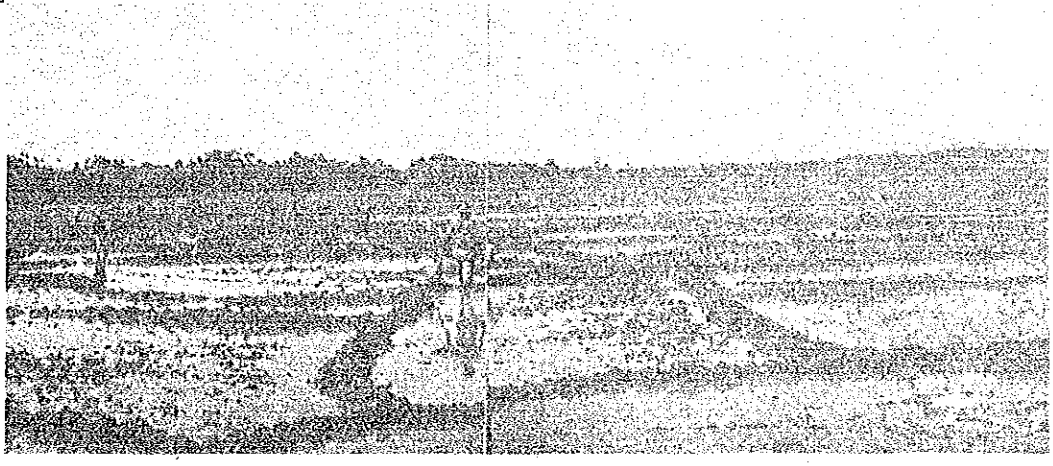
No. 2

DOMINICAN REPUBLIC

FEASIBILITY STUDY
ON
THE AGUACATE-GUAYABO
AGRICULTURAL DEVELOPMENT PROJECT

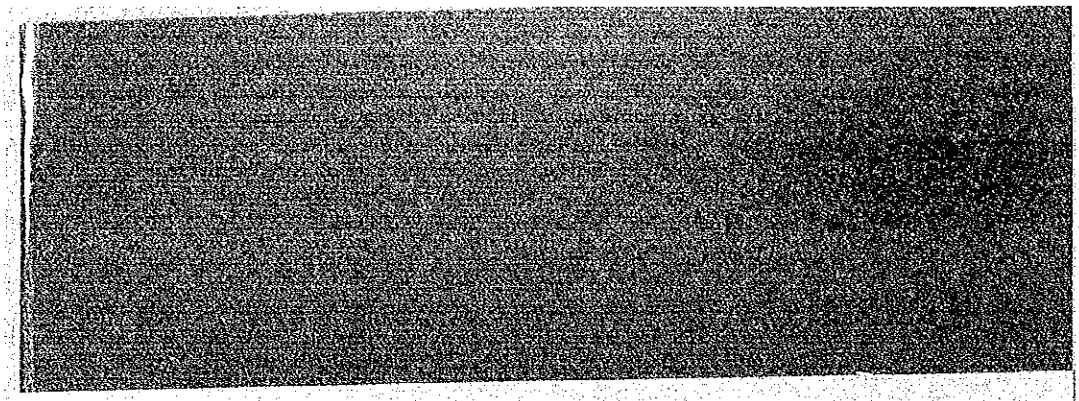
FINAL REPORT

VOLUME 1
MAIN REPORT



AUGUST 1986

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)



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P R E F A C E

It is with great plesure that I present this Feasibility Study Report on the Aguacate-Guayabo Agricultural Development Project to the Government of the Dominican Republic.

This report embodies the result of field survey which was carried out in the Aguacate-Guayabo area from July, 1985 to January, 1986 and feasibility study conducted by a Japanese team commissioned by the Japan International Cooperation Agency following the request of the Government of the Dominican Republic to the Government of Japan.

The survey team, headed by Mr. Satoru Kido, had a series of close discussions on the Project with the officials concerned of the Government of the Dominican Republic and conducted a wide-ranging field survey. After the survey team returned to Japan, further studies were conducted and the present report has been prepared.

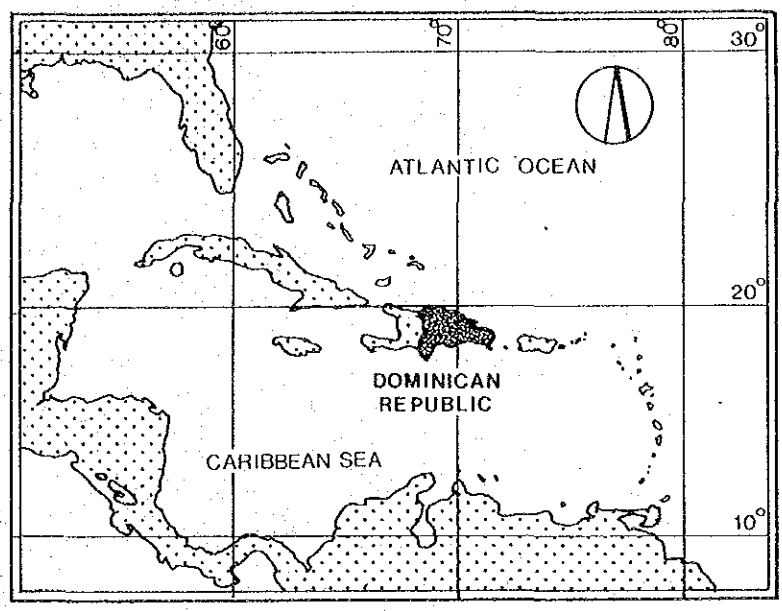
I hope that this report will be useful as a basic reference for development of the project.

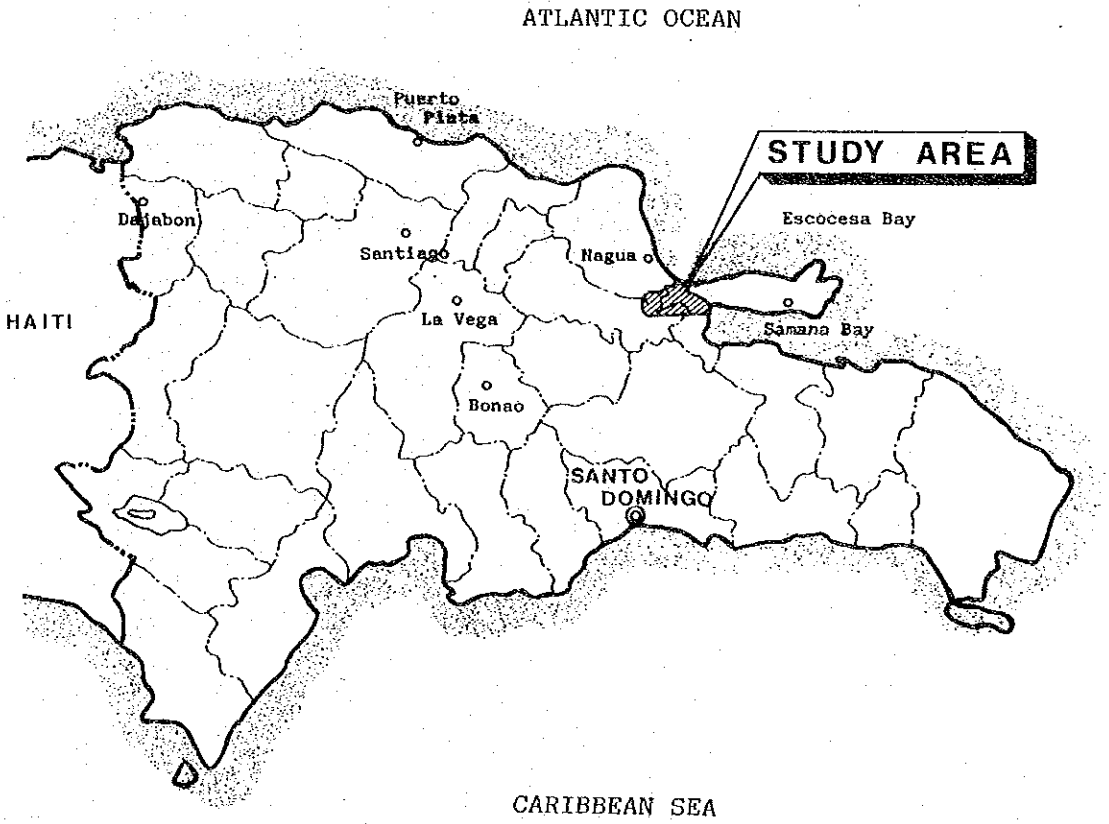
I wish to express my deep appreciation to the officials concerned of the Government of the Dominican Republic for their close cooperation extended to the Japanese team.

August, 1986

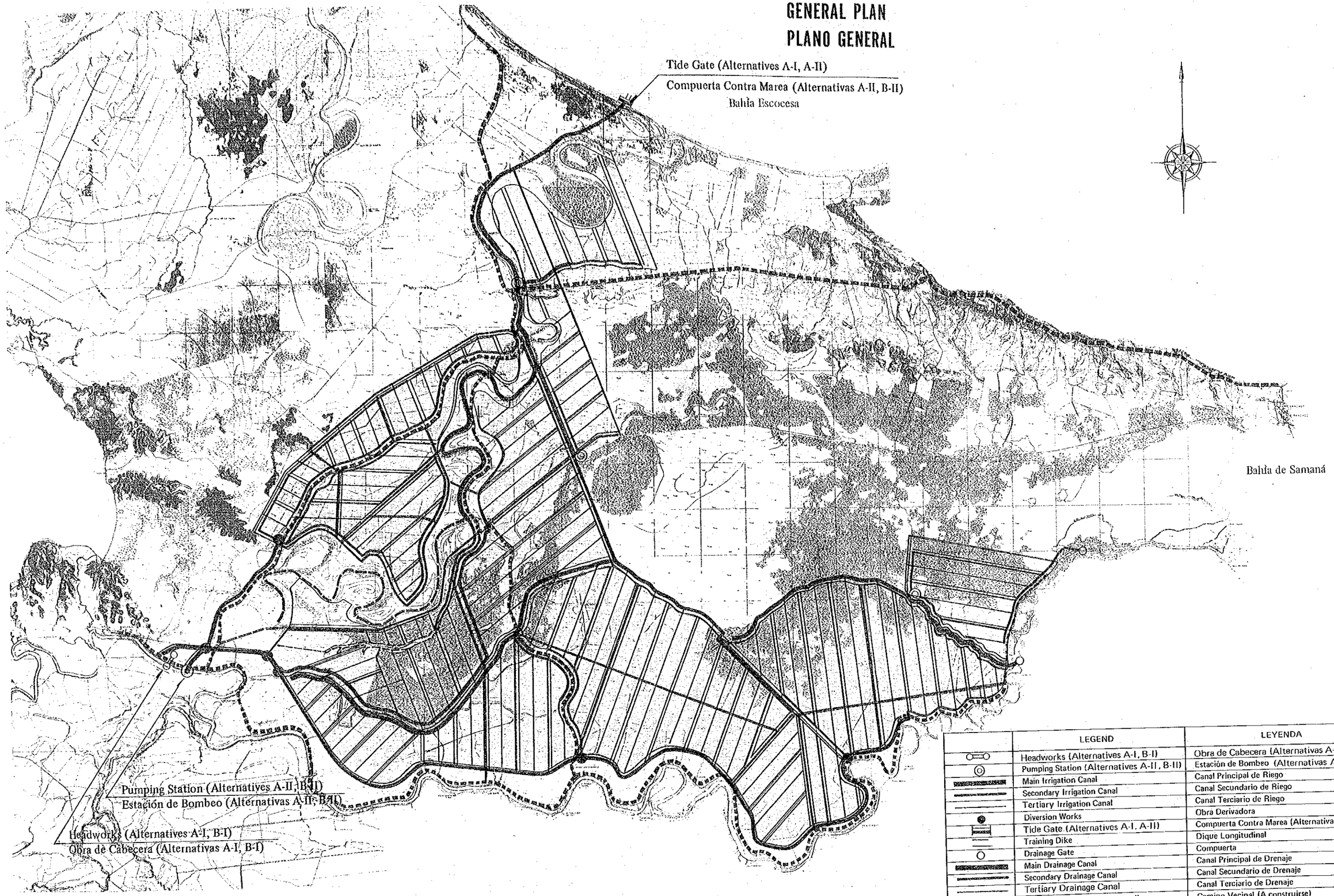
Keisuke Arita
President
JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION MAP





GENERAL PLAN
PLANO GENERAL



Note: Alternatives A-I, A-II ▭ ▭
Alternatives B-I, B-II ▭

Nota: Alternativas A-I, A-II ▭ ▭
Alternativas B-I, B-II ▭

LEGEND	LEYENDA
Headworks (Alternatives A-I, B-I)	Obra de Cabecera (Alternativas A-I, B-I)
Pumping Station (Alternatives A-II, B-II)	Estación de Bombeo (Alternativas A-II, B-II)
Main Irrigation Canal	Canal Principal de Riego
Secondary Irrigation Canal	Canal Secundario de Riego
Tertiary Irrigation Canal	Canal Terciario de Riego
Diversion Works	Obra Derivadora
Tide Gate (Alternatives A-I, A-II)	Compuerta Contra Marea (Alternativas A-I, A-II)
Training Dike	Dique Longitudinal
Drainage Gate	Compuerta
Main Drainage Canal	Canal Principal de Drenaje
Secondary Drainage Canal	Canal Secundario de Drenaje
Tertiary Drainage Canal	Canal Terciario de Drenaje
Trunk Road (to be constructed)	Camino Vecinal (A construirse)
Trunk Road (Existing)	Camino Vecinal (Existente)
Trunk In-farm Road	Camino de Acceso
Lateral In-farm Road (I)	Camino Interparcelario Secundario (I)
Lateral In-farm Road (II)	Camino Interparcelario Secundario (II)

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GLOSSARY OF TERMS

Abbreviation or Symbol	Definition
(Organization)	
B.A.	Agricultural Bank
C.D.E.	Dominican Electric Corporation
CEDIA	Agricultural Investigation Center
CEDOPEX	Dominican Exportation Promotion Center
ECRA	Farmers' Enterprise of Agrarian Reform
IAD	Dominican Agrarian Institute
INDRHI	National Institute of Hydraulic Resources
INESPRE	Price Stabilization Institute
JICA	Japan International Cooperation Agency
OEA	American States Organization
OECF	Overseas Economic Cooperation Fund
ONAPLAN	National Planning Office
SEA	Ministry of Agriculture
SEOPC	Ministry of Public works and Communications
(Monetary Unit)	
RD$	Dominican Republic Peso
US$	United States Dollar
(Measurement Unit)	
mm	Millimeter
cm	Centimeter
km	Kilometer
kg	Kilogram
t	Ton
m^2	Square meter
km^2	Square kilometer
ha	Hectare
m^3	Cubic meter
m^3/s	Cubic meter per second

Abbreviation or Symbol	Definition
(Measurement Unit)	
m/s	Meter per second
t/ha	Ton per hectare
(Economic Terms)	
B/C	Benefit-Cost Ratio
C.I.F.	Cost, Insurance and Freight
NPV	Net Present Value
GDP	Gross Domestic Product
GNE	Gross National Expenditure
(Others)	
%	Percent
°C	Centigrade
pH	Potential of Hydrogen
EC	Electric conductivity

CONVERSION TABLE

US$ 1 = RD$ 3.12

1 Tarea = 0.0629 hectare

1 Fanega = 110-120 kilogram

SUMMARY AND RECOMMENDATION

SUMMARY AND RECOMMENDATIONS

1. SUMMARY

1.1 General

(1) The purpose of this agricultural development plan is to promote agriculture of the Aguacate-Guayabo area within the AGLIPO area. This follows development of the El Pozo area where construction, as a first step of the AGLIPO Agricultural Development Plan, has already begun. The current plan is to promote and further expand the extent of agricultural development in the AGLIPO area. The development level such items as irrigation and drainage systems will be almost as same as the El Pozo Project. In the effort to realize an early actualization of the effects of investment, the following plans have been formulated.

(2) The development plan is focused on rice production. Through the consolidation of agricultural infrastructures as well as the introduction of a double cropping cultivation system with improved varieties of rice in new developing areas, an improvement in rice productivity is expected.

(3) So as to implement a double cropping system, the shortfall in irrigation water will be obtained from the Yuna River. With a view to attaining high level of agricultural production, irrigation canals and agricultural production infrastructure such as road networks, etc. will be constructed.

(4) The introduction of double cropping with high-yield improved varieties of rice will become viable by a mitigation of flooding damage. This in turn will lower the normal water level through the improvement of drainage system composed of the Caño Gran Estero and the Guayabo River.

1.2 Background of the Project

(1) The Dominican Republic is suffering from a balance of payments problem caused by a trade deficit. Among the causes are the stagnation in the production of sugar, which is among the most profitable exports, due to depressed international prices, the increased importation of oil and petroleum products, and an increase in food imports to cope with the growth in population.

(2) Although the production of rice, which is one of the staple foods of the Dominican people, has recently increased, the consumption level has also increased due to an increase in population, and the national standard of living therefore, creating a supply shortage. Although rice had been imported to cover the shortfall, further importation was suspended after 1982 due to a worsening of the trade deficit. Therefore, in order to make up for a chronic shortfall in rice, to reduce the level of staple crop imports, and to save foreign currency, an increase in the production of rice, which appears promising for domestic agriculture, is desired.

(3) In order to improve the balance of payments situation and to achieve self-sufficiency in food, the government of the Dominican Republic has given agricultural development the highest priority among its economic development plans. For this purpose, the agrarian reform projects have been undertaken by the IAD and the consolidation of irrigation facilities by the INDRHI.

(4) Against such a background the government of the Dominican Republic is promoting the AGLIPO Agricultural Development Project focusing mainly on the development of rice production. The AGLIPO comprises three areas: El Aguacate, Limon del Yuna, and El Pozo. Among these three areas, construction works focusing on paddy fields in 7,500 ha of the El Pozo area was started in September of 1985 as the first stage of the AGLIPO Agricultural Development Project with financial assistance of the Japanese Government.

(5) Additionally, aiming at the further agricultural development of the AGLIPO area in succession to the El Pozo Project, the Government of the Dominican Republic requested in April 1984 the Japanese Government to carry out another feasibility study for the agricultural development project in the Aguacate-Guayabo which involves the development of Guayabo area located adjacent to Aguacate area. In response to this request, the Japanese Government decided to conduct the Study through the Japan International Cooperation Agency (JICA). A preliminary study team was dispatched to the Dominican Republic in November 1984 to conclude an agreement on the Scope of Works for the Study. In accordance with the stipulation of the Scope of Works, JICA sent the Phase I Study Team to the Dominican Republic from July to September, 1985 and the Phase II Study Team from November, 1985 to January, 1986 to carry out field works.

1.3 The Study Area

(1) Location

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

(2) Population

According to the 1981 census the population of the study area was 7,700 for El Aguacate area and 9,300 for El Guayabo area, 17,000 in total. Most of this population was engaged in agriculture. The number of settlements in El Aguacate and El Guayabo areas was 681 and 667, respectively for a total of 1,348 settlements.

(3) Climate

The study area has a humid tropical rain-forest climate with an average annual rainfall of about 2,000 mm. The amount of rainfall varies greatly from month to month with the heaviest rainfall coming in the months of May to August and November to December, meanwhile, the least rainfall occurs during the months of January to April and September to October. The annual average temperature is 26.2°C with the highest monthly average being 27.4°C in August and September and the lowest being 24.4°C in January.

(4) Land Use

Land use of the study area is summarized below. Swamp and swampy forests including the area used for grazing land occupy over 50% of the area.

(Unit: ha)

Land Use	El Aguacate	El Guayabo	Total	
Paddy Field	2,000	2,100	4,100	(17.0%)
Orchard & Upland	1,300	2,300	3,600	(14.9%)
Grazing Land	3,100	2,700	5,800	(24.1%)
Swamp & Swampy Forest	1,800	8,400	10,200	(42.3%)
Others	200	200	400	(1.7%)
Total	8,400	15,700	24,100	

(5) Soil

The distribution of soils of the area is as presented in the next page. Histosol formed by peat covers over 50% of the land area, if the associated soil orders are included.

Soil Orders	Area	%
Vertisol	1,690	7.0
Inceptisol	5,240	21.7
Molisol	2,880	12.0
Alfisol	550	2.3
Histosol	10,030	41.6
Associations	3,650	15.2
Lagoons	60	0.2
Total	24,100	100.0

Land classification is made according to the USDA system which is commonly used in the Dominican Republic. Additionally, another specification was set for the land capability classification with a view to increasing rice production area expected in this project and to assessing the development of peat soils extending over most of the study area. In accordance with this specification, the development area has been determined. Land classification for paddy rice production is shown below.

Classes	Suitability	Area (ha)	%
A1	Very suitable	5,870	24.4
A2	Suitable	1,640	6.8
A3	Moderately Suitable	2,300	9.5
A4	Marginally Suitable	2,530	10.5
A5	Not Suitable	1,700	7.1
A6	Non-arable Use	10,060	41.7
Total		24,100	100.0

The table indicates that a total of 9,810 ha of land classified in A1 to A3 is primarily qualified as capable land for rice production. Including soil in class A4, which is marginally suitable for agriculture, the total land area which may be used for paddy rice cultivation is 12,340 ha or 51% of the study area.

(6) Agriculture

Although rice is the main agricultural product of the study area suited to double cropping from a climatic point of view, few farms, with the exception of those in irrigated areas, carry out double cropping due to a lack of irrigation water. Single cropping is prevailing in rain-fed paddy fields with seeding time dependent upon rainfall conditions. In the double cropping system, which is carried out in irrigated areas, the seeding of the first crop is done in January and February, transplanting from February to March and harvesting from June to July, in the case of the second crop, seeding takes place from June to July, transplanting from July to August and harvesting from October to December. As for rice varieties, improved varieties such as Juma 57, ISA 40, and Tanioka are cultivated generally in irrigated paddy fields, while Mingolo and Ingles are cultivated in rain-fed rice fields. Damage from blight and disease organisms such as brown leaf spot and rice blast occur in peat soil fields in El Guayabo area. The average yield of unhulled rice is in the range of 2.3 - 2.7 tons/ha. Annual productions for crops other than rice are cocoa, 210 tons (dry beans), coconut, 2,000 tons (desiccated nut), and yautia, 8,800 tons.

(7) Irrigation System

The paddy fields of 4,100 ha within the study area have not been adequately prepared and there are many of them which had been once developed and have been abandoned without being cultivated. As for irrigated paddy fields, there are a natural levee area situated along the Yuna River which is directly irrigated by small pumps (ϕ100 - 300 mm) from the Yuna River and the area which is benefitted by the Aguacate pumping station.

However these equipments are too old to provide irrigation water constantly. The rain-fed paddies have serious problems associated with a lack of water during the dry season. The size of the fields is irregular and no in-farm road which permits the passage of vehicles exists with the exception of one portion of the El Aguacate area.

(8) Drainage

The drainage system in the study area is divided into two systems: the Caño Gran Estero and the Guayabo River. However, both rivers have a gentle slope thus allowing the growth of weeds and water plants. Blockage at the mouth of the Caño Gran Estero combined with the effect of the high water level of the Yuna River on the Guayabo River results in lowering the draining capacity of these systems, which in turn leads to crop loss even in the event of a small flood. Recently, however, the frequency of flooding on the Yuna River has been reduced owing to the effect of flood control benefitted by the construction of Hatillo dam as well as the sinkage of the Barracote weir, etc. The density of the drainage canal network of the study area is larger than that of the irrigation canals, however, the drainage canals are not functioning properly due to the lack of flow capacity of the channel and the growth of weeds. Therefore, improvement in drainage together with irrigation is necessary for the development of the area.

1.4 Development Plan

(1) Basic Development Concept

In formulating the development plan for the study area (24,100 ha), special consideration was given to development area and water intake method. Furthermore, after studying such factors as soil, topography, land use, irrigation, and drainage, the development plan has been summarized in the following four alternatives.

Alternatives	Description	Development Area (ha)		Proposed Main Facilities			
		Total	Irrigable Area	Facilities		Development Level	Remarks
A-I	All lands capable for the paddy field development are included. The greater part of the irrigation water will be obtained from the Yuna River by constructing headworks.	8,600	8,300	Irrigation system	Headworks: 1 Sub-pumping Station: 3	Irrigation water will be supplied against drought of 1:5 return period	. Irrigation water will be supplementarily obtained from the Cano Gran Estero and in this connection, a tide gate has been proposed to mitigate the invasion of sea water . Traditional varieties will be seeded in poor drainage area . Considerable amount of initial investment is required
				Drainage System	Training Dike: 1 Tide Gate: 1 Drainage Gate: 1	Inundation will not be caused against flooding of 1:5 return period	
				Road Network		In-farm road will be allocated every one side of each farm	
A-II	All lands capable for the paddy field development are included. The greater part of the irrigation water will be obtained from the Yuna River by constructing pumping station.	8,600	8,300	Irrigation System	Main Pumping Station: 1 Sub-pumping Station: 3	Irrigation water will be supplied against drought of 1:5 return period	. Apart from observations mentioned in A-I, additional cost for the operation and maintenance of pumping station will be incurred
				Drainage System	Training Dike: 1 Tide Gate: 1 Drainage Gate: 1	Inundation will not be caused against flooding of 1:5 return period	
				Road Network		In-farm road will be allocated every one side of each farm	
B-I	Lands to be irrigated exclusively by the construction of headworks are included. Lands with poor drainage are excluded.	7,400	7,000	Irrigation System	Headworks: 1	Irrigation water will be supplied against drought of 1:5 return period	. Development area will be less in 1,300 ha than the Alternative A . Considerable amount of initial investment is required
				Drainage System	Training Dike: 1 Drainage Gate: 1	Inundation will not be caused against flooding of 1:5 return period	
				Road Network		In-farm road will be allocated every one side of each farm	
B-II	Lands to be irrigated exclusively by the construction of pumping station are included. Lands with poor drainage are excluded.	7,400	7,000	Irrigation System	Pumping Station: 1	Irrigation water will be supplied against drought of 1:5 return period	. Development area will be less in 1,300 ha than the Alternative A . Additional cost for the operation and maintenance of pumping station will be incurred
				Drainage System	Training Dike: 1 Drainage Gate: 1	Inundation will not be caused against flooding of 1:5 return period	
				Road Network		In-farm road will be allocated every one side of each farm	

(2) Land Use Plan

The land use plan for the study area is shown below.

Land Use	Actual Situation (ha)	Alternative A Area (ha)	Alternative A Balance (ha)	Alternative B Area (ha)	Alternative B Balance (ha)
Paddy Field	4,100	8,300	+4,200	7,000	+2,900
Orchard & Upland	3,600	2,900	-700	2,900	-700
Grazing Land	5,800	4,500	-1,300	5,000	-800
Swamp	4,900	2,000	-2,900	2,800	-2,100
Swampy Forest	5,300	5,000	-300	5,000	-300
Others 1/	400	1,400	+1,000	1,400	+1,000
Total	24,100	24,100		24,100	

Note: 1/ includes residential area, road, irrigation and drainage canals, etc.

(3) Cropping Pattern

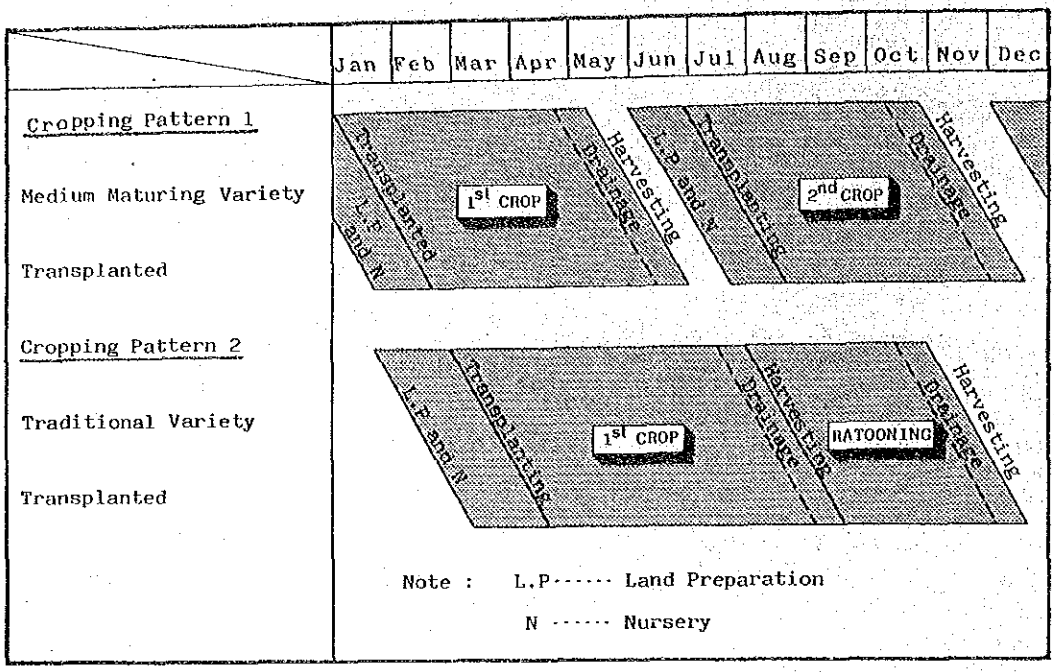
Rice has been selected as the only crop to be developed in the proposed irrigated area after studying climate and soil conditions of the study area, and in terms of profitability.

Rice production will be realized in the following manners:

- Double cropping with improved varieties (Juma, ISA, and Tanioka), which will be transplanted or direct-seeded into the proposed irrigation area except for the poor drainage area.

- Single cropping with traditional variety (Mingolo), which will be transplanted into the poor drainage area of the Alternative A (1,100 ha) and harvested twice a year by means of the ratooning method.

The proposed cropping pattern for rice production is illustrated below:



(4) Production Plan

The production plan has been set forth dividing the total project life into the following two terms:

- Medium Term: Initial six years after completion of construction works. This term is considered to be a transition period for the implementation of proposed cropping pattern.

- Long Term: From seventh year and onward after the completion of construction works.

The target harvested area, yield and production for each term are as indicated below:

	Actual Situation			Medium Term Target			Long Term Target		
	Harvested Area (ha)	Yield (t/ha)	Production (t)	Harvested Area (ha)	Yield (t/ha)	Production (t)	Harvested Area (ha)	Yield (t/ha)	Production (t)
Alternative A	3,680	1.5	6,550	12,400	2.6-3.8	42,700	15,300	3.0-5.0	63,660
Alternative B	3,050	2.5	7,625	11,000	2.8-3.8	38,600	14,000	3.2-5.0	58,760

(5) Irrigation Plan

The development level of irrigation plan is set forth on the basis of 1:5 return period of drought. Irrigation water will be obtained primarily from the Yuna River at a maximum requirement of 5.9 m^3/s. Two alternatives composed of headworks and pumping stations as a means of obtaining water have been discussed. As to canal systems, independent canals are proposed for main and lateral systems, while dual purpose canals will be constructed within paddy fields.

In Alternative B, the entire area (7,000 ha) will be irrigated with water from the Yuna River. However, in Alternative A, 7,000 ha will be irrigated from the Yuna River and the remaining 1,300 ha are to be irrigated by pumping up water from the Caño Gran Estero and the Guayabo River.

(6) Drainage Plan

The development level for the drainage plan is established for 1:5 return period of flooding. The proposed drainage system is composed of two systems: the Caño Gran Estero and the Guayabo River. In the Alternative A, which aims to obtain irrigation water from the Caño Gran Estero a training dike will be installed to prevent the blockage of the river mouth, and a tide gate is proposed against the invasion of salt water. A drainage gate will be built to mitigate back flow from the Yuna River into the Guayabo River.

In order to save construction cost natural rivers and existing drainage canals will be utilized as much as possible for a drainage canal network.

(7) Facility Plan

Quantities of main facilities for each alternative proposal are shown below.

Facilities	Alternatives			
	A - I	A - II	B - I	B - II
Irrigation System				
Main Intake Facilities	Headworks	Pumping Station	Headworks	Pumping Station
Sub-Pumping Stations	3	3	-	-
Main Canals	62.65 km	62.10 km	56.55 km	56.00 km
Lateral Canals	242.60 km	242.60 km	200.90 km	200.90 km
Drainage System				
Training Dike	1	1	1	1
Tide Gate	1	1	-	-
Drainage Gate	2	2	1	1
Main Canal	44.30 km	44.30 km	44.30 km	44.30 km
Lateral Canal	31.30 km	31.30 km	22.40 km	22.40 km
Road Network				
Rural Road	0.70 km	0.70 km	0.70 km	0.70 km
Access Road	46.70 km	46.70 km	43.90 km	43.90 km
In-farm Road	165.15 km	164.60 km	137.70 km	137.15 km
Bridge	9	9	8	8

Design criteria for principal facilities are as summarized below:

Headworks (Yuna River)	Design water requirement	:	5.90 m^3/s
	Design water intake level	:	EL 7.60 m
	Type	:	Movable weir + Emergency floodway
	Design river bed	:	EL 3.80 m
	Design water depth	:	3.80 m
	Length of headworks	:	68.50 m
	Scouring sluice	:	B 12.50 m x H 4.107 m x 1 set
	Flood sluice	:	B 25.00 m x H 3.90 m x 2 sets
	Intake gate	:	B 2.00 m x H 2.00 m x 2 sets
	Hoist	:	Motor
Pumping Station (Yuna River)	Pumping up capacity	:	5.90 m^3/s
	Intake water surface	:	EL 3.70 m
	Discharge water surface	:	EL 8.00 m
	Actual head	:	4.30 m
	Type of pump	:	Vertical mixed flood
	Diameter	:	900 mm x 3 units
	Power	:	Motor
Training Dike (Cano Gran Estero)	Type	:	Concrete block for breakwater
	Total length	:	320 m
	Crest height	:	EL 1.00 m
Tide Gate (Cano Gran Estero)	Dimension of gate	:	B 13.50 m x H 4.00 m x 3 sets
	Crest height of gate	:	EL 1.00 m
	Elevation of bed	:	EL -3.00 m
	Hoist	:	Motor

1.5 Project Implementation Plan

(1) Construction Period

The construction period will be divided into two phases: preparatory works phase and construction works phase. The preparatory works will be conducted in the first two and half years which involve arrangement of loan, detailed design and preparation of tender documents. The construction works phase is set at four years and construction of irriation facilities will begin at the earliest stage of the whole construction stage so that the project benefits might be generated as early as possible.

(2) Project Costs

The total costs of each alternative are estimated at RD$188,594,000 for the Alternative A-I, RD$179,478,000 for the A-II, RD$133,660,000 for the B-I, and RD$127,351,000 for the B-II. The breakdown of these costs is presented as follows:

(Unit: RD$1,000)

Alternatives	Item	Foreign Currency Portion	Local Currency Portion	Total
A - I	Direct Construction Cost	55,179 (59.7%)	37,259 (40.3%)	92,438
	Indirect Cost	17,465	2,303	19,768
	Contingency	25,408	50,980	76,388
	Total Project Cost	98,052 (52.0%)	90,542 (48.0%)	188,594
A - II	Direct Construction Cost	52,338 (60.0%)	34,828 (40.0%)	87,166
	Indirect Cost	17,615	2,218	19,833
	Contingency	24,378	48,101	72,479
	Total Project Cost	94,331 (52.6%)	85,147 (47.4%)	179,478
B - I	Direct Construction Cost	36,560 (58.0%)	26,429 (42.0%)	62,989
	Indirect Cost	15,374	1,934	17,308
	Contingency	17,286	36,077	53,363
	Total Project Cost	69,220 (51.8%)	64,440 (48.2%)	133,660
B - II	Direct Construction Cost	34,008 (57.7%)	24,930 (42.3%)	58,938
	Indirect Cost	15,374	1,910	17,284
	Contingency	16,832	34,297	51,129
	Total Project Cost	66,214 (52.0%)	61,137 (48.0%)	127,351

The contingency for the project costs is classified into physical and price contingencies. Physical contingency is 15% of the direct and indirect costs and price contingency is annually 3.0% for the foreign currency portion and 13.0% for the local currency portion, considering the price escalation in the future.

(3) Operation and Maintenance and Replacement of Machinery Costs

According to the proposed operation and maintenance plan, annual operation and maintenance and machinery replacement costs during the project life have been estimated as follows:

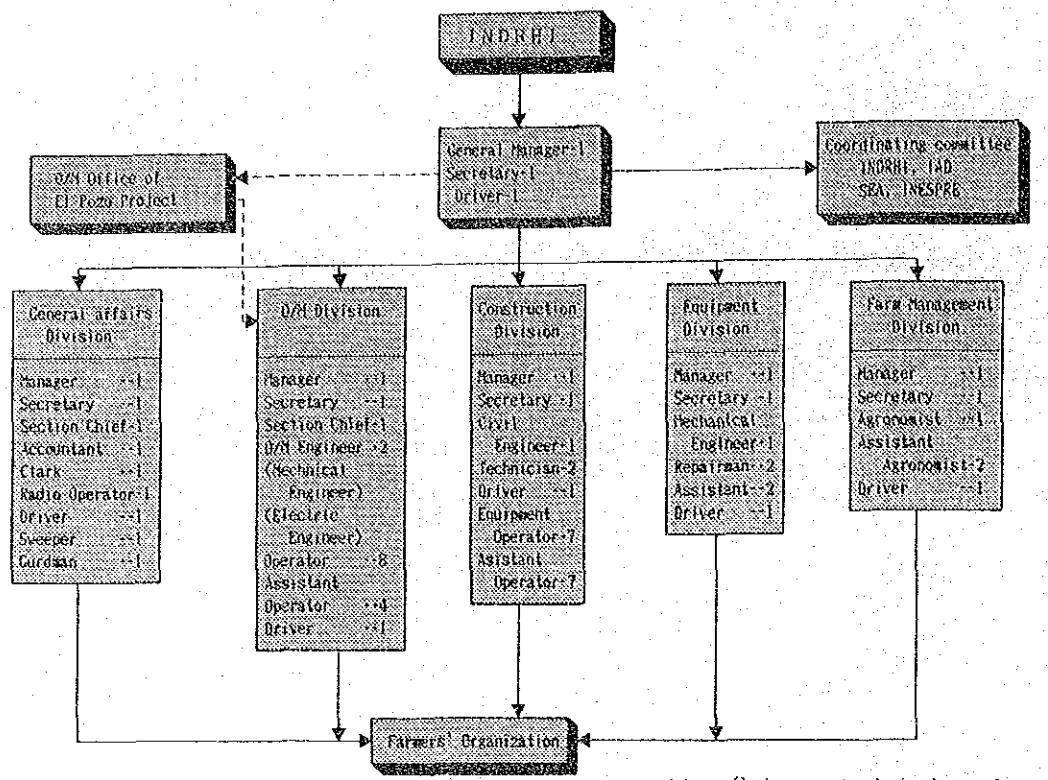
(Unit: RD$1,000)

Alternatives	Annual O/M Cost		Cost for Replacement of Machinery
	Cost	Portion of Electric Charge (%)	
A - I	2,010	5.2	30,724
A - II	2,936	22.1	36,494
B - I	1,261	0.1	22,658
B - II	2,243	26.0	29,969

(4) Implementation Agency and Operating Organization

An implementation agency and operating organization constitute a core function to ensure that the project's benefits and effects could be actually achieved. Thus, in order to do this it is necessary to include such functions as project planning, construction management, agricultural promotion in the area. The INDRHI will be the leading agency for the implementation of construction works, but in post-construction phase, the INDRHI should execute the project in coordination with IAD, SEA, INESPRE and B.A.

A sample of the project operation organization is shown below.



Note : () shows personnels in charge of the El Pozo Project

1.6 Project Evaluation

(1) Rice Price

The economic price of rice (paddy at farm-gate) is set at RD$840/ton, which value is calculated adding freight and insurance charges to Santo Domingo to international trade price in the U.S. (Financial price: RD$707.70/ton of sustaining price in 1985 by INESPRE).

(2) Project Benefits

In accordance with rice production plan, project benefits expressed in economic price are as summarized below:

(Unit: RD$1,000)

Alternatives	Medium Term Target	Long Term Target
A - I	10,872	21,753
A - II	10,109	20,990
B - I	11,057	21,478
B - II	10,278	20,699

Note: Medium Term: Initial six years after completion of construction works
Long Term: From seventh year and onward

(3) Economic Internal Rate of Return (EIRR)

The economic evaluation for the project has been made on the assumption that the project life is 50 years. The economic internal rate of return (EIRR) of each alternative is calculated below.

Alternatives	EIRR	With 10% Discount Rate	
		B/C	NPV (RD$1,000)
A - I	10.7%	1.03	7,006
A - II	10.5%	1.02	5,388
B - I	13.5%	1.18	30,428
B - II	13.3%	1.16	27,656

As the result, Alternatives B-I and B-II are evaluated to be more favorable in terms of the EIRR . And the Alternative B-I is more advantageous than the B-II supported by high value with respect to B/C and NPV, and the low costs in O & M and machinery replacement. Hence, the Alternative B-I is considered to be the most feasible plan in the context of economic evaluation.

Sensitivity analysis of Alternatives A-I and B-I as represented among the four alternatives is carried out to pinpoint the event of a decrease in the paddy yield or rice price, and/or an increase in the cost of the Project.

	Alternative A-I	Alternative B-I
- Project cost increased by 10%:	9.9%	12.6%
- Rice price or yield reduced by 10%:	8.7%	11.3%
- Project cost increased by 10% and rice price or yield reduced by 10%:	8.0%	10.5%

(4) Repayment of Foreign Currency Loan

The repayment plan of the foreign currency loan is set under the following conditions:

Annual interest rate	:	5%
Grace period	:	7 years
Loan period	:	25 years (semi-annual repayment with constant amount uniformity of the principal)

The annual foreign currency to be paid in the maximum level amounts to RD$10,064,000 in the Alternative A-I and to RD$7,105,000 in the Alternative B-I.

(5) Surplus of Agricultural Household Economy

The annual surplus in agricultural household economy for a model farmer in each land class is estimated as follows:

	Medium Term		Long Term	
	Per Household (Mean)	Total Amount	Per Household (Mean)	Total Amount
Alternative A	RD$363	RD$1,205,160	RD$3,486	RD$11,573,520
Alternative B	RD$883	RD$2,472,400	RD$4,446	RD$12,448,800

(6) Social Evaluation

After completion of the project, the following favorable effects can be expected.

- The increase in rice production that can be achieved over current levels are 55,000 tons in Alternative A and 51,000 tons in Alternative B.

- The saving of foreign currency of approximately US$10.5 million for Alternative A and US$9.7 million for Alternative B will be possible annually through increased rice production, which in turn contributes to the enhancement of the national economy.

- The number of settlers in the project area will increase and the population will reach 16,000 in Alternative A and 14,000 in Alternative B.

- The establishment of double cropping system (7,200 ha for Alternative A and 7,000 ha for Alternative B) will result in an increase in the demand for labor from other areas at the time of seeding and harvesting.

Further increase of the facilities needed for commercialization, rice mill plants, etc. are expected, and other industries which process by-products such as straw, and rice bran, in addition to livestock breeding will be developed.

(7) Comprehensive Evaluation

With the implementation of the present project, the under-developed Aguacate-Guayabo area will produce 12% of the total national production of paddy rice. Therefore, the project will also contribute toward food self-sufficiency and improve the balance of payments situation, creating new granary including El Pozo area and stimulating the development opportunity of swamps for the agricultural purpose.

The proposed four alternatives, which are combination of difference development area (Alternatives A & B) and different intake method (Alternatives I & II), present almost similar characteristics in terms of irrigation and drainage system. After economic and financial evaluations have been made, it is concluded that the Alternative B-I is the most feasible plan.

2. CONCLUSION

Four Alternatives have been formulated for the Aguacate-Guayabo Agricultural Development Project, of which the Alternative B-I with a develpment area of 7,000 ha and irrigation water intake by means of headworks has been selected as an optimum development plan. The implementation of the Aguacate-Guayabo Agricultural Development Project with Alternative B-I is justified in economic, financial, technical and social terms. With the implementation of the Project (Alternative B-I), it is expected that the following impacts are expected.

2.1 Project in General

Of the total study area (24,100 ha), the Project comprises a development area of 7,400 ha, of which 7,000 ha of paddy field will be benefitted by the supply of irrigation water and improvement of the poor drainage system; in addition to the currently developed paddy field of 3,300 ha, the inclusion of a total of 3,700 ha of undeveloped land such as grazing fields, swamps, for paddy field development has been proposed after having evaluated their capability for rice production. As a result, total paddy field area will cover 7,000 ha. In such paddy fields, annual double cropping is technically viable, therefore, the harvested area will be increased from 3,050 ha to 14,000 ha, then the production of rice will increase from 7,625 t to 58,760 t, equivalent to about 12% of total national production. Assuming that the farm size is regulated at 40 tarea (2.5 ha) per family, a total of 2,800 families can be newly settled in the project area.

2.2 Irrigation Plan

All irrigation water will be diverted from the Yuna River by gravity with constructing headworks and conveyed to the development area through irrigation canals and diversion works. The maximum intake volume from the Yuna River has been estimated to be 5.90 m^3/s.

2.3 Drainage Plan

Normal surplus and inundating water will be drained into two systems of the Cano Gran Estero and the Guayabo River via principal and lateral drainage canal network. The construction of a training dike at the outlet of the Cano Gran Estero and a drainage gate at the confluence of the Guayabo River with the Yuna River is also included in the scheme.

2.4 Project Implementation Period and Project Costs

The project implementation period consists of the preparatory stage (2.5 year) which includes loan procedure, detailed design and preparation of tender documents and the construction stage (4 years).

The direct construction costs is estimated to be at RD$62,989 thousand. The total project costs comprising direct construction cost, indirect cost, physical contingency [(construction costs + indirect cost) x 15%] and price contingency will be RD$133,668 thousand. Additionally, RD$1,261 thousand will be incurred yearly for the operation and maintenance of the structures.

2.5 Project Evaluation

Benefits expected from the implementaion of the Project are estimated to be RD$21,478 thousand, expressed as the economic price. The economic internal rate of return (EIRR) is calculated at 13.5%. The benefit-cost ratio and the net present value with discount rate at 10% are 1.18 and RD$30,428 thousand, respectively.

Sensitivity analyses are made with respect to construction cost and rice price as follows:

Factors of Sensitivity Analysis	EIRR (%)
I. 10% increase in construction cost	12.6
II. 10% decrease in rice price or productivity	11.3
III. 10% increase in construction cost and 10% decrease in rice price or productivity	10.5

Of total project costs the foreign currency portion (RD$69,220 thousand) will be procured by a loan from foreign banking institutions with an interest rate set at 5% per annum for the 25 year amortization period.

If the repayment of loan is made semi-annually per capita rate of the principal after 7 years' grace period, the maximum annual amount of amortization together with interest payment will be RD$7,105 thousand.