Regents" after implementation of the project.

APPENDIX

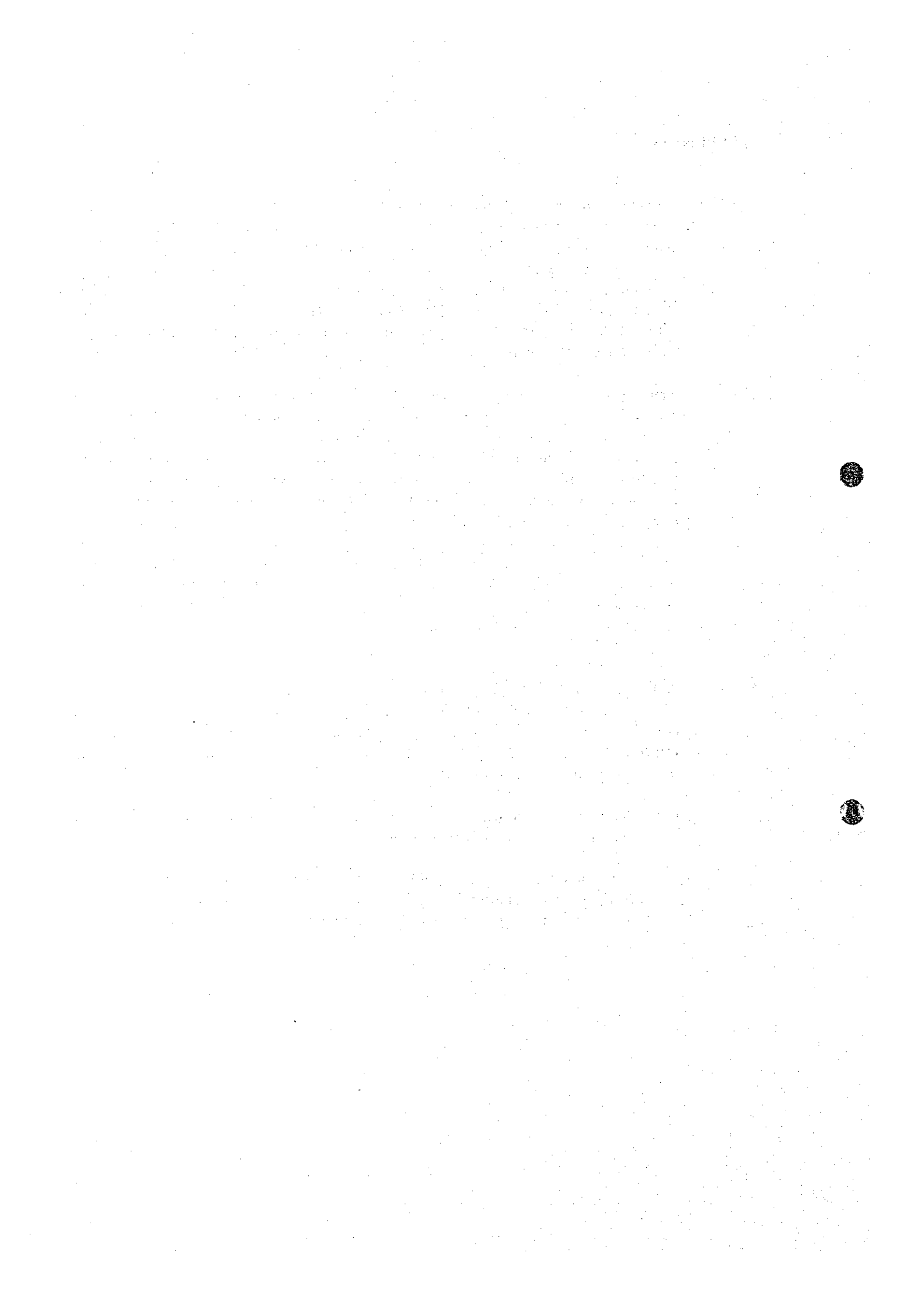
Within the present Feasibility Study on the Limon del Yuna Agricultural Development Project, three (3) alternative plans (Alternative plan A, B-1, and B-2) were presented and the Alternative Plan A was selected as the optimum plan among three plans justified by its technical adaptability and economic rentability. Therefore, the Study team recommended to implement the project based on the Alternative Plan A. The aforementioned three alternative plans were formulated through exchange of opinions between the Study team and the Dominican counterpart personnel during the field works in the Dominican Republic.

Nevertheless, after completing the field works, it is reported that the settlement of persons evacuated from the Los Haitises National Park is in progress in the lands covered by pasture where it is proposed to construct a reservoir in the Alternative Plan A. Faced with this situation, the Dominican side manifested their anxiety about sacrificing the pasture land for construction of a reservoir, and the same anxiety was presented in the comments on the Draft Final Report in such manner is substitutable to the construction of the reservoir.

So as to relax the anxiety of the Dominican side cited before, the Study team has formulated a plan (the Alternative A') which aims to irrigate the same area as contemplated in the Alternative Plan A, not by construction a reservoir but by installation a pumping station and has evaluated its technical and economic feasibility.

Although the benefit of the Alternative Plan A' is slightly higher than the Alternative Plan A, this increase in benefit will be invalidated by rise in operation and maintenance cost. Consequently, EIRR for both plans is almost the same. Even though the economic return is equal, the undermentioned reasons suggests that the Alternative Plan A is more benefitable than the Alternative Plan A'.

- (1) About half of the pasture area is in the habit of being inundated. In such area agricultural productivity remains in relatively low.
- (2) Large amount of budget might be spent annually for operation and maintenance of the pumping station. When the pump does not work, a considerable loss in harvest is anticipated. It is desirable that pump should be restricted to inevitable use.



MAIN REPORT

TABLE OF CONTENTS

	Page
Preface	
Letter of Transmittal	
Location Map of the Study Area	
General Plan of the Project	
Summary	
CHAPTER 1. INTRODUCTION -----	1 - 1
1.1 Preface -----	1 - 1
1.2 Background of the Study -----	1 - 1
1.3 Objective of the Study -----	1 - 3
1.4 The Study Area -----	1 - 3
1.5 Reports -----	1 - 3
CHAPTER 2. NATIONAL SOCIO-ECONOMIC BACKGROUND-----	2 - 1
2.1 Macroeconomic Overview -----	2 - 1
2.2 Performance of the Agricultural Sector -----	2 - 1
2.3 Policies on Agricultural Development -----	2 - 2
2.4 Policies on Development of Irrigation System -----	2 - 3
2.5 National Production, Supply and Demand of Rice -----	2 - 4
2.6 The AGLIPO Project Area -----	2 - 5
CHAPTER 3. FACT FINDING OF THE STUDY AREA -----	3 - 1
3.1 General Aspects -----	3 - 1
3.2 Meteorology and Hydrology -----	3 - 2
3.3 Topography and Geology -----	3 - 8
3.4 Soil Survey and Soil Classification -----	3 - 13
3.5 Land Use and Land Tenure -----	3 - 17
3.6 Socio-economic Survey -----	3 - 20
3.7 Agricultural Production-----	3 - 23
3.8 Marketing and Processing of Agro-products -----	3 - 32
3.9 Institutional Supporting System and Rural Organization -----	3 - 38
3.10 Irrigation and Drainage System-----	3 - 48
3.11 Flooding Damage-----	3 - 56
3.12 Existing Socio-rural Infrastructures -----	3 - 62
3.13 Role of Women-----	3 - 63
3.14 Environment -----	3 - 64
3.15 Actual Situation of AGLIPO I (El Pozo) Area -----	3 - 70

CHAPTER 4. CONSTRAINTS AND POTENTIALS ON DEVELOPMENT	4 - 1
4.1 Constraints on Development -----	4 - 1
4.2 Potentials on Development -----	4 - 4
4.3 Development Strategies -----	4 - 8
CHAPTER 5. FORMULATION OF THE DEVELOPMENT PROJECT -----	5 - 1
5.1 Objectives of the Project -----	5 - 1
5.2 Alternative Plans on Development -----	5 - 2
5.3 Land Use Plan -----	5 - 6
5.4 Agricultural Production and Farming System Development Plan	5 - 7
5.5 Agro-products Marketing and Processing Plan -----	5 - 16
5.6 Irrigation and Drainage Plan -----	5 - 19
5.7 Flood Mitigation Plan -----	5 - 26
5.8 Rural Infrastructure Development Plan -----	5 - 30
5.9 Facilities Plan -----	5 - 32
5.10 Institutional Services and Rural Organization Development Plan	5 - 39
CHAPTER 6. IMPLEMENTATION, OPERATION AND MAINTENANCE OF THE PROJECT -----	6 - 1
6.1 Project Execution Agency -----	6 - 1
6.2 Project Implementation Program -----	6 - 1
6.3 Project Implementation Calendar -----	6 - 2
6.4 Project Cost Estimate -----	6 - 4
6.5 Operation and Maintenance -----	6 - 7
CHAPTER 7. PROJECT EVALUATION -----	7 - 1
7.1 Objective of Project Evaluation -----	7 - 1
7.2 Project Evaluation Method -----	7 - 1
7.3 Component of the Costs and Benefits of the Project -----	7 - 2
7.4 Valuation of Project's Costs and Benefits at Economic Price ---	7 - 3
7.5 Economic Analysis -----	7 - 5
7.6 Financial Analysis -----	7 - 6
7.7 Project's Indirect Benefits -----	7 - 7
7.8 Monitoring and Evaluation of the Project -----	7 - 9

	Page
CHAPTER 8. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) -----	8 - 1
8.1 The Terms of EIA-----	8 - 1
8.2 Environmental Impact Assessment-----	8 - 1
8.3 Assessment of the Impacts of Agricultural Chemicals-----	8 - 4
8.4 Environmental Conservation Plan-----	8 - 87
 CHAPTER 9. CONCLUSION AND RECOMMENDATIONS -----	 9 - 1
9.1 Conclusion-----	9 - 1
9.2 Recommendations-----	9 - 2

APPENDIX : Formulation of the Alternative Plan A' and its Technical and Economic Evaluation

TABLES

FIGURES

ATTACHED

- DOCUMENTS : A.1: SCOPE OF WORK FOR THE STUDY AND ITS MUNUTES OF MEETING**
A.2: MINUTES OF THE MEETINGS DURING THE STUDY
A.3: LIST OF PERSONNEL CONCERNED WITH THE STUDY

LIST OF TABLES

	Page
3.4.1 List of Soil Series - New Series-----	T - 1
3.4.2 List of Soil Series - Corrected Former -----	T - 2
3.7.1 Harvested Area, Yield and Production of Upland Crops in Limon Del Yuna at 1994 based on Reconnaissance Survey -----	T - 3
3.9.1 Operation & Maintenance Cost & Collected Water Charge -----	T - 4
3.9.2 Water Charge of the Dominican Republic in 1990	
3.14.1 List of Agro-chemicals prohibited of Importation and/or Trading Presidential Decree of the Dominican Republic -----	T - 4
(Number 217-91) - 1991-----	T - 5
3.14.2 Use of Agro-chemicals in the Study Area-----	T - 6
3.14.3 Water Analysis Results-----	T - 7
5.4.1 Conversion Profile of Land Use-----	T - 8
5.4.2 Area of Paddy Field by Land Use Plan-----	T - 9
5.4.3 Target Production of Vegetables and Other Food Crops-----	T - 10
7.5.1 Project's Cash Flow for Economic Costs and Benefits-----	T - 11
7.7.1 Amortization Schedule of Foreign Currency Loan-----	T - 14
8.2.1 Environmental Impact Assessment -----	T - 15
8.3.1 Projection by Agro-chemicals Application-----	T - 16
8.3.2 Guidelines of WHO (World Health Organization) about the Allowable Quantity of Agro-chemicals in the Drinking Water -----	T - 17

LIST OF FIGURES

3.3.1	Geological Map of the Study Area -----	F - 1
3.4.1	Geological Profile -----	F - 2
3.4.2	Location of Boring and Borrow Pit -----	F - 3
3.4.3	Soil Map -----	F - 4
3.4.4	Soil Classification Map -----	F - 5
3.7.1	Lands Classification based on Rice Productivity -----	F - 6
3.10.1	Actual Irrigation System -----	F - 7
3.10.2	Actual Irrigation Blocks -----	F - 8
3.14.1	Location of Water Quality Analysis -----	F - 9
3.14.2	Agro-chemicals Analysis Method by Vacuum System -----	F - 10
3.14.3	Annual Variation of the River Water Quality (1994-1995) -----	F - 11
3.14.4	Diagram of Distribution of Irrigation Water -----	F - 12
3.14.5	Annual Variation of the River Water Quality -----	F - 13
5.4.1	Rice Cropping Plan -----	F - 14
5.4.2	Upland Crop Cropping Plan (1) Fundamental Patterns of Rotational Cropping -----	F - 15
5.4.2	Upland Crop Cropping Plan (2) Three Years Rotational and Continuously Cropping System -----	F - 15
5.8.1	Road Network Plan -----	F - 16
6.6.1	Organization Chart of the "Junta de Regantes" -----	F - 17
8.1.1	Correlation over the Environmental Impact Assessment -----	F - 18
8.4.1	Agro-chemicals prohibited in the Dominican Republic and other Latin-American countries -----	F - 19

Acronyms

Acronyms	In Spanish	In English	和 文
BAGRICOLA	Banco Agrícola	Agricultural Bank	農業銀行
C.D.E	Corporación Dominicana de Electricidad	Dominican Electric Corporation	ドミニカ電力公社
CEDIA	Centro de Investigaciones Arroceras	Agricultural Investigation Center	稲作中央試験場
CEDOPEX	Centro Dominicano de Promoción de Exportación	Dominican Exportation Promotion Center	ドミニカ輸出促進センター
CENDA	Centro Norte de Desarrollo Agropecuario	Agricultural and Livestock Development North Center	農牧業開発 北部地区センター
CENDATECA	Centro Nacional de Tecnología en Cacao	Cacao Technology National Center	カカオ技術開発 センター
CESDA	Centro Sur de Desarrollo Agropecuario	Agricultural and Livestock Development South Center	農牧業開発 南部地区センター
CIAZA	Centro de Investigación Agropecuaria en Zonas Aridas	Arid Zone Research Center	乾燥地帯研究 センター
CIRESS	Centro de Investigación de Recuperación de Suelos Salinos	Saline Soil Recovery Research Center	塩分土壤研究 センター
CVMA	Centro de Ventas de Materiales Agropecuarios	Agricultural Materials Sales Center	農業資材販売 センター
DNF	Dirección Nacional Forestal	National Forestry Bureau	国家森林局
DNP	Dirección Nacional de Parques	National Parks Bureau	国家公園局
FARY	Federación Agrícola de Limón del Yuna	Limon del Yuna Agricultural Federation	リモン・デル・ ジュナ農業連盟
FAO	Organización de las Naciones Unidas para la Agricultura y la Alimentación	Food and Agricultural Organization	国際食糧農業機構
FIDE	Fondo de Inversiones para el Desarrollo Economico	Economic Development Investment Fund	経済開発投資基金
IAD	Instituto Agrario Dominicano	Dominican Agrarian Institute	農地庁
IDECOOP	Instituto de Desarrollo y Crédito Cooperativo	Cooperative Development and Credit Institute	共同組合促進、 融資庁
INDRHI	Instituto Nacional de Recursos Hidráulicos	National Institute of Hydraulic Resources	水利庁
INAPA	Instituto Nacional de Agua Potable y Alcantarillado	National Institute of Water Supply and Sewer System	上下水公社
INESPRE	Instituto Nacional de Estabilización de Precios	Price Stabilization Institute	価格安定庁
JAD	Junta Agroempresarial Dominicana	The Dominican Agri-business Council	ドミニカ 農業経営者連合会
JICA	Agencia de Cooperación Internacional del Japón	Japan International Cooperation Agency	国際協力事業団
OEA	Organización de los Estados Americanos	The Organization of American States	米州機構
ONAPLAN	Oficina Nacional de Planificación	National Planning Bureau	国家企画局
ONE	Oficina Nacional de Estadística	National Statistics Office	国家統計事務所
SEA	Secretaria de Estado de Agricultura	Ministry of Agriculture	農業省

Abbrevlation

Acronyms	In Spanish	In English	和 文
mm	milímetro	millimeter	ミリメートル
cm	centímetro	centimeter	センチメートル
m	metro	meter	メートル
km	kilómetro	kilometer	キロメートル
in.	pulgada	Inch	インチ
cm ²	centímetro cuadrado	square centimeter	平方センチメートル
m ²	metro cuadrado	square meter	平方メートル
km ²	kilómetro cuadrado	square kilometer	平方キロメートル
ha	hectárea	hectare	ヘクタール
tarea	tarea	tarea	タレア
l	litro	liter	リットル
kl	kilolitro	kiloliter	キロリットル
G	galón	galon=3.75liter	ガロン
m ³	metro cúbico	cubic meter	立方メートル
kg	kilogramo	kilogram	キログラム
t	tonelada	ton	トン
lb	libra	pound=453.6g	ポンド
qq	quintal	quintal=45.36kg	キンタール
US\$	Dólar Estadounidense	United States Dollar	米国ドル
RD\$	Peso Dominicano	Dominican Peso	ドミニカペソ
¥	Yen Japonés	Japanese Yen	日本円
m/s,m/sec	metro por segundo	meter per second	毎秒当たりメートル
m ³ /s	metro cúbico por segundo	cubic meter per second	毎秒当たり立方メートル
mm/day	milímetro por día	millimeter per day	日当たりミリメーター
t/ha,ton/ha	tonelada por hectáreas	ton per hectare	ヘクタール当たりトン
EL.	elevación	elevation	標高
%	por ciento	percent	パーセント
hr	hora	hour	時間
No.	número	number	番号