(2) Advanced Area

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

Paddy Yield in the Advanced IAD Settlement Areas

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

Source: IAD Boletin Informativo Anual
(See TABLE G.3.7)

The high level of production technology is applied under adequately provided irrigation and drainage systems in the above area.

3.2 Other Major Crops

3.2.1 Cacao

The main cacao plantation area is limited to the natural levee along Caño Gran Estero and the Yuna River. Almost all the cacao plantation areas mentioned above is classified as the first class land for upland crops in the land classification for upland/crops. The following problems are pointed out about the existing cacao plantation:

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

- Cacao trees of most plantations are grown under excessive shading without introducing proper shading trees like leguminous trees which bring about another merit of supplying naturally fixed nitrogen.

- No preventive measures are taken for rats and woodpeckers damages.

Cacao products is one of the three major farm products in the Dominican Republic. The northeast region is one of the largest cacao producing areas, where about 55 percent of the total cacao plantation areas are located. There are about 1,700 hectare of cacao plantation in the study area. The cacao production is not active with above-mentioned problems mainly because the price is recently going down and farm credit has been decreased by B.A. However the increase of cacao products is planned with maintaining the present plantation according to SEA Plan Operativo 1985. Under these circumstances, the first class land under existing cacao plantation will be preferably reserved and renewed with new varieties for the following purposes: (1) To provide the source of cash income for the aged peoples (2) To reserve such elevated land as cacao plantation area which will be able to utilize for various purpose than rice cultivation.

3.2.2 Yautia Pipiota

Aside from yautia pipiota, another yautia (Xanthosoma Sagittifolium) is grown in small scale, usually at homestead for home consumption. Yautia pipiota is suited to even swampy and shaded land with organic soils so far as the water is not stagnated. At least about 700 hectares of swampy lands are cropped with yautia pipiota. The cultivation of yautia pipiota is so extensive that no other operation than planting and harvesting is usually made. The estimated yield is about 12 ton per ha according to local farmers' opinion.

According to SEA Plan Operativo (1985), yautia cropping area is planned up to 2,500 ha. for the Aguacated and Limmon del Yuna areas, expecting to develop one of the largest yautia production area. It is considered that yautia pipiota is also included as one of yautia in the plan.

The B.A. has decided to designate yautia as another crop to give production credit in the study area. Yautia is one of the most promissing substitute crops of plantain and cassava, because the price hike has arisen. Moreover, the export expansion of yautia in 1985 is expected by about 70 percent of the total production.

TABLE G.3.1 RICE VARIETY AND ITS PRODUCTION CONDITION

Area	Production Condition		Variety
	Irrigation/Drainage	Soils	
1. El Aguacate			
- IAD Settlement	Comparatively fair, but on-farm facilities are inadequate.	A1, A2 and A4 lands are prevailing with about equal area coverage.	Improved varieties and local varieties in each half area.
- Private Land	Natural levee with pump irrigation	Mainly A1 and A2 lands, but organic soils are included.	Mainly improved varieties, especially in the rice double cropping area in A1 and A2 lands, but local varieties are prevailing in the organic soil areas.
2. El Guayabo			
- IAD Settlement (Natural Levee)	Almost fair, but on-farm facilities are mostly not available	A1 and A2 lands	Mainly improved varieties.
- IAD Land Settlement Area (Other Area than the above)	Poor	Monthly organic soils (A4, A5, A6) are prevailing	Mainly local varieties
- Private Land Area	(The production condition and varieties are same to those in IAD land settlement natural levee).		

TABLE G.3.2 PRESENT AGRICULTURE IN THE IAD LAND SETTLEMENT AREA

Item	Unit	Total	El Aguacate 1/	Cienega Vieja	El Guayabo
1. Area					
- Distributed land	ha	5,540	2,050	470	3,020
- Non-distributed land	ha	7,440	3,610	0	3,830
Total		12,980	5,660	470	6,850
2. Number of settlers					
- Final distribution Year		1,830 (1974)	436 (1974)	194 (1983)	1,200 (1976)
- 1985		1,348	487	194	667
3. Land use of distributed land					
- Rice field	ha	2,720	1,270	320	1,130
- Cacao orchard	ha	330	230	70	30
- Upland field	ha	230	150	80	-
- Pasture	ha	1,400	400	-	1,000
Sub-total 2/		4,680 (3.5)	2,050 (4.2)	470 (2.4)	2,160 (3.2)
- Wasted land		860	-	-	860
Total		5,540	2,050	470	3,020
4. Area coverage of direct seeded rice	%	N.A.	0	N.A.	20
5. Area coverage by rice variety					
(1) Juma varieties	%	N.A.	25	N.A.	30
(2) ISA varieties	%	N.A.	20	N.A.	10
(3) Tanioka varieties	%	N.A.	5	N.A.	5
(4) Traditional varieties	%	N.A.	50	N.A.	55

Note: 1/ ... including Rincon Molinillo area
2/ ... The figures in the parenthesis show the average area per settler (1985)

Source: IAD Aguacate and Guayabo Offices

TABLE G.3.3 SUMMARY OF FARM MANAGEMENT SURVEY (1/6)

(No. 1)

Area 1	General			Seed-bedding								
	No. of sample farmer	Harvested area (tarea)	Yield (saco/tarea)	area of seed bed (tarea)	Height of seed bed (cm)	Method of plowing	No. of plowing (time)	Application of fertilizer	Application of pesticides	Rate of seeds (qq/tarea)	Water depth (cm)	Possibility of water control
A-1, T	14 1/	51	2.35	1.9	30 (1) 0 (13)	Tractor(13) Animal (1)	3-4	"Yes" (1) "No" (13)	"Yes" (1) "No" (13)	8.7	3-20	"Possible"
A-1, D	6	53	2.10									
(Weighted average for A-1			2.27)									
A-2, T	1	1,200	3.00	20.0	0	Animal	1	"No"	"Yes"	7.5	Just mois	"Possible
A-2, D	4	175	3.07									
(Weighted average for A-2			3.03)									
B-1, T	3	55	2.86	1.6	0	Tractor (1) Animal (2)	3-4	"Yes (1) "No" (2)	"No"	7.6	4-9	"Possible"
B-1, D	1	80	2.88									
(Weighted average for B-1			2.87)									
B-2, T	4	30	1.74	0.8	0	Tractor (2) Animal (2)	4	"Yes" (1) "No" (3)	"No"	5.0	0-7	"Possible"(3) "Partially Possible"(1)

Notes: (1) A ... Aguacate Area, B ... Guayabo Area, T... Transplanted, D ... Direct-seeded
(2) 1/ .. Excluding the data for the four farmers out of 16 sample farmers, because of ineffectiveness of the data.
(3) The figures in the parenthesis show the number of response.

TABLE G.3.3 SUMMARY OF FARM MANAGEMENT SURVEY (2/6)

(No. 2)

Area	Seed-bedding (Cont'd)						Direct-seeding			Land Preparation	
	Availability of technical assistance	Plant height of seedlings (cm)	Problem	Application of seed selection	Application of seed disinfection	Application of pre-germination	Application of pregermination	Water depth in seeding work (cm)	Rate of seeds (qq/tarea)	Method	application of fertilizers
A-1, T	"Available" (2) "Not available" (11)	20-60	Irrigation (4) Nothing (10)		"No" (9) "Yes (4)	"No"				Tractor	
A-1, D							"Yes" (5) "No" (1)	3-10	7.3	Tractor(5) Animal (1)	
A-2, T	Not available	50	Nothing	No seed selection	"No"	"No"				Tractor	No application
A-2, D							"No"	0-8	7.0	Tractor	
B-1, T	Available (1) Not available (2)	35-70	Irrigation (1) Credit (1) Nothing (1)		"Yes" (2) "No" (1)	"No"				Tractor(2) Animal (1)	
B-1, D							"No"	Just moist	6.0	Tractor	
B-2, T	Available (2) Not available (2)	45-50	Drainage (1) Nothing (3)		"Yes" (1) "No" (3)	"No"				Tractor	

TABLE G-3-3 SUMMARY OF FARM MANAGEMENT SURVEY (3/6)

(No. 3)

Area	Land preparation (cont'd)	Trans planting							Weeding			
	Duration of land preparation	Water depth of trans-planting	Possibility of water control	Month of Trans-planting	Duration of trans-planting (day)	Distance (cm)	No. of seedlings	Depth of seddlings in soils (cm)	Days after planting	Lobor Source of weeding	Kind of weed	Times of weeding
A-1, T	10-45	2-15	Possible (13) Partially (1)	Apr-Oct	30-60	13-25	15	2-10	25-45	Employee (14) Employee + Family (5) Family only(3)	Popa Die Gallo Lambedora Canutillo	1-3
A-1, D	15-30								45-60		Cillo Canutill Pelo Mico etc.	2-3
A-2, T	30	5	Possible	Aug.	45	15	N.A.	5	45	Employee	Popa Pelo Mico Pie Gallo	2
A-2, D	25-40								35-45		Idem Arrocillo	2-3
B-1, T	15-30	Just Moist	Possible	May-Oct	30-45	15	10-25	2-3	30-35	Employee	Arrocillo Pie Callo Hierba	2
B-1, D	25								45		Popa Berro Pelo Mico	2
B-2, T	15-60	0-10	Possible (2) Impossible (2)	Jul-Aug	30-45	20-25	5-12	2-5	20-45	Employee	Popa Lambepora Suelda Masamorra Paiy	2

TABLE G.3.3 SUMMARY OF FARM MANAGEMENT SURVEY (4/6)

(No. 5)

Area	Water Management (cont'd)		Harrest and Threshing							
	Water depth (cm)	Problems	Drainage days before harvest (days)	Method of threshing	Treatment of straw	Buyer	trans-portation	Cutting height (cm)	No. of harvest (time)	Problems
A-1, T	2-35	Pump (1) Irrigation (1) Drainage (2)	25-50	Paleando		INESPRE (13) Factory (5) Middlemen (1)		20-75	1 2 (1)	Irrigation (13) Drainage (5) Credit (5) Tractor (1)
A-1, D	6-20	Irrigation (2) Drainage (2)	10-30	Paleando				40-80	1 (5)	Irrigation (4) Drainage (1) Credit (3) Tractor (1)
A-2, T	20		30	A Palo	Burning	Esparce	By animal power	100	1	Leveling (1) Electrification
A-2, D	3-6		25-40	A Palo				30-70	2	Irrigation (3) Credit (2) Leveling & Electrification (1)
B-1, T	10-50	Irrigation (3) Drainage (2)	20-40	Cosechado Ro (1) Paleando (2)		INESPRE		60-80	21 (1) 1 (2)	Irrigation (4) Drainage (3) Tractor (1)
B-1, D	15	Irrigation	5	Paleando				70	2	Irrigation & Leveling
B-2, T	8-30	Irrigation (2) Drainage (2)	15	Paleando		INESPRE		70-110	1	Irrigation (3) Drainage (3) Pump (1)

TABLE G.3.3 SUMMARY OF FARM MANAGEMENT SURVEY (5/6)

(No. 4)

Area	Weeding (cont'd)	Pest Control			Fertilization		Water Management			
	Application of herbicides	Application of insecticides	Application of fungicides	Insects	N-P-K (kg/ha)	Days after planting	Irrigation facilities	Drainage facilities	Mid season drainage possibility	O/M body of facilities
A-1, T	"Yes"	"Yes" (2) "No" (12)	Pircularia (3) "No" (16)	Esperanza Verda Hiede Vivo Gusano	17.9-13.6-9.4	25-50	Canal	Drainage Canal	Possible	Farmers
A-1, D		"No" (6)			10.4-6.8-6.8	10-30	Canal (6) Pump (1)	Drainage Canal	Possible (3) Partial (3)	Farmers (3) INDHRI (3)
A-2, T		"No" (1)	"No"	Esperancita Verda	8.7-17.4-8.7	30	Pump	Drainage Canal	Possible	N.A.
A-2, D		"Yes" (2)	"No"		47.1-26.9-22.5	25-40	Pump	Drainage Canal	Possible	Farmers (1) INDHRI (3)
B-1, T		"Yes" (2) "No" (1)	Pircularia (2) "No" (1)	Gusano Hiede Vivo Esperanza	13.4-9.8-6.9	20-40	Canal (1) Pump (2)	Drainage(2) Canal Nothing (1)	Possible (2) Not possible (1)	Farmers (2) INDHRI (1)
B-1, D		"Yes"	Pircularia		5.2-10.5-5.2	50	Canal	Drainage Canal	Possible	Farmers
B-2, T		"Yes" (2) "No" (2)	Pircularia (1) "No" (3)	Hiede Vivo Gusano	8.0-2.8-2.1	20-35	Canal (3) Rainfed(1)	Drainage Canal (2) Nothing (2)	Possible (2) Not possible (2)	Farmers

TABLE G.3.3. SUMMARY OF FARM MANAGEMENT SURVEY (6/6)

(No. 6)

Area	Other Crops than Rice		Opinion			
	Cacao	Yautia	No. of cropping	Varity of 1st crop	Varity of 2nd crop	
A-1, T	2 (@ 9 tarea)	1 (@ 3 tarea)		Juma (7) ISA (5) Tanioka (2)	Juma (3) ISA (7) Tanioka (2) Ingres (2)	
A-1, D				Juma (2) ISA (4)	ISA	
A-2, T	3 (@ 21 tarea)			ISA	ISA	
A-2, D				ISA	Juma (3) ISA (1)	
B-1, T	1 @ 30 tarea	1 @ 10 tarea		ISA (2) Tanioka (1)	ISA	
B-1, D				ISA	ISA	
B-2, T				ISA	ISA (3) Mingoro (1)	

TABLE G.3.4 APPLIED AMOUNT OF CHEMICAL FERTILIZERS

Area	Rate (kg/ha)			Remarks
	N	P_2O_5	K_2O	
1. El Aguacate				
- IAD Land Settlement Area	15	11	8	
- Private Land Area	33	25	20	Natural levee along Yuna River
2. El Guayabo				
- IAD Land Settlement Area (Natural Levee)	11	10	3	
- IAD Land Settlement Area (Other Area)	8	3	2	Lowland area

Source: Farm Management Survey, 1985

TABLE G.3.5 ESTIMATE OF PRESENT RICE YIELD

(Unit: ton/ha)

Item	El Aguacate	El Guayabo
1. Statistical yield for the IAD settlement area (1976 - 1985)[1/]	2.42	2.31
2. Sample yields of raw paddy in the Farm Management Survey [2/]		
(1) IAD settlement area - Non-lowland	3.27 (2.27 sac/tarea)	4.13 (2.87 sac/tarea)
- Low land	-	2.51 (1.74 sac/tarea)
(2) Private land area	4.36 (3.03 sac/tarea)	
3. Estimated yield of dry paddy		
(1) IAD settlement area	2.4[3/]	2.3[4/]
(2) Private land area [5/]	2.7	2.7

Note: 1/ ... Excluding the minimum and maximum yields in Table G.2.1.

2/ ... Converted at the rate of 90 kg/sac.

3/ ... Referred to the above statistical yield which is 74 percent of the related sample yield. The difference between two figures includes decrease in drying and cleaning and averaging of past yields.

4/ ... Referred to the above statistical yield which are almost equal to the average of the converted yields for the related two sample yields by applying above rate of 74 percent.

5/ ... Estimated on the basis of the sample yields for the private land area and IAD settlement areas.

TABLE G.3.6 YIELD COMPONENT OF TRANSPLANTED AND DIRECT-SEEDED RICE

Crop/Variety		Transplanted[1/] (Juma 57)	Direct-seeded[2/] (ISA 40)
No. of Hill per m^2	(1)	17.1	-
No. of Panicle per Hill	(2)	18	-
No. of Panicle per m^2 (3)=(1)x(2)		308	462
No. of Spikelet per Panicle	(4)	77	50
% of Ripened Spikelet per m^2	(5)	52.8	64.9
No. of Ripened Spikelet per m^2 (6)=(3)x(4)x(5)		12,514	14,992
Weight of 1,000 Ripened Paddy (g)	(7)	28.9	26.7
Yield per ha (kg/ha) (8)=(6)x(7)x1/1,000		3,617	4,003

Note: 1/ ... Average of three representative hills which were selected from 20 sample plot of IAD Aguacate Settlement area. The 20 sample hills was previouly taken from 150 sample hills which were harvested at random.

2/ ... Average of representative hills which were selected from three sample areas in one selected sample plot. Each sample area is one m^2.

TABLE G.3.7 RICE YIELD IN THE PROGRESSED AREA (IAD SETTLEMENT AREAS)

Year	Jarabacoa				Bonao (Juma)				El Pozo			
	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)
1980	2,235	1,805	7.01	12,654	-	-	-	-	51,900	48,948	5.37	262,763
1981	2,350	1,200	7.33	8,798	21,507	21,507	6.11	131,441	62,767	47,596	4.71	223,704
1982	2,254	2,254	7.95	17,999	21,119	21,119	6.79	143,536	*10,284	*8,770	6.20	*54,421
1983	2,448	703	8.34	5,864	21,374	20,605	6.36	131,143	*14,699	*14,699	7.01	102,947
1984	3,464	1,941	8.07	15,666	28,168	19,022	5.90	112,256	*13,655	*13,188	6.42	*84,769
Mean	2,550	1,581	7.71	12,196	18,434	16,451	6.30	103,675	30,661	26,640	5.47	145,721
									*12,879	*12,219	6.61	*80,712
	(5.6 ton/ha)				(4.5 ton/ha)				(3.9, *4.7 ton/ha)			

Note : * .... Colectivo only
Source: IAD Boletin Informativo Anual (1981-1985)

3.2.3 Coconut

The coconut plantation concentrates at the foot of the Loma La Cordillera. The total area of coconut plantation is estimated at about 1,400 ha. The average yield of desiccated nut per hectare of harvested area is estimated at 1.0 ton.

4. Crop Production

The estimated production of major crops in the study area is shown in TABLE G.4.1.

The total production of paddy in the study area is estimated at about 8,400 ton, which component 5,200 ton for the IAD settlement areas and 3,200 ton for the private. The total production of respective major crops are estimated at about 8,800 ton of yautia pipiota, about 210 ton of cacao (dry bean) and about 2,000 tons of coconut (desiccated nut).

5. Animal Husbandry

No statistical data on the number of animals in the study area are available because of the results of 1981 Agricultural Census are not published yet. The number of cattle in the related provinces with the study area is shown in TABLE G.5.1.

According to the data on the number of cattle and related production in the three concerned provinces to the study area, there about 208,330 thousand heads of cattle are raised while the number of milking cow are accounted by 23 thousand head. About 39 thousand tons and 51 thousand tons of beef and milk production are recorded, respectively in 1981.

TABLE G.4.1 ESTIMATED CROP PRODUCTION AT PRESENT

Area/Crop	Aguacate				Guayabo				Total			
	Planted Area (ha)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)	Planted Area (ha)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)	Planted Area (ha)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
1. IAD Settlement Area												
(1) Rice	1,680	1,230	2.4	2,952	1,110	980	2.3	2,254	2,790	2,210	2.4	5,206
(2) Yautia Pipiota	230	230	12.0	2,760	-	-	-	-	230	230	12.0	2,760
(3) Cacao	330	280	0.15	42	-	-	-	-	330	280	0.15	42
2. Private Land Area												
(1) Rice	510	370	2.7	999	950	840	2.7	2,268	1,460	1,210	2.7	3,267
(2) Yautia pipiota	200	200	12.0	2,400	310	310	15.0	4,650	510	510	12.0	6,120
(3) Cacao	970	820	0.15	123	400	340	0.15	51	1,370	1,160	0.15	174
(4) Coconut	-	-	-	-	1,400	1,190	1.7	2,030	1,400	1,190	1.7	2,023

TABLE G.5.1 NUMBER OF CATTLE AND PRODUCTION (1981)

Province	No. of Cattle		Production	
	Cattle (1,000 head)	Milking Cow (1,000 head)	Beef (1,000 ton)	Milk (1,000 ton)
Duarte	108	10	3	22
Maria T. Sánchez	84	11	30	25
Samaná	16	2	6	4
Total	208	23	39	51

Source: Agricultural Census, 1981

6. Development and Extension of Rice Production Technology

6.1 Development of Rice Production Technology

Centro de Investigacions Arroceras (CEDIA) is responsible for the extension of rice production technology. The CEDIA, belonging to SEA, located in Bonao is divided into six divisions to cover these fields of (i) Breeding, (ii) Agronomy, (iii) Water Management, (iv) Pest control, (v) Soils and Fertilizing and (vi) Farm Machinery. The branch station of CEDIA is located in El Pozo for the experimentation of rice production.

The research on rice cultivation in the organic soils is important to promote the agricultural development in the study area. It seems, however, that very limited research has been conducted by CEDIA.

6.2 Extension

The Bureau of Agricultural Extension belonging to SEA is responsible for agricultural extension services. It has Agricultural Extension offices in each Municipio. Most of the study area is under the jurisdiction of the Arenoso Agricultural Extension Office, which has three extension staff. One extension staff handles about seven Barrio or about 400 farms on an average. Although five-day visit to the farmers is planned as a general rule, only once every two weeks extension staff could visit farmers. The reason would be to spare most of their time for other supporting works and to have no proper transportation facilities for the services. The input supply for production of rice such as seed, fertilizers and other chemicals is not being taken by the Agricultural Extension Office, whereas the seeds and seedlings other than rice are supplied by the extension staff. Under such circumstances, the extension activities have to be strengthened through various measures, for instance, installation of demonstration plots as many as possible in the farmers' fields to reply their requirements.

The IAD and the B.A. extend also various services on the improvement of farm management through their daily activities in the administration works for settlers and loans, respectively. Such services, however, are by nature supplementary to the SEA extension services.

7. Agricultural Supporting Services

7.1 Agricultural Credits

Primary access to agricultural credits is made through the B.A. About 67% of the beneficiaries in the agrarian reform project areas, are rendered financial assistance by the B.A. A branch office of the B.A. is located in Arenoso in which 99% of crop loans and 95% of their total value were destinated for the production of rice in 1983. The conditions of loans by the B.A. are a 6 month term at a 16% interest rate. The number, value and area covered by the credit of the B.A. in arenoso with respect to each crops and other agricultural activities are as shown in Tables G.7.1 and G.7.2.

The problems associated with the B.A.'s credit service are the lack of financial resources to satisfy the demand and the long period of transactions from approval to payment. For instance, as indicated in Table G.7.2 of total value approved for the credit, the payment was made only 32% for El Aguacate and 27% for El Guayabo for the years 1975 - 1981. The proportion of repayment in both agrarian reform project areas was below 10%. In view of the fact that most of the farmers depend on the Bank's financial assistance to cultivate crops and that burgeoning grain production constitutes the principal strategy of the Dominican Government, the Bank cannot suspend rendering agricultural credits to the farmers even if they do not repay previous loans and herein exists the bottleneck of the Bank.

In the event that one fails to be approved by the Bank for its credits or that the Bank's credit will not reach his hand in time for the land preparation and for the purchase of inputs, he will appeal his financial

need to other lending sources such as middlemen, cooperatives, his relatives or friends, etc. In such cases, the interest rates are as high as 10% a month.

7.2 Farmers' Organization

In view of the improving socio-economic conditions of the beneficiaries, the IAD has given a higher rank to the organization of farmers settled in the agrarian reform project area. The target of this promotion is to attain self-management in the course of crop production which comprises the marketing of products, agricultural credit, ownership of machinery, etc. For this purpose, IAD, by means of the Plan for the Consolidation of Farmer's Settlements, has undertaken to organize in each agrarian reform project area as the Empresas Campesinas de Reforma Agraria (ECRA) - farmer's enterprises for the agrarian reform.

Up to date, the ECRA has not been organized in the study area; only an organization in the form of an association is found. These associations are constituted at the initiative of the governmental institutions. Each association is organized by one president, one secretary and one accountant. They take charge of the daily routines of the association, organization of meetings and contacts with related government institutions assisted by members of committees. In the case of this organization, the members are not working together in the same farmland to cultivate crops but they are associated so as to jointly receive the agrarian credits and to possess the same agricultural machinery. By forming an association, the access to the credit becomes easier, but if a member of the association fails to reimburse the loan, it should be compensated by the rest of the association.

In the study area over 37.2 percent (41 percent for El Aguacate and 34.5 percent for El Guayabo) of the beneficiaries are organized in associations; there are 8 associations in El Aguacate and 17 in El Guayabo with 200 and 239 members, respectively (See Tables G.7.3 and G.7.4).

It seems that this form of association has not matured in the study area. One association in El Aguacate could not report its production for the year of 1984.

The situation is more complicated in El Guayabo: one association (Nueva Union) includes 13 members without distributed land and another association (Trabajadores Arroceros) is composed of "ocupant's" - illegally settled farmers. Generally speaking, the beneficiaries who are working under better conditions are unlikely to participate in the associations.

TABLE G.7.1 AGRICULTURAL CREDIT AT B.A.'S ARENOSO BRANCH

	Destination of Credit	Quantity	Amount (RD$)
1.	Crop Production		
	Rice	1,500	8,372,467
	Cacao	31	80,021
	Plantain	6	8,335
	Yautia	2	4,950
	Sub total	1,539	8,465,773
2.	Agricultural Machinery	105	52,521
3.	Improvement of Farmland	5	46,729
	Total	1,649	8,565,023

TABLE G.7.2 AGRICULTURAL CREDIT

(Unit: RD$)

Year	Crop	Quantity	Approved Amount	Disbursed Amount	%	Reimbursed Amount	%
EL AGUACATE							
1975	Rice	38	72,730	37,176	51	-	-
1976	"	53	87,313	30,917	35	-	-
1977	"	887	1,413,833	524,329	37	47,054	9
1978	"	758	1,134,588	462,598	41	54,994	12
1979	"	103	198,881	47,156	24	-	-
1980*	"	-	-	-	-	-	-
1981	"	755	1,418,860	261,390	18	-	-
EL GUAYABO							
1975	Rice	430	916,843	453,863	49	41,394	9
1976	"	316	934,500	448,481	47	23,525	5
1977	"	398	913,209	341,999	37	68,867	20
1978	"	412	875,245	453,316	51	32,384	7
1979	"	461	1,282,720	443,825	34	-	-
1980*	"	-	-	-	-	-	-
1981	Arroz	1,145	4,764,928	491,879	-	-	-
TOTAL			9,687,445	2,633,363	27.2%	166,170	6.3%

TABLE G.7.3 FARMERS' ASSOCIATION IN EL AGUACATE

Association	Year of Fundation	No. of Associate	Farmland Area (ha)		Cultibated 1/	Yield 2/	
			Total	Per Associate	Area (ha)	Total (ton)	Ton per ha
Nueva Esperanza	April, 1981	36	130.2	3.6	123.3	588	4.8
Los Milagros	Oct. 1984	21	77.0	3.7	n.a.	n.a.	n.a.
Los Bueyeros	March, 1982	25	88.7	3.5	95.2	484	5.1
Los Voluntarios	Nov. 1983	28	100.0	3.6	76.7	370	4.8
Jose Cardin	Oct. 1983	27	74.8	2.8	103.8	492	4.7
El Desencano	Nov. 1980	21	75.5	3.6	102.5	291	2.8
Los Desamparados	Feb. 1985	12	38.4	3.2	n.a.	n.a.	n.a.
La Carmencita	Dec. 1985	30	102.8	3.4	n.a.	n.a.	n.a.
Total		200	687.4	3.4	501.5	2,225	4.4

Notes: 1/ Cultivated area comprise 1st and 2nd stages of the year.
2/ Yield is estimated based on rice with husk.
3/ Figures for "Cultivated Area and Yield are for the year of 1984

Sources: Information provided by IAD's Administrative Office at El Aguacate.

TABLE G.7.4 FARMERS' ASSOCIATION IN EL GUAYABO

Association	Year of Fundation	No. of Associate	Farmland Area (ha)		Cultibated 1/ Area (ha)	Yield 2/	
			Total	Per Associate		Total (ton)	Ton per ha
Nueva Aurora	Nov. 1980	6	15.1	2.5	15.1	50	3.3
Los Nuevos Hermanos	Jan. 1983	22	66.7	3.0	126.4	901	7.01
La Nueva Union	1979	34 (12) 4/	47.2	2.1	94.4	361	3.8
La Protectora	May, 1982	6	15.1	2.5	34.0	267	7.9
San Martin de Porre	April, 1982	8	20.1	2.5	51.6	185	3.6
Nueva Ideal	Oct. 1978	17	20.1	1.2	39.0	138	3.5
Paz y Progreso	July, 1981	5	9.7	1.9	9.0	38	4.0
Santa Ana	Sept. 1981	9	20.1	2.2	20.1	76	3.8
Amante a ala Libertad	June, 1981	7	27.1	3.9	27.1	103	3.8
Los Hermanos Unos y Otros	May, 1984	18	37.7	2.1	75.4	276	3.7
Trabajadores Arroceras	Nov. 1978	16	38.7	2.4	57.5	192	3.3
Santa Cesilia	Aug. 1983	15	38.7	2.6	40.3	139	3.5
La Nacional	Jan. 1985	16	40.3	2.5	40.3	139	3.5
Unidad Amante al Progreso	June, 1983	15	25.2	1.7	25.2	96	3.8
El Progroso	Oct. 1984	20 (3) 5/	55.7	3.3	55.7	180	3.2
Unidad Amor y Paz	Sept. 1984	12	17.6	1.5	17.6	69	3.9
Defensora Campesina	May, 1984	13	30.2	2.3	30.2	112	3.7
Total		239	525.3	2.2	776.8	3,386	4.3

Notes: 1/ Cultivated area comprise 1st and 2nd stages of the year.
2/ Yield is estimated based on rice with husk.
3/ Figures for "Cultivated Area and Yield are for the year of 1984
4/ Figure in parenthesis indicates farmers without farmland.
5/ Figure in parenthesis indicates illegally occupied farmers.

8. Marketing Rice

8.1 National Level

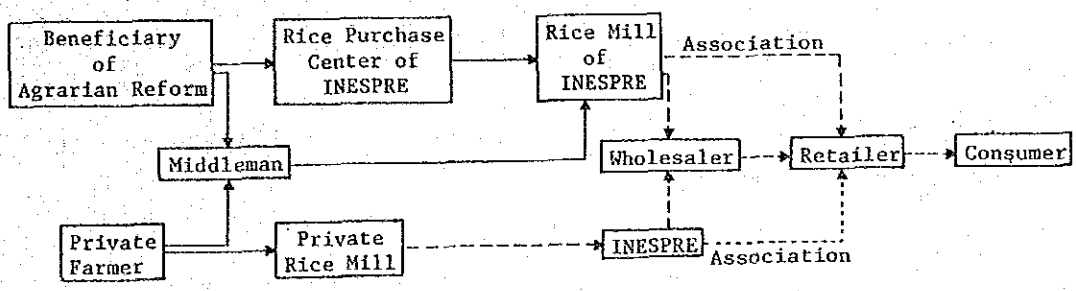
The dominican farmers sell rice for the bulk of their production, though the proportion of auto-consumption for this cereal is higher than other crops; some farmers sell their total production without leaving rice for the consumption of their family, because, they have to reimburse Bank's loan. The domestic commercialization of rice is represented by the following three principal channels:

a) Unhulled rice, from farmer to the Purchase Center of the INESPRE or middleman.

b) Unhulled rice, from the Purchase Center of the INESPRE or middleman to the Rice Mill Factory of the INESPRE.

c) Hulled Rice, from the INESPRE to wholesalers and retailers.

The global channel of market from farmer to consumer is as illustrated below.



Note: ——→ Unhulled rice
----→ Hulled rice

Since 1973, in which the Decree No. 3269 was enacted with view to regulate the prices, the participation of the INESPRE in the commercialization of rice has become so predominated that it has purchased about 84% of national production for the period of 1979 - 1983.

Participation of INESPRE in the Purchase of Rice 1979-1984

Year	Production (ton)	Purchase of INESPRE (ton)	%
1979	262,200	221,801	85.6
1980	258,106	234,170	90.7
1981	262,547	225,113	85.7
1982	259,592	217,424	83.1
1983	327,031	249,330	76.2
Total	1,369,476	1,147,838	83.8

Source: Plan Operativo 1984, INESPRE

The difference between the national production and the purchase of the INESPRE is identified by the auto-consumption (about 5%) and commercialization out of the INESPRE's channel. And, the fluctuation of INESPRE's participation is not explained by the political decision of the Government but the availability of INESPRE's financial resources.

The table below indicates the prices and margins for each agent of rice market as of September, 1983.

Summary of Price and Margin of Hulled Rice

	Price (RD$/ton)	Margin (RD$/ton)	%	Accumulative Margin (%)
Farmer	476.74		73	73
Rice Milller	543.48	66.74	10	83
INESPRE	581.74	38.26	6	89
Wholesaler	611.52	29.78	5	94
Retailer	652.17	40.65	6	100

Source: INESPRE, SEA

8.2 Regional Level

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

Rice, harvested in the farm, is filled in the bags supplied by INESPRE, carried to the nearest road by animales and transported to the rice purchase center of INESPRE without being hulled. The rice purchase centers related with the study area are located at La Jagua (El Guayabo), Limon del Yuna and El Pozo. In case of La Jagua, harvested rice are transported to the rice mill of the INESPRE at Villa Riva from October 1, 1985 to December 20, a total of 2,090 tons rice was purchased by INESPRE at La Jagua.

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

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

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

8.3 Rice Processing Facilities

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

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

PURCHASE OF RICE BY INESPRE AT LA JAGUA

Date	No. of Bags Purchased	Total Weight Expressed in Fanega	Total Weight Converted to Ton
Oct. 1 - Oct. 7	2,423	1,728.41	224.7
Oct. 8 - Oct. 14	1,516	1,163.54	151.3
Oct. 15 - Oct. 21	1,025	725.89	94.6
Oct. 22 - Oct. 28	2,265	1,626.29	211.4
Oct. 29 - Nov. 4	2,337	1,716.38	223.1
Nov. 5 - Nov. 11	3,001	2,177.28	283.0
Nov. 12 - Nov. 18	2,001	1,479.72	192.4
Nov. 19 - Nov. 25	1,033	728.10	94.6
Nov. 26 - Dec. 2	2,503	1,559.80	202.8
Dec. 3 - Dec. 9	1,411	923.31	120.0
Dec. 10 - Dec. 16	2,213	1,552.76	201.9
Dec. 17 - Dec. 20	911	715.41	93.0
Total	22,629	16,098.89	2,092.80

TABLE G.8.1 WEIGHT OF ONE "FANEGA" AND MOISTURE AND FOREIGN MATERIALS CONTENTS

Series	No. of Bags	Total Weight		KG per Bag	KG per Fanega	Moisture Contents (%)	Foreign Materials Contents (%)
		KG	Fanega				
1.	63	7,205	55.43	114.3	130.0	22	8
2.	56	4,542	34.37	81.2	132.2	24	8
3.	15	1,653	12.76	110.2	129.5	23	8
4.	24	2,393	18.21	95.7	131.4	23	9
5.	15	1,560	11.74	104.0	132.9	23	10
6.	32	3,310	25.46	103.4	130.0	23	8
7.	17	1,625	12.51	95.6	129.9	21	8
8.	20	1,839	14.77	92.0	124.5	21	7
9.	13	1,064	6.93	81.8	153.5	28	15
10.	10	927	6.52	92.7	142.2	25	18
11.	33	2,921	22.95	88.5	127.3	21	9
12.	82	7,333	53.93	89.4	136.0	23	12
13.	19	1,753	12.89	92.3	136.0	23	12
14.	22	2,280	17.19	103.6	132.6	24	9
15.	159	13,922	102.44	87.6	135.9	23	12
16.	50	4,846	36.05	96.9	134.42	23	11
17.	13	1,129	8.92	86.8	126.6	22	7
18.	26	2,473	19.22	95.1	128.7	21	10
19.	8	760	5.69	95.0	133.6	24	9
20.	22	2,115	16.44	96.1	128.6	21	10
21.	33	3,582	27.56	108.5	130.0	22	8
22.	134	12,091	91.86	90.2	131.6	21	12
23.	33	3,057	23.38	92.6	130.8	22	10
24.	76	7,488	58.55	98.5	127.9	22	8
25.	10	959	7.30	95.9	131.4	22	9
Average	986	92,827	703.07	94.15	132.0	22.7	9.9

Note: The Table has been prepared based on the investigation made on December 21, 1985 at the Purchase Center of INESPRE set up at IAD's Administrative Office of El Guayabo.

9. Agrarian Reform

9.1 General Description

In the Dominican Republic, agrarian reform was started in the decade of 1920 with the provision of national land to particular farmers. Up to 1961, agrarian reform program had been focused on the settlement of landless farmers in frontier zones with Haiti so as to establish duly delimited border and to avoid in migrations.

In 1962, IAD was established as an organization to take charge of agrarian reform projects and, since then, the program has been accelerated and consolidated with the settlement of beneficiaries all over the country.

Actually, agrarian reform project areas play very important roles in the sense of the agricultural development of the Republic. In 1984, about 57% of total rice production was made in the IAD's settlement area; other crops which contributed highly to the total national were: industrial tomate (45%), yam (38%), garlic (23%) and onion (14%).

9.2 Situation of the Projects

There exists three project areas in the study area: Aguacate, Guayabo and Cienega Vieja.

With regard to the Cienega Vieja area which was just established in 1983, the following items have been disclosed during the field work.

- No information on the actual land use of the distributed land is available because an administrative office has not been established.

- Approximately 470 ha of the land has been distributed beneficiaries most of whom live in Arenoso and Villa Riva (outside of the settlement area).

- Any infrastructure such as roads or irrigation/drainage systems has not been provided, and any IAD services for the farm management in the distributed lands are not rendered. Actually, there is no plan to construct any infrastructural facilities in the relevant area.

- About 25 percent of the distributed land is utilized to grow rice under high rainfall conditions without farm credits from the B.A. The remaining area is left as marsh lands.

The total area developed for paddy field in the said three IAD land settlement project areas amount to about 4,600 ha, of which rice was planted on about 54 percent of that area in 1984. There are two main reasons why a large area of the field was not used for rice cultivation; one is that the irrigation and drainage facilities are not adequately provided in a majority of the area, and the other is that the returns from rice cultivation are not high enough to repay the farm credit which was loaned by the B.A.

9.3 Plan for the Consolidation of Farmer's Settlements

Under a Loan Agreement made between the Government of the Dominican Republic and the Inter-American Development Bank in 1973, the IAD has been implementing the "Plan for the Consolidation of Farmer's Settlement" with regard to sample settlement project areas. The Plan aims at an increase in production, elevation of productivity, efficient use of the labor force, increase in farmer's income and improvement in the socio-economic situation of the beneficiaries in the IAD's agrarian reform project areas. In order to achieve these targets, the construction of physical (irrigation and drainage systems, rural and in-farm roads), and social (water supply, electrification, living quarters) infrastructure and provisions for assistance services to farmers (technical assistance, extension, credit) have been made by the IAD.

El Aguacate is included in the above-mentioned sample project areas; approximately 8 km of in-farm roads were completed already and, at the present, living quarters for the IAD's technical staff, a crop supply storage warehouse as well as an administrative office are being constructed. In the future, it is anticipated that other projects such as beneficiaries' living quarters, roads, water and electric supply systems will be constructed (See Table G.9.1).

TABLE G.9.1 PROGRAM FOR THE CONSOLIDATION OF THE EL AGUACATE LAND SETTLEMENT AREA

Description of Projects	Progress of Projects as of Jan. 1986 (%)	Proposed Cost (RD$)
7.94 km Road	100	267,215.59
4 Living Quarters for the IDA's Staff	50	50,281.16
1 Supply Storage Warehouse	80	13,797.47
1 Administrative Office	70	11,501.82
200 Living Quarters for Beneficiaries	0	1,830,116.00
1 Water Supply System	0	296,605.00
1 Km Road	0	76,711.51
Electrification System in Residential Area	0	135,055.00
Total		2,681,283.63

Note: In addition to above works, the rehabilitation of irrigation and drainage canals (70 km) is proposed and a study to estimate cost of this work is presently being made by the IAD.

Source: Implementing Office of the Plan for the Consolidation of Farmer's Settlement, IAD

ANNEX H: TOPOGRAPHIC SURVEY AND OTHERS

CONTENTS

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ANNEX H: TOPOGRAPHIC SURVEYS

1. Topographic Surveys

The areas covered by existing maps (scale: 1/10,000, prepared in 1967) reaches 18,100 ha, which accounts for three quarter of the study area (24,100); the areas which are not covered by existing maps correspond to their greater part to El Guayabo. These existing maps do not necessarily show the whole of actual canal and road networks due to a long lapse of time.

In this connection, in the course of the present study, new maps to cover 6,000 ha have been prepared together with the modification of existing maps; preparation of new maps has been carried out based on the aerial photographs taken in 1979 at scale 1 : 20,000 and in 1983 at 1 : 40,000.

At the same time, control point surveying, leveling and field reconnaissance survey were carried out to collect the necessary information and data for mapping.

Extent of works for topographic surveying are shown in Fig. H.1.1.

1.1 Control Point Surveying

For the purpose of supplying with necessary information for the aerial triangulation works and for the preparation of new topographic map at scale 1 : 10,000, a total of nine control points have been set up. The triangulation point at Canoa, located to the West of Sanchez with E.L. 465 m, was utilized for the control point and the same point situated to the West of El Pozo with E.L. 460 m was utilized for the azimuth surveying.

The surveying was carried out by means of GUPPY (made in Japan, 6") for angle observation and by means of traverse surveying using GIODIMETER 14A (made in Sweeden for 15 km) for distance surveying (See Fig. H.1.1).

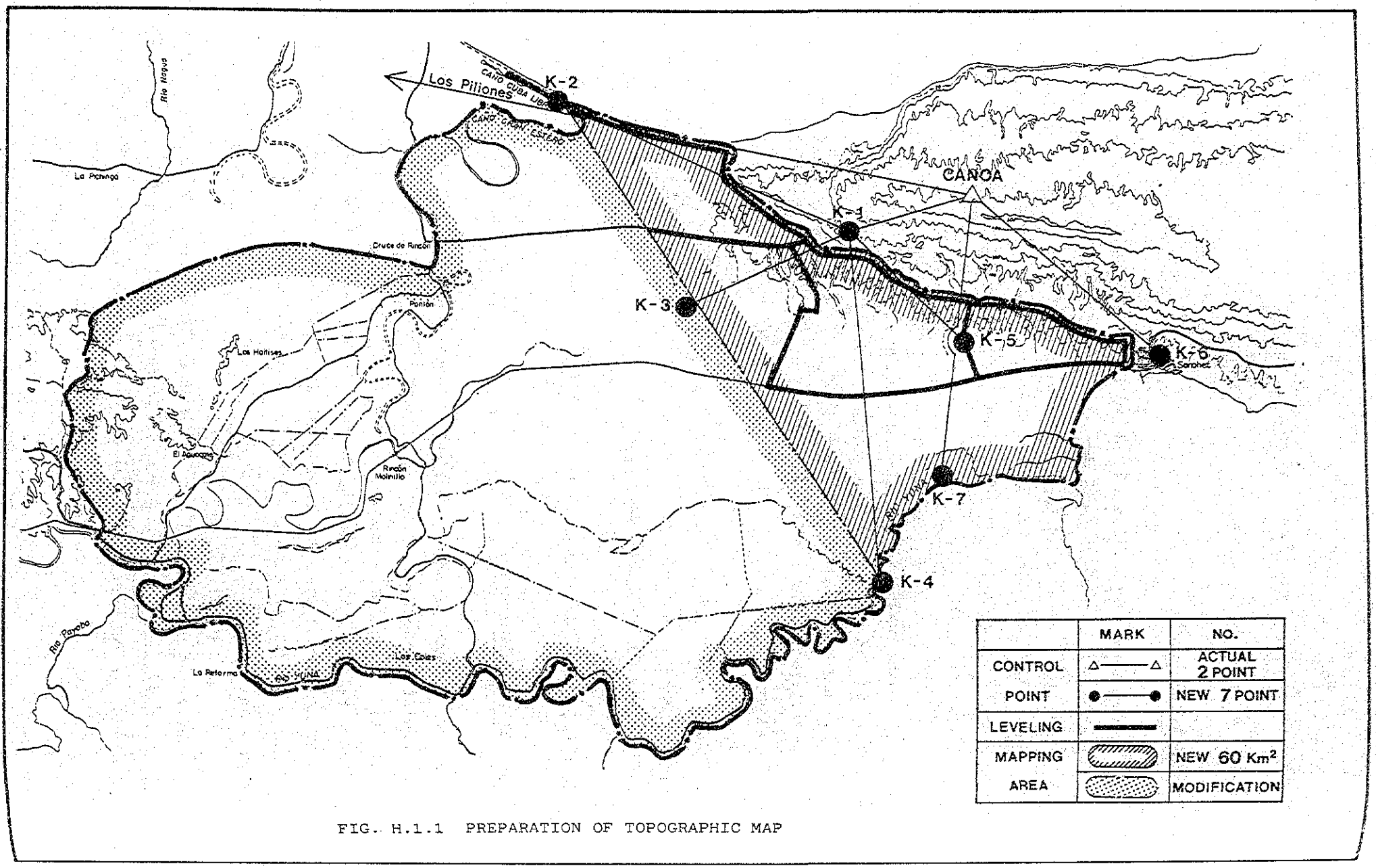


FIG. H.1.1 PREPARATION OF TOPOGRAPHIC MAP

1.2 Leveling

Leveling was realized in view of revising the slant to be found in the aerial photographs; by completing this work, more precise map is to be elaborated.

Existing control points were used for leveling and the following infrastructures also utilized for this purpose: access road between Cruce de Rincon and Sanchez and Arenoso and the confluence of the Yuna River and the Guayabo River and the railroad between Rincon Molinillo and Sanchez. The branch lines were also set up as required and bench marks have been installed along the access roads. These works were carried out with auto-level (made in Japan) and by means of parallel surveying method. The total surveying distance reached to 90 Km in total.

1.3 Miscellaneous Works

1.3.1 Placement of Bench-mark

In the course of field works, some bench-marks were placed along the Yuna River and the Cruce de Rincon - Sanchez Road, because existing bench-marks placed along the Cruce de Rincon - Rincon Molinillo - Arenoso Road can not cover the whole of study area.

New bench-marks are presented in Fig. H.1.2.

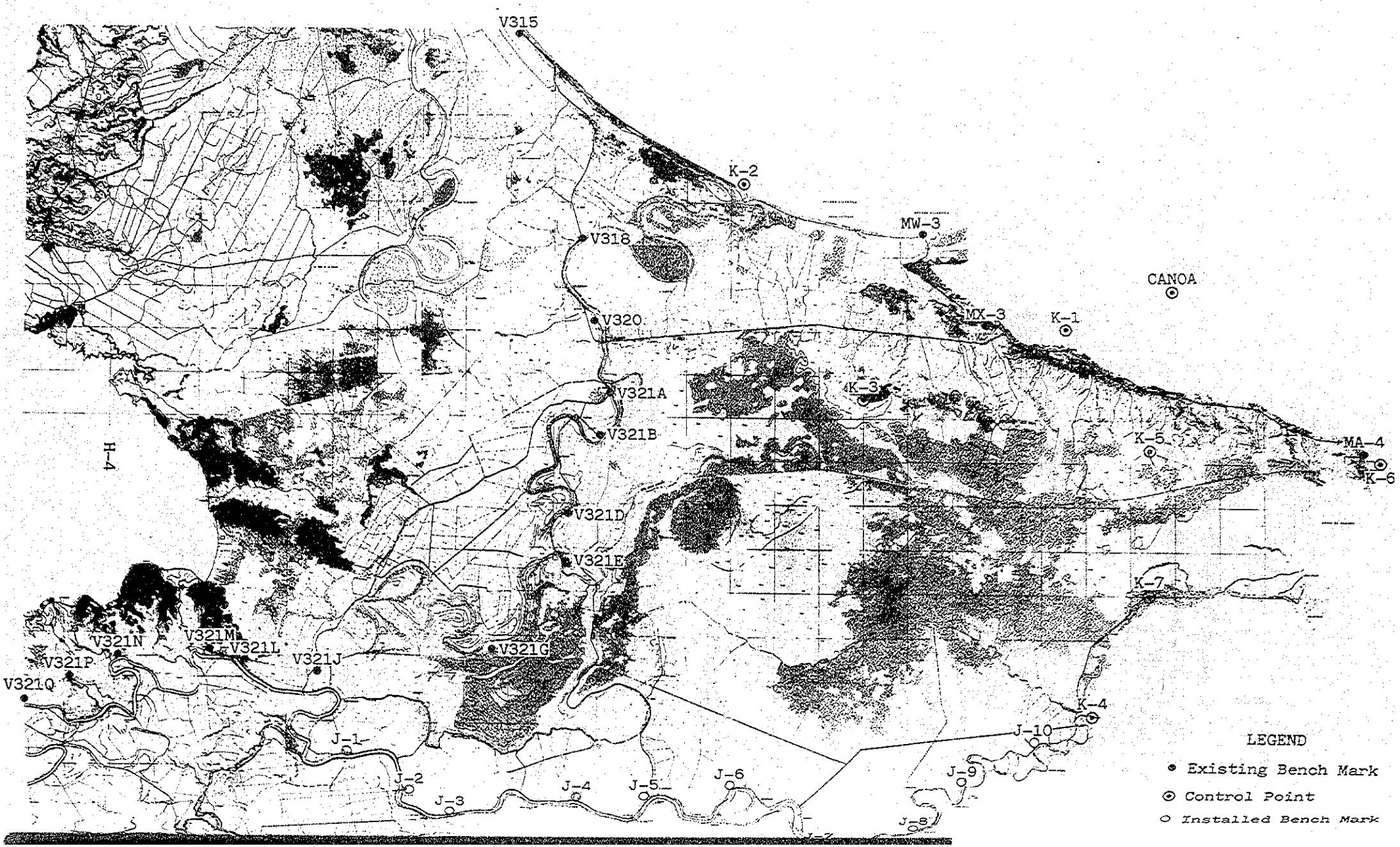

V315
K-2
MW-3
V318
CANOA
V320
MX-3
K-1
V321A
K-3
V321B
K-5
MA-4
K-6
H-4
V321D
V321E
K-7
V321N
V321M
V321L
V321G
V321P
V321J
V321Q
K-4
J-10
J-1
J-2
J-3
J-4
J-5
J-6
J-9
J-8
LEGEND
Existing Bench Mark
Control Point
Installed Bench Mark

TABLE H.1.1 ELEVATION OF BENCH MARKS AND STATION OF TRIANGULATION

TRIANGULATION POINTS

STATION	(X)	(Y)	ELEVATION (M)
CANOA	2,129,804.02	430,230.36	464.70
K - 1	2,129,124.66	428,244.59	273.080
K - 2	2,129,124.66	428,244.59	3.219
K - 3	2,127,655.69	423,931.80	31.724
K - 4	2,120,488.66	428,972.11	2.366
K - 5	2,126,473.44	430,413.19	1.944
K - 6	2,126,057.40	435,803.27	37.435
K - 7	2,123,013.32	430,538.49	1.741

LIST OF BENCH MARKS

INSTALLED B.M

STA.	ELE.(M)
BM 1	6.003
2	6.452
3	4.825
4	9.617
5	23.052
6	73.408
7	47.743
8	32.656
9	0.739
10	2.016

INSTALLED B.M

STA.	ELE.(M)
J 1	9.484
2	9.611
3	8.800
4	7.380
5	7.282
6	7.295
7	4.822
8	4.811
9	3.971
10	2.310

EXISTING B.M

STA.	ELE.(M)
V315	2.9001
V318	2.6403
V320	2.7874
V321A	2.8914
V321B	3.0160
V321D	5.0739
V321F	4.8577
V321G	5.8915
V321J	9.5488
MX-3	44.2659
MW-3	1.8580
MA-4	13.1518
V321L	11.3072
V321M	11.2684
V321N	12.7902
V321P	13.4630
V321Q	15.4366

1.3.2 Profile and Cross Sectional Leveling

The following levelings were carried out.

- Profile leveling
  - . Borehole sites
  - . Regulating Reservoir Site
  - . Along Villa Riva - Arenoso Railways

- Cross-sectional leveling
  - . Proposed Sites for Headworks
  - . Sites of Water Level Gauging Stations

2. Installation of Hydro-meteorological Stations

For the purpose of agricultural development project, meteorological and hydrological data are one of the most important factors. In and surround the study area there are a few observating stations. In order to obtain hydrological and meteorological data in the survey area, JICA supplied equipment as listed below.

Automatic tidal gauge	1 set
Automatic water level gauge	2 sets
Automatic rain gauge	2 sets
Meteorological station equipment	1 set

The location of stations are shown in Fig. H.2.1.

2.1 Automatic Tidal Gauge

The location of station is on the old jetty of Sanchez port and the structure of the station is shown in Fig. H.2.2.

Installed automatic tidal gauge is Kyowa LFT-V for 1 month recording period.

2.2 Water Level Gauge

Two stations were constructed, one in Yuna River and the other in Cano Gran Estero.

Installed water level gauge is IKEDA KEIKI ADR-105 for 3 months recording period.

2.2.1 Yuna River

Based on the discussion with Dominican authority (INDRHI), the location was decided in La Jagua, about 18 km from river mouth and the left bank of Yuna River.

The skelton of the station is shown in Fig. H.2.3.

2.2.2 Caño Gran Estero

The location of the station is the right bank of the river mouth of Caño Gran Estero.

The skelton of the station is shown in Fig. H.2.4.

2.3 Rain Gauge

Two rain gauge were installed, one located at the confluence of Yuna River and Guayabo River and the other at the back yard of IAD Aguacate office.

Installed rain gauge are IKEDA KEIKI SKI-3 for 3 months recording period.

2.4 Meterological Station

The location of the meteorological station is at the back yard of old IAD Aguacate office and the layout of equipment is as shown in Fig. H.2.5.

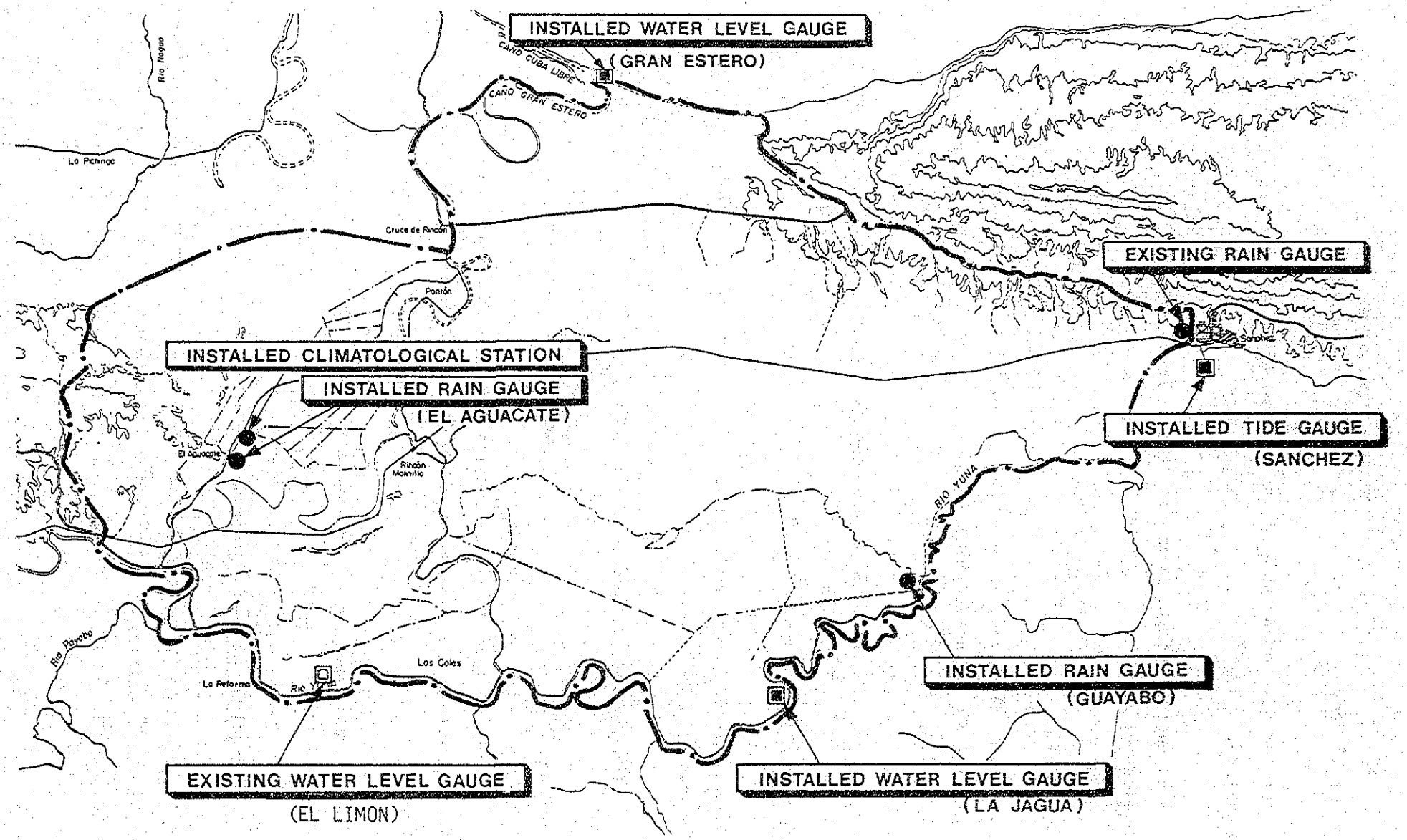
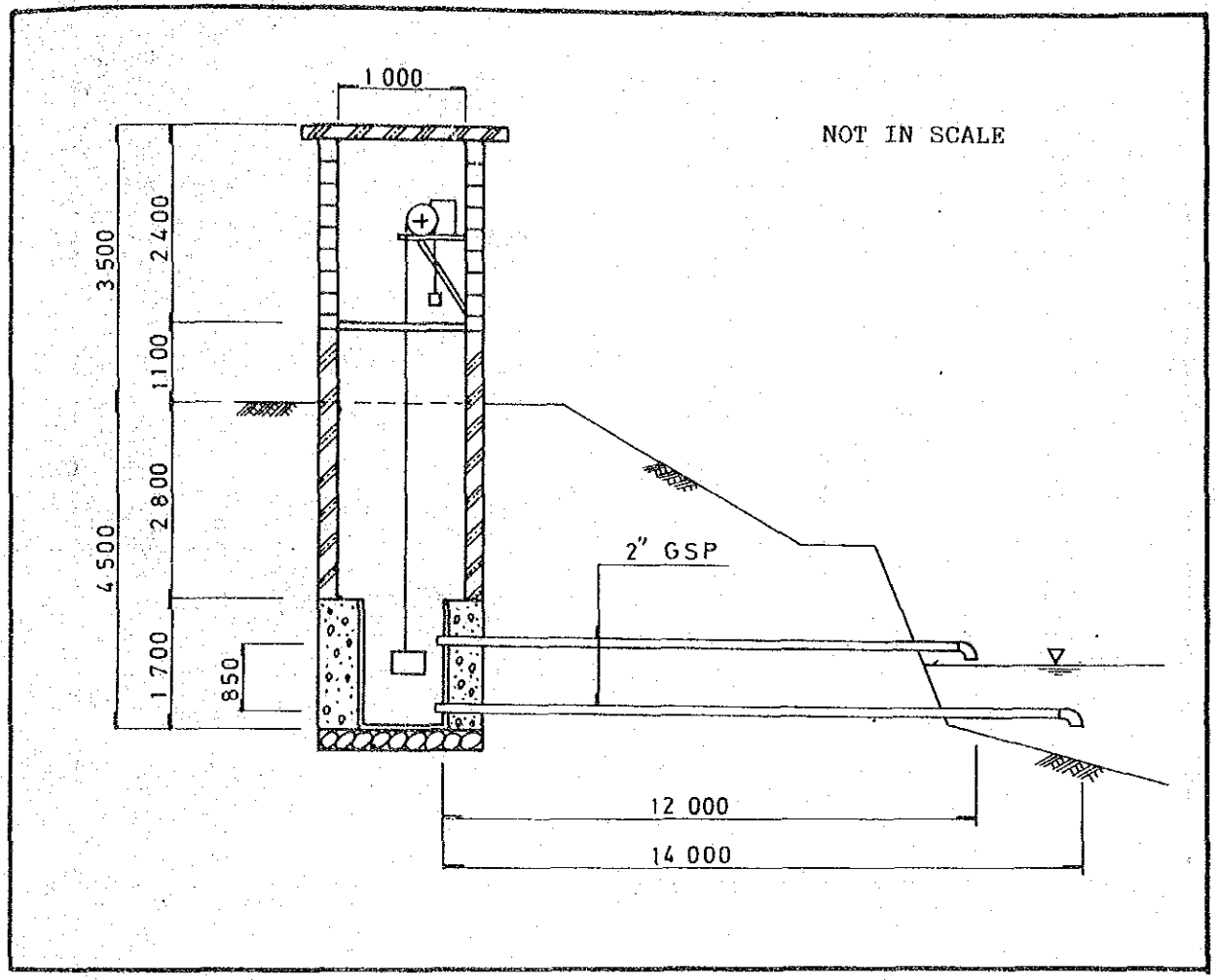


FIG. H.2.1 HYDRO-METEOROLOGICAL STATION



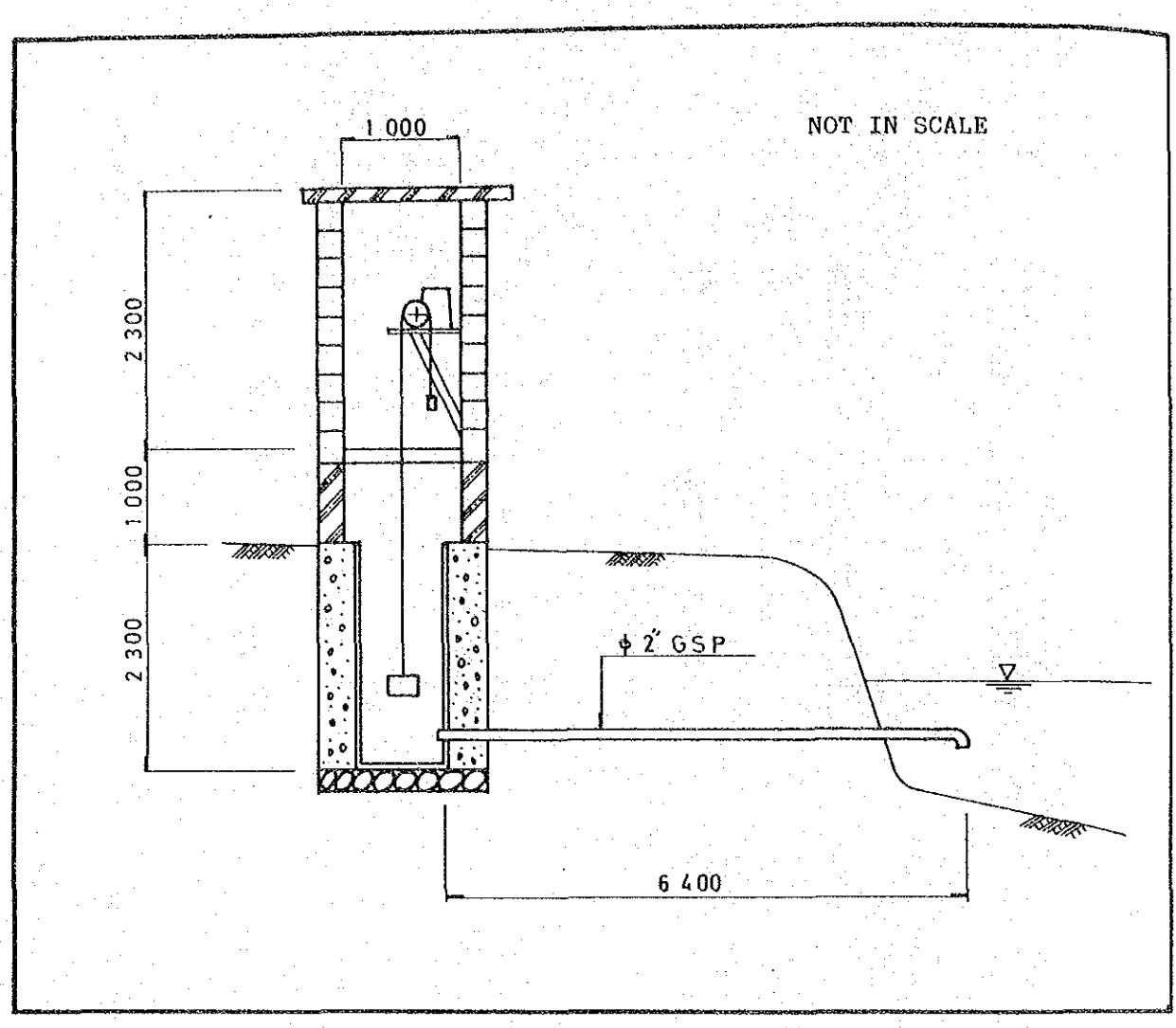
LEGEND

REINFORCED CONCRETE

LEAN CONCRETE

CONCRETE BLOCK

FIG.H.2.2 WATER LEVEL GAUGE (LA JAGUA)



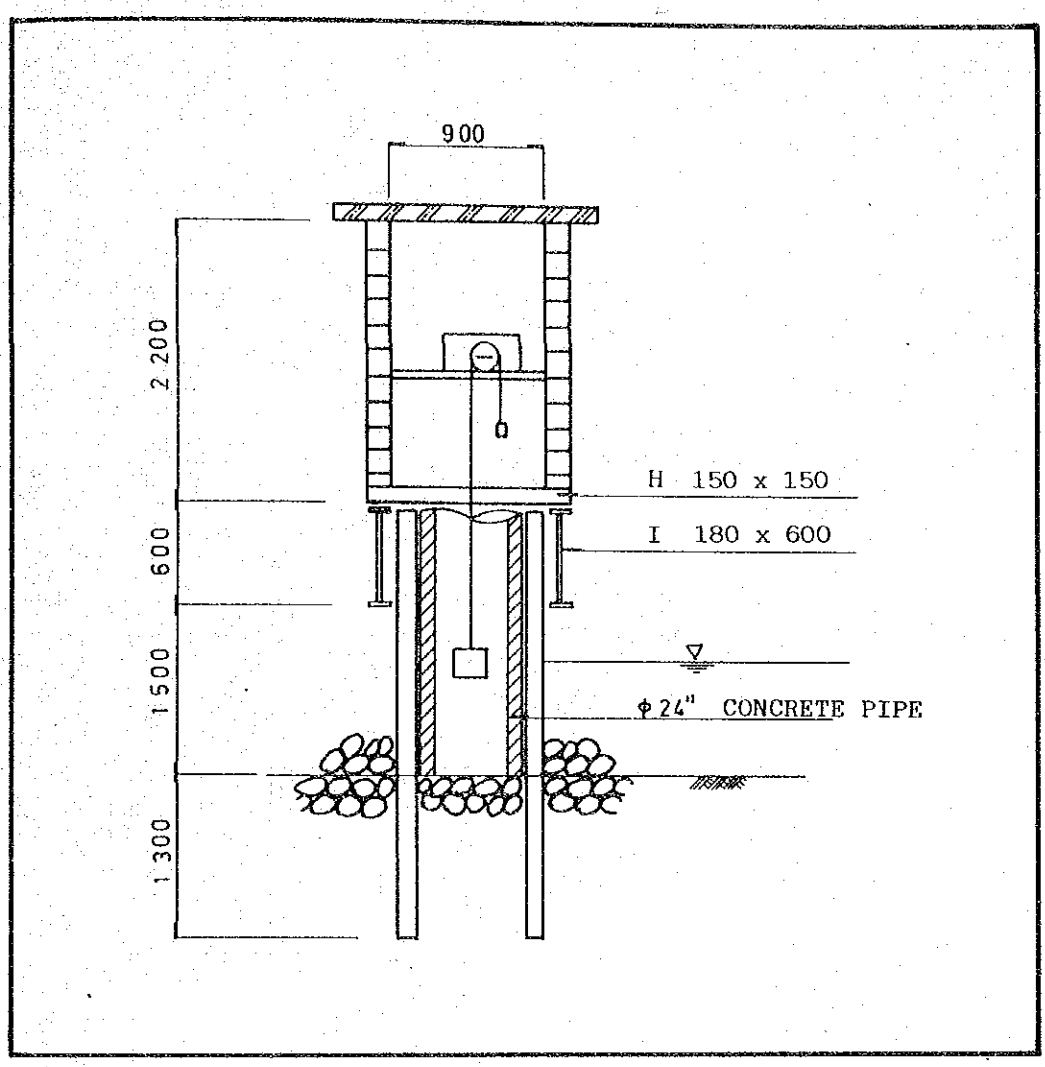
LEGEND

REINFORCED CONCRETE

LEAN CONCRETE

CONCRETE BLOCK

FIG. H.2.3 WATER LEVEL GAUGE (CAÑO GRAN ESTERO)



LEGEND

LEAN CONCRETE

CONCRETE BLOCK

FIG. H.2.4 TIDE GAUGE (SANCHEZ)

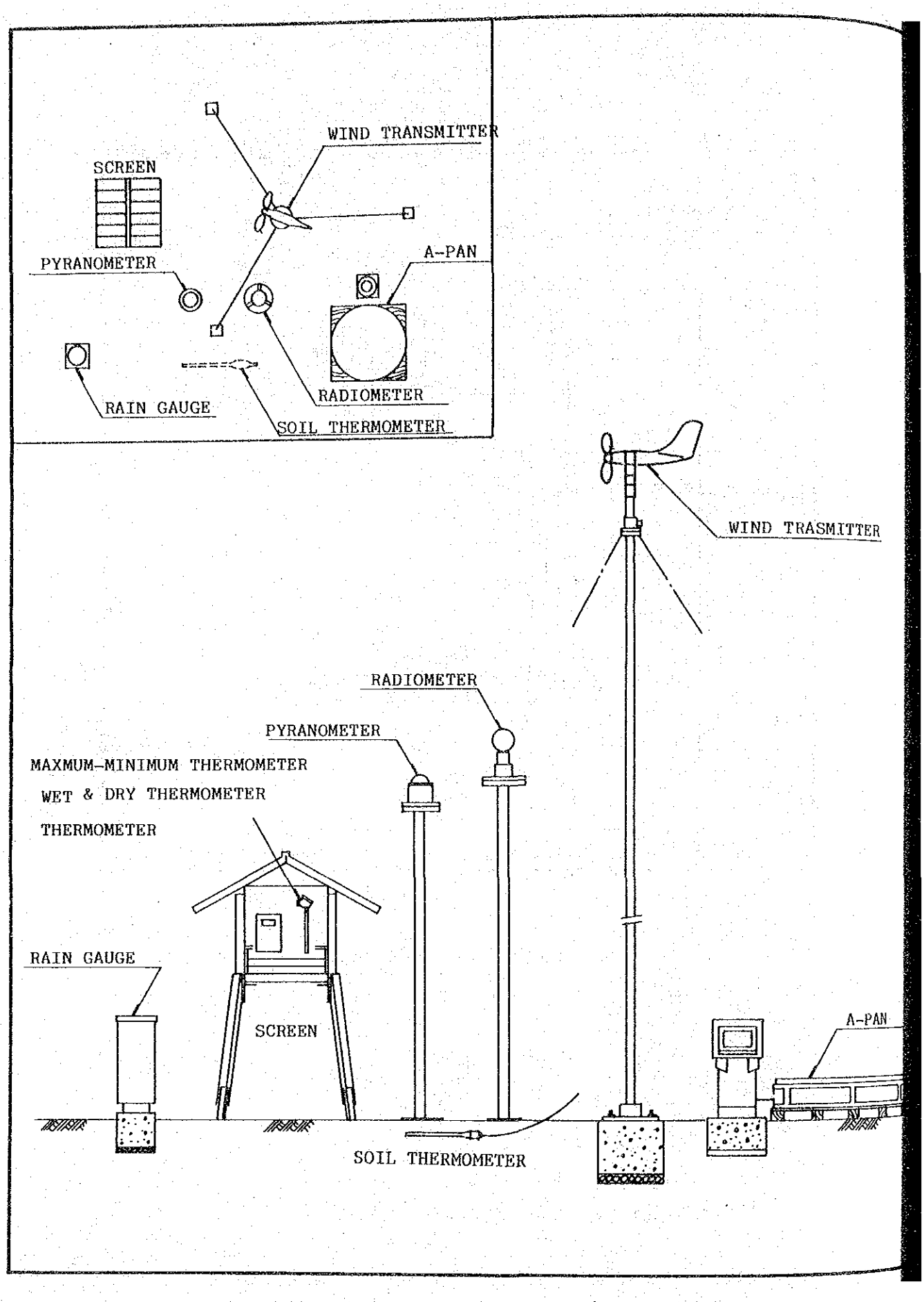


FIG. H.2.5 CLIMATOLOGICAL STATION (AGUACATE)

II. PLANNING AND EVALUATION

ANNEX I: AGRICULTURE DEVELOPMENT PLAN

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ANNEX I: AGRICULTURE DEVELOPMENT PLAN

1. Land Use Plan

A land use plan to cover the total study area will be prepared in due consideration of the following components.

- Existing land use practice
- Land tenure
- Soil condition
- Topographic and geological condition
- Cropping patterns
- Water resources
- Irrigation and drainage
- Degree of difficulty for the construction works
- Environmental preservation
- Expected benefit by crop cultivation

1.1 Guideline by the Present Land Use

1.1.1 Paddy Field

A total of 4,100 ha is allocated to the paddy field and this land will be used as if it is no constraints in the context of water resources and land capability will be presented.

1.1.2 Cacao

Cacao constitutes an important cash crop among crops being cultivated in the study area. The total area covered by this crops reaches to 1,700 ha, which is mainly extended in the natural bank along the Caño Gran Estero. Considering that cacao is an important cash crop and cultivated for the most part in private land, the present hectarage covered by this crop will be kept unless it impedes the division for the development of paddy field.

1.1.3 Coconut

The coconut plantations are located in the foot of a mountain called "Loma la Cordillera" and sea side area of the Escocesa Bay and their total area covers around 1,800 ha. The areas actually allotted to coconut plantation will be maintained because these areas are topographically unsuitable for rice production.

1.1.4 Upland Crops

Upland crops such as cassava and banana are cultivated in lands with total area of 200 ha which are composed of uplands along the Nagua-Sanchez highway and a natural bank along the Yuna River. Being located in upland and small in scale, lands allotted to upland crops will be conserved.

1.1.5 Pasture

The animal husbandry is practiced in hilly lands in the western and northern parts of the study area, useless paddy fields and swampy lands. Among these lands, hilly lands will be preserved for pasture because the rice production in these lands is not appropriate; the rest will be examined their capability for the rice cultivation by means of soil analysis.

1.1.6 Swampy Land

The study area is featured by a large extension of swampy land: "Ceja" in the northern part of the Aguacate, the central zone of the Guayabo, etc. The greater portion of these swampy land contains peat soil layer. In accordance with characteristics and thickness of peat soil layer, a guideline for land capability classification has been prepared and consulting with this guideline swampy lands within the study area will be assessed their qualification to be developed for paddy field.

1.1.7 Swampy Forest

The swampy forests are extended in the central part of the swamp land and in the left side at the mouth of the Yuna River and they are left uncultivated though natural growth of "yautia" is found within them.

The swampy forests will be conserved without being developed because of the following reasons.

a. The development of the swampy forest requires vast investment
b. The forestal resources should be conserved
c. The river-mouth area of the Yuna River is cultivated for the shrimp fishery
d. Lands with swampy forest are occupied by the peat soil layer

The actual land use practice will be maintained or improved as summarized below.

Preservation of the Present Land Use	Development for Paddy Field	Environmental Conservation
- Cacao - Coconut - Upland crops	- Present paddy field - Pasture and swampy land qualified by land capability classification	- Swampy forest

1.2 Guideline by Land Capability Classification

By means of the land capability classification maps prepared for the assessment of the existing land, a land use proposal has been prepared (details of the land capability classification is described in ANNEX-D Soil).

1.2.1 Land Capability Classification for the Development of Upland Crops

a. Lands classified between Class 1 and Class 3 will be developed for the paddy field except those located on the natural bank along the Yuna River.

b. Lands within the range of Class 4 will be developed for the paddy field.

c. Land located on the natural bank along the Yuna River will be allocated to residential areas and gardens.

1.2.2 Land Capability Classification for the Development of Paddy Field

a. Lands with a range between Class A1, and Class A4 will be developed for the paddy field

b. Lands classified in Class A5 and Class A6 will be excluded from the development area. Nevertheless, the isolated lands surrounded by lands with superior class will be included in the development area; some lands are also included in the development area for the convenience in dividing land for the development of paddy field.

1.3 Land Use Plan

Taking into account of aforementioned aspects, a land use plan has been prepared.

Land Use Plan

		Present	Alternative A	Alternative B
Aguacate Area	Paddy Field	2,000	3,500	3,400
	Cocoa	900	900	900
	Coconut	-	-	-
	Upland Crops	-	-	-
	Pasture	3,100	1,800	1,800
	Swampy Land	1,200	900	1,000
	Swampy Forest	600	600	600
	Alieneated Land	200	700	700
	Sub total	8,400	8,400	8,400
Guayabo Area	Paddy Field	2,100	4,800	3,600
	Cocoa	400	400	400
	Coconut	1,400	1,400	1,400
	Upland Crops	500	200	200
	Pasture	2,700	2,700	3,200
	Swampy Land	3,700	1,100	1,800
	Swampy Forest	4,700	4,400	4,400
	Alineated Land	200	700	700
	Sub total	15,700	15,700	15,700
Total	Paddy Field	4,100	8,300	7,000
	Cocoa	1,700	1,300	1,300
	Coconut	1,400	1,400	1,400
	Upland Crops	500	200	200
	Pasture	5,800	4,500	5,000
	Swampy Land	4,900	2,000	2,800
	Swampy Forest	5,300	5,000	5,000
	Alineated Land	400	1,400	1,400
	Sub total	24,100	24,100	24,100

Notes: Alternative A: To be developed the whole developable area.
Alternative B: Both areas of the right bank of Caño Gran Estero and left bank of Guayabo River are eliminated from Alternative A.

2. Crop Selection and Cropping Pattern

2.1 Selection of Crops

Rice is selected as the principal crop in the proposed irrigation area due to the following reasons:

(1) The increase in rice production meets the national development strategies of the country for self sufficiency of rice.

(2) The physical conditions such as climate and soils in the project area are adaptable to grow rice than any other crops.

(3) The greater portion of lands actually developed is allocated to rice production and farmers are accustomed to cultivating this crop.

(4) The projection of rice has advantage in terms of profitability and commercialization.

In the proposed land use plan, lands with soils suitable for upland crops are excluded from the proposed irrigation area where cacao and other upland crops can be cropped without irrigation as it is presently done.

2.2 Cropping Pattern

2.2.1 Cropping Pattern with Project

The following two types of rice cultivation are proposed;

(1) Double cropping with non-photo-sentive and short stem improved varieties which will be transplanted or direct-seeded twice a year in the proposed irrigation area except the swampy area.

(2) Single cropping with tall local varieties which will be transplanted in swampy lands in the left bank of the Guayabo River, where the control of flooding is technically difficult. The harvest in these lands will be envisaged twice a year by means of ratooning method.

The improved varieties are divided into two types; namely, early maturing varieties (ISA 40, Tanioka, etc.) and medium maturing varieties (Juma 57, Juma 58 etc.). Such varieties as Mingoro, which have tall height and ratooning ability, is selected for the swampy area. The characteristics of the selected varieties are shown in the Table I.2.1. Four types of cropping calendars are prepared for the selected varieties with fifty days of lag period, taking into consideration farm labor balance in the project area. Out of the four calendars, two are taken as representatives in the proposed cropping pattern, respectively of the transplanting with medium maturing varieties and the direct-seeding with early maturing varieties (Refer to Figs. I.2.1 to I.2.3).

2.2.2 Cropping Pattern without Project

Referring to the rice production data for the IAD settlement areas in the study area, there is no significant increase of rice planted area for the past ten years. Assuming that the situation in the private cultivation area would be same to that in the IAD settlement area, it is estimated that the small change of cropping pattern will occur throughout the project area under the condition of "without project".

3. Proposed Farming Practices

In due consideration of survey result on the existing farming practices, the proposed farming practices are studied for the proposed cropping pattern together with details of the proposed farm operations which are shown in the Fig. I.3.1 to Fig. I.3.3.

3.1 Sowing and Raising Seedlings

Rice seeds have to be renewed at least once every four croppings with the certified seeds and be selected by using a solution of specific gravity. The selected seeds will have to be disinfected by using disinfectants and then incubated. The seed requirement is 45 kg per ha for the improved varieties and 50 kg per ha for the traditional varieties and it is 100 kg per ha in case of direct seeding.

About 400 m^2 of seedbed has to be prepared to transplant one hectare. The seedbed should be as flat as possible. Fertilizing is essential, and the recommendable dosage is 15 kg of 16-24-12. Careful water management is very important to raise healthy seedlings. The nursery period is 30 days after seeding for the improved varieties and 40 days for traditional varieties.

3.2 Land Preparation

Plowing is carried out at least 15 days before transplanting or direct-seeding and then soil breaking is followed. The plowing and soil breaking is made by a tractor or a power tiller. Puddling and levelling is carried out by a tractor animal power.

The land preparation for direct seeding will have to be made in the same way as that for the transplanted rice, keeping the soil surface as flat as possible. The standing water have to be removed so as to make surface soils stiff enough to avoid seed submerging into soils. Therefore, it is recommendable to prepare temporary drainage furrows inside plots at an interval of 8 m.

3.3 Transplanting/Direct-seeding

Cross-wise straight row transplanting is made by manual with a spacing of 20cm x 20cm, which means the number of hills per m^2 at 25 and planting 2 to 3 seedlings per hill is recommendable. The water depth is dept shallow at transplanting time by drainage of excessive water.

And then careful water control to avoid deep water depth is required to accelerate vigorous rooting and tillering. Especially in case of direct seeding, the standing water depth should be increased in parallel with the growth height of seedlings.

3.4 Fertilizer Application

The total fertilizer requirement of three nutrient elements is estimated at 70-55-28 (N,P,K) for the improved varieties in both case of transplanting and direct-seeding. Half amount of nitrogen is applied as top dressing, at about 20 days before heading. The total fertilizer requirement for the cultivation of local varieties with ratooning cultivation is estimated at 68-49-24.

68 kg of the total nitrogen amount is divided into three parts; namely, basal fertilizer (30 kg), top dressing at 20 days before first heading (8 kg) and top dressing for ratooning (30 kg). The nitrogen top dressing for ratooning will be made just after bud arrangement. Regarding fertilizer application to rice in the organic soils, there would be many points which must be clarified about the soil maturing after the project construction and soil management during the maturing. The fertilizer requirement have to be studied together with above soil problems.

3.5 Weeding

About five days after transplanting, a pre-emergence typed herbicide is applied for the transplanting rice. For effective operation of weeding, it is recommendable to introduce manual rotary weeder by applying transplanting method of cross-wise straight row. The direct seeding rice will need to apply herbicides twice, which are with pre-emergence and post-emergence typed herbicides. One of examples of pre-emergence typed herbicides is "buthachlor + 2.4-D Amine", while for the post-emergence, 2.4-D Amine.

3.6 Plant Protection

Seed desinfection is indispensable. One of the recommendable disinfectants is Benlate. Systematic plant protection has to be applied, which consists of not only insecticide application but also such cultural control, including selection of resistant varieties to prevailing insects and diseases, setting of such cropping calendar to minimize infection of insects and diseas, removable of parasite weeds nd crop residues, etc. To reduce production cost and side-effect to the natural environment, minimum amount of chemicals have to be applied in the plant protection by monitoring of pest infection. Considering the life-cycle of insects, it will be required to apply twice the granular formulation insecticides which have both contact and systemic effects to various kinds of harmful insects. One example is Carbofaran (Fradan). This insecticide will be applied during seedlings raising.

3.7 Harvesting

Harvesting is carried out by manual labor. Small typed power threshers will be introduced in order to make efficient threshing operation and also to improve the removable of unfilled grains and impurity. And it is essential to introduce artificial drying to reduce grain moisture content at least upto 18% at farmers' level.

4. Crop Yield and Production

4.1 Crop Yield without Project

It is considered that there will be no significant changes of output and input of rice cultivation in almost all the project area "without project" in future. Even though yields will increase slightly over the project period, the balance between output and input will be offset by the increase of output. Therefore, the yield increase "without project" in future has been neglected in this study.

4.2 Crop Yield with Project

On the basis of the attained yields of rice at the experimental stations and the farmers' fields in the study area and its vicinity, the target yield in the full development year of the medium and long terms is respectively estimated by variety and land class as follows:

Target Yield by Land Class

(Unit: ton/ha)

Land Class*	Improved		Traditional	
	Medium term	Long term	Medium term	Long term
1R	3.8	5.0	-	-
2R	3.4	4.0	3.6	-
3R	-	3.2	2.8	-
4R	-	-	2.6	3.0

Note: It is assumed that the classified land into A1 is the first class land (1R) in term of land capability to grow rice after project construction. In the same way, the classified land into A2 and A3 is the second class land (2R) while A4 or the lower classes land is the third class (3R) land. The areas of the left banks of Guayabo river and Caño Gran Estero are classified as fourth land (4R) due to insufficient drainage.

It is considered that no significant yield different between the transplanting and the direct seeding of rice under the conditions that the direct seeding will not be continued in the proposed cropping plan.

The detailed process of target yield formulation is as follows;

4.2.1 Estimation of Potential Yield

The following experimental yields are collected to get the quadratic equations which shows the regression between the yields and the applied nitrogen amount.

Experimental Yield

(Unit: ton/ha, dry paddy)

Season	Nitrogen Amount (kg/ha)						
	0	20	40	60	80	100	120
Dry	3.9	4.3	4.8	4.9	5.1	5.6	5.6

Note : Average Yield for Juma 57 and 58 which were transplanted in January, 1973.

Source: Bonao Experimental Station, CEDIA.

The quadratic equation of regression between yield (y) and the applied nitrogen amount (x) is shown as follows;

$$y = 3.92 + 0.02071x - 0.00005357x^2$$

The curve of the equation is illustrated in Fig. I.4.1.

4.2.2 Attained Yield in the Project and Its Vicinity

IAD settlement area of Jarabacoa, Bonao (Juma) and El Pozo (collective farming area) are selected as the representative of the advanced rice cultivation area in the said Yuna-Boba-Camu river basin and its vicinity as described previously.

According to the Feasibility Report on the AGLIPO (El Pozo) Agriculture Development Project, the application rate of nitrogen is about 45 kg/ha in the collective farming area, where an average yield of 4.7 ton/ha is attained. The above yield data and the applied nitrogen amount are substituted for the above-mentioned regression equations which are based on the experimental yields. The following equation is obtained;

$$y = 3.72 + 0.0207x - 0.00005357x^2$$

4.2.3 Yield at Optimum Amount of Nitrogen Application

Optimum amount of nitrogen application and their yields are computed as follows, taking into account the cost of nitrogen fertilizer and production value;

$$\text{Opt. nitrogen (kg/ha)} = \frac{0.02071 \times Py - Pn}{2(0.00005357 \times Py)}$$

$$= \frac{0.02071 \times \text{RD\$707} - 4.0}{2(0.00005357 \times \text{RD\$707})} = 140 \text{ kg}$$

Yield with nitrogen application at 140 kg/ha = 5.6 ton/ha

where; Py = RD$707/ton (Paddy)
Pn = RD$4.0/kg (Nitrogen)

4.3 Crop Production with Project

In each target of the medium term and the long term, the total amount of rice and the increment with project are estimated as follows:

Rice Production and Increment with Project

(Unit: dry paddy ton)

Alternative	Present	Medium Term		Long Term	
		Production	Increment	Production	Increment
A	8,550	42,700	34,150	63,660	55,110
B	7,625	38,800	31,175	58,760	51,135

Note: For further details, see Table I.4.2

5. Farm Management Plan

5.1 Farm Size

For the project implementation, the rice field will be expanded from 2,790 ha to 8,300 ha in the Alternative A plan and from 2,590 ha to 7,000 ha in the alternative B plan. The farm size of rice cultivation area is assumed at 2.5 ha (40 tarea).

5.2 Cropping System

In the long term target, double cropping of rice with improved varieties except for the areas of left bank of the Guayabo River and right bank of Caño Gran Estero will be introduced fully in the Alternative A. The single cropping with the local varieties which will be harvested twice by means of ratooning will be introduced in the areas of left bank of the Guayabo River and right bank of Caño Gran Estero. In the Alternative B, double cropping with improved varieties will be introduced throughout the area. The transitional cropping pattern during the medium term target is as described previously.

Yautia pipiota cropping area may be expanded outside the irrigation area after project construction because additional lands to plan the crop will be available through improvement of drainage and transportation conditions.

5.3 Mechanization and Labor Balance

5.3.1 Mechanization Plan

Farm mechanization plan is formulated as follows;

(1) Basic Plan of Farm Mechanization

With the increase of cropping intensity after the irrigation project, cropping operation should adhere to the water management schedule. This is the main reason why farm mechanization will be

required after the irrigation project. Other purposes of mechanization are the decrease of yield losses caused by the delay of farm operation and also the losses in quality by no on-farm drying of paddy.

Under the present condition that limited number of machinery are introduced in the project area, it is recommendable that partial mechanization will be introduced with a minimum number of machinery for the supplemental use of animal power and man power. The maximum use will be made with the minimum number of machinery by applying collective use of machinery among farmers' groups or contractor-base use of machinery, following the proposed farm operation systems which is indicated in Fig. I.5.1. Besides 4-wheel tractors, it is planned that three kinds of small farm machinery, power tillers, threshers and driers will be introduced.

(2) Farm Machinery Selection and Area Coverage

There are two recommended farm operation methods for rice cultivation. One is semi-mechanization by using 4-wheel tractors and related machinery, and the other is semi-mechanization by using power tillers and related machinery. The selection of farm machinery and the estimated area coverage of mechanization in these two farm operation methods are as follows:

Area Coverage of Farm Mechanization by Operation

Operation	Selected Machineries		Degree of Mechanization (%)
	Machinery	Attachment	
1. Land preparation	4-wheel tractor (60-70HP Diesel)	Disc Harrow (2.0 m)	50
2. Land preparation	Power tiller (10-12HP Diesel)	Rotary (0.70m) Harrow (1.5 m)	50
3. Threshing	Power thresher (Axial flow, 5-6HP)		100
4. Drying	IRRI vertical bin batch (2.2-ton, 5HP Gasoline engine)	- (Supplemental drying)	100

The capacity and efficiency of the selected machinery are shown in Table I.5.1.

(3) Farm Machinery Requirement

The number of the selected machinery is computed below with assumption that the required number of machinery will be introduced in each turnout service area (average size = 40 ha) except for the 4-wheel tractors, applying the operation efficiency of the selected machinery in Table I.5.1.

1) 4-Wheel Tractor

One unit of 4-wheel tractors will be used in each four turnout service areas (average size = 40 ha x 4) as follows;

Mechanized area:

80 ha = 40 ha x 4 x 50% (Degree of mechanization)

Efficiency: 0.8 days/ha/unit
(two passings per time x 2 times)

Workable days: 62 days = 65 days x 95%
where, 65 days ... land preparation period
(50 days + 15 days)
95% ..... assumed ratio of workable days

Required unit per 4 turnout service areas:
0.8 ha x 0.8 days/ha ÷ 62 days = 1 unit

2) Power Tiller

One unit of power tiller are required in each turnout service area as follows;

Mechanized area: 20 ha = 40 ha x 50%
(Degree of mechanization)
Efficiency : 2.9 days/ha/unit
(Plowing & soil breaking)

Workable days : 62 days = 65 days x 95%
where, 65 days ... land preparation period
95% ..... assumed ratio of workable days
Required unit per turnout service areas:
* 20 ha x 2.9 days/ha ÷ 62 days = 1 unit

Note: * ... 2.9 days = 1.6 days (Plowing) +
1.3 days (First harrowing)

3) Thresher

Two units of power threster will be operated for 100 percent of the expected paddy production in each turnout service areas as follows;

Power Thresher

Mechanized area: 40 ha = 40 ha x 100%
(Degree of mechanization)
Efficiency : 2.2 days/ha unit
Workable days : 42 days = 50 days x 85%
where, 50 days ... harvesting period
85% ..... assumed ratio of workable days
Required unit per turnout service areas:
40 ha x 2.2 days ÷ 42 days = 2.0 units

4) Dryer

To assure the quality of paddy it is recommendable to dry the threshed paddy by half (up to 18 percent of moisture content) at on-farm level. For the purpose, one unit of dryer is required;

Area coverage : 40 ha = 40 ha x 100%
(Degree of mechanization)
Efficiency : Paddy 4.4 tons/day
= 2.2 tons/bin x 2 rotations/day
Workable days : 45 days = 50 days x 90%
Required unit per one turnout service area:
40 ha x 5.0 ton/ha ÷ (45 days x 4.4 tons/day) = 1 unit

5.3.2 Machinery Cost

The machinery cost per ha for rice cultivation is estimated as follows:

Fixed cost : RD$99
Variable cost: RD$134
Total RD$233/ha (see Tables I.5.2 and I.5.3)

Note: Above figures mean average machinery costs for the every case of farm mechanization.

The average cost of draft animal is estimated at RD$48 for 8 animal-days per hectare.

5.3.3 Labor and Draft Animal Requirement

The labor and draft animal requirement of the project crops are estimated in Tables I.5.4 and I.5.5.

5.3.4 Farm Labor Balance

Assuming that 2.0 men of the converted labor force will be available per farm on the average in the project area, the farm labor balance between supply and requirement was estimated for the average farm (2.5 ha), as shown in Table I.5.6. The existing low employment opportunities will be improved to a considerable extent with increase of labor requirement and more equitable distribution of monthly distribution of labor requirement and will balance the available labor force in the project area where the utilization of under-employment labor force in the project area (mostly landless farm laborers) and in the surrounding area of the project cover the slight labor shortage.

TABLE I.2.1 CHARACTERISTICS OF RICE VARIETIES

Variety	Plant Height (cm)	Growth Period: Transplanted (Summer) (day)	Growth Period: Transplanted (Spring) (day)	Growth Period: Direct-seeded (Summer) (day)	Growth Period: Direct-seeded (Spring) (day)	Potential Yield (ton/ha)
1. Improved, medium maturing						
- Juma 57	85	150	160	140	150	5.5
- Juma 58	92	160	170	150	160	5.8
2. Improved, early maturing						
- ISA 40	88	130	140	120	130	5.5
- Tanioka No.5	105	130	140	120	130	5.0
*- J282-30-1-25	95	120	130	110	120	
*- J276-43-15	92	125	135	115	125	5.5-5.8
*- IR2153-276-1--1 10 PR 509	89	120	130	110	120	
3. Local						
- Mingoro	> 150		150			4.9
- Toño Brea	> 150		150			4.9

Note : * ..... Under the approvement by SEA as the recommendable varieties.

Source: CEDIA, Bonao

TABLE I.4.1 RICE YIELD IN THE PROGRESSED AREA (IAD SETTLEMENT AREAS)

Year	Jarabacoa				Bonao (Juma)				El Pozo			
	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)	Planted Area (tarea)	Harvested Area (tarea)	Unit Yield (qq/tarea)	Production (qq)
1980	2,235	1,805	7.01	12,654	-	-	-	-	51,900	48,948	5.37	262,763
1981	2,350	1,200	7.33	8,798	21,507	21,507	6.11	131,441	62,767	47,596	4.71	223,704
1982	2,254	2,254	7.95	17,999	21,119	21,119	6.79	143,536	*10,284	*8,770	6.20	*54,421
1983	2,448	703	8.34	5,864	21,374	20,605	6.36	131,143	*14,699	*14,699	7.01	102,947
1984	3,464	1,941	8.07	15,666	28,168	19,022	5.90	112,256	*13,655	*13,188	6.42	*84,769
Mean	2,550	1,581	7.71	12,196	18,434	16,451	6.30	103,675	30,661	26,640	5.47	145,721
									*12,879	*12,219	6.61	*80,712
	(5.6 ton/ha)				(4.5 ton/ha)				(3.9, *4.7 ton/ha)			

Note : * .... Colectivo only
Source: IAD Boletin Informativo Annual (1981 - 1985)

TABLE I.4.2 RICE PRODUCTION

Area/Land Class	Present			Medium Term Plan			Long Term Plan		
	Harvested Area (ha)	Yield (ton/ha)	Production (ton)	Harvested Area 1/ (ha)	Yield (ton/ha)	Production (ton)	Harvested Area 1/ (ha)	Yield (ton/ha)	Production (ton)
1. Alternative A	3,420	2.5	8,550	12,400		42,700	15,500		63,600
- 1R, Improved				5,800	3.8	22,040	5,800	5.0	29,000
- 2R, Improved				2,400	3.4	8,160	4,800	4.0	19,200
- 2R, Local				1,200	3.6	4,320	-	-	-
- 3R, Local				1,900	2.8	5,320	-	-	-
- 3R, Improved				-	-	-	3,800	3.2	12,160
- 4R, Local				1,100	2.6	2,860	1,100	3.0	3,300
2. Alternative B	3,050	2.5	7,625	11,000		38,800	14,000		58,760
- 1R, Improved				5,800	3.8	22,040	5,800	5.0	29,000
- 2R, Improved				2,200	3.4	7,480	4,400	4.0	17,600
- 2R, Local				1,100	3.6	3,960	-	-	-
- 3R, Local				1,900	2.8	5,320	-	-	-
- 3R, Improved				-	-	-	3,800	3.2	12,160

Note: 1/ The respective planted area is equal to the harvested area.

TABLE I.5.1 CAPACITY AND EFFICIENCY OF MACHINERIES/DRAFT ANIMAL BY OPERATION

Operation/Machinery & Animal	Ope. Width (1) (m)	Ope. Speed (2) (km/hr)	Theoretic Ope. Capacity (3) (ha/hr)	Field Efficiency 1/ (4) (%)	Field Ope. Capacity (5)=(3)x(4) (ha/hr)	Ope. Efficiency (6) (%)	Actual Ope. Capacity (7)=(5)x(6) (ha/hr)	Hours per ha (8) (hr/ha)	Times (9) (Time)	Hours per ha (10)=(9)x(8) (hr/ha)	Ope. Hours per day (11) (hr/day)	Days per ha (12)=(9)/(11) (day/ha)
1. Plowing, Power Tiller W/ Rotary	0.67	1.6	0.107	89	0.095	80	0.076	13.1	1	13.1	8	1.6
2. Plowing, 4-wheel Tractor W/ Disc Harrow	2.00	5.2	1.040	78	0.811	85	0.690	1.4	2	2.8	8	0.4
3. Soil Breaking, Power Tiller	0.67	2.0	0.134	89	0.119	80	0.095	10.5	1	10.5	8	1.3
4. Final/Harrowing, Bullock W/Harrow/Leveler	1.0	2.4	0.240	80	0.192	70	0.134	7.5	3	22.5	8	2.8
5. Final Harrowing, Power Tiller W/Harrow/Leveler	1.4	3.2	0.448	82	0.367	80	0.294	3.4	2	6.8	8	0.9
6. Threshing, Power Thresher	-	-	0.122 (0.5 ton)	82	0.100 (0.4 ton)	80	0.064 (0.3 ton)	15.6	1	15.6	7	2.2
7. Drying, Drier	-	-	-	-	0.060 (0.33 ton)	80	0.048 (0.33 ton)	20.8	1	20.8	17	1.2
8. Hauling, Carabao with Cart	-	2.5	(0.2 ton)	80	(0.16 ton)	70	(0.11 ton)					

Note: 1/ ... Such losses in the fields as turning of machineries, adjustment of machineries, etc. are deducted from theoretical capacity.

2/ ... Such losses happening outside the fields as transportation of machineries between garage and fields, inspection of machineries just before operation (min. 10 minutes), fixing and removal of machineries with putting lubricant oils (min. 30 minutes) etc. from the field operation capacity.

TABLE I.5.2 FARM MACHINERY COST (FIXED COST)

Machinery	(1) Aquisition (RD$)	(2) Life Span (year)	(3) Depreciation Cost 1/ (RD$/year)	(4) Repair Cost (RD$/year)	(5) Other Fixed Cost 2/ (RD$/year)	(6) Total Cost (RD$/year)	(7) Coverage per Unit (ha)	(8) Total Cost per ha (RD$)	(9) Area Coverage (%)	(10) Fixed Cost per ha (RD$)
4-wheel tractor	100,000	10	9,000	8,000 (8%)	1,000	18,000	800 hr/ year	23/hr	50	64
Power tiller	6,500	5	1,170	520 (8%)	65	1,755	20.0hax2.0 4/	44	50	22
Powered thresher	1,850 3/	8	208	56 (3%)	19	283	40.0hax2.0 4/	4	100	4
Dryer	4,000	8	450	200 (5%)	40	690	40.0hax2.0 4/	9	100	9
Total										99

Note: 1/ ... Computed as (1) x 0.9/(2)
2/ ... Computed as (1) x 0.01
3/ ... Price without engine because the engine of hand tractor can be used for thresher
4/ ... Cropping intensity of rice

TABLE I.5.3 FARM MACHINERY COST (VARIABLE COST)

Operation/Machinery	(1) Ope. hours per ha (hr/ha)	(2) Fuel Consumption (lit.hr)	(3) Fuel (lit.)	(4) Unit Cost (RD$/lit.)	(5) Cost of Fuel (RD$/ha)	(6)=(5)x1.3 Cost Inclusive of Oil (RD$/ha)	(7) Area Coverage (%)	(8) Variable Cost per ha (RD$)
1. Plowing, 4-wheel tractor	2.8	D. 4.0	11.4	1.0	11.4	14.8	50	7
2. Soil breaking, 4-wheel tractor	2.8	D. 4.0	11.4	1.0	11.4	14.8	50	7
3. Plowing, power tiller + rotary	13.1	D. 1.5	19.7	1.0	19.7	25.6	50	13
4. 1st harrowing, power tiller + harrow	10.5	D. 1.0	10.5	1.0	10.5	13.7	50	7
5. Threshing, powered thresher	12.5	D. 1.0	12.5	1.0	12.5	16.3	100	16
6. Drying, drier	16.6	G+0 1.5 K 2.7	G+0 24.9 K 44.8	1.0 1.0	24.9 44.8	32.4 58.2	100	91
Total								134

Note: D .... Diesel
G .... Gasoline
K .... Kerosene

TABLE I.5.4 LABOR REQUIREMENT, RICE, TRANSPLANTED

(Unit: man-day/ha)

Operation	W/Project, Future[1] Man-day	W/Project, Future[1] Animal-day	W/Project, Future[2] Man-day	W/Project, Future[2] Machinery
1. Seed-bedding				
a. Land Preparation/ Sowing	1.2	1.0	1.2	1.0
b. Care of Seedings	1.5	-	1.5	-
Sub-total	2.7	1.0	2.7	1.0
2. Land Preparation				
a. Cleaning/dike Mending	3.0	-	3.0	-
b. Plowing	(1x)1.6	1.6	(2x)0.4	0.4
c. Breaking/Harrowing	(1x)1.3	1.3	(2x)0.4	0.4
d. Final Harrowing/ Leveling	(3x)2.8	2.8	(3x)2.8	2.8
Sub-total	8.7	5.7	6.6	3.6
3. Planting				
a. Pulling/Deliver of Seedlings	7.5	0.5	7.5	0.5
b. Furrowing/Planting/ Thinning	20.0	-	20.0	-
Sub-total	27.5	0.5	27.5	0.5
4. Fertilizing				
a. Basal Fertilizers	1.5	0.4	1.5	0.4
b. Top-dressing	1.5	0.4	1.5	0.4
Sub-total	3.0	0.8	3.0	0.8
5. Pest Control	3.5	2.0	3.5	2.0
6. Cultivation/Weeding	10.3	-	10.3	-
7. Irrigation/Drainage	5.0	-	5.0	-
8. Harvesting				
a. Reaping/Plucking/ Bundling	17.7	-	17.7	-
b. Hauling/Piling	3.8	1.9	3.8	1.9
c. Threshing/Winnowing	6.3	2.1	6.3	2.1
Sub-total	27.8	4.0	27.8	4.0
9. Post Harvesting				
a. Drying	1.2	2.2	1.2	2.2
b. Saching/Piling/ Delivery	3.0	1.0	3.0	1.0
Sub-total	4.2	3.2	4.2	3.2
10. Total 3/	92.7	17.2(8.0)	90.6	15.1(8.0)

Remarks: 1/ ..... Semi-mechanized by power tiller
2/ ..... Semi-mechanized for four wheel tractor
3/ ..... The figures in the parenthesis; Draft animal

TABLE I.5.5 LABOR REQUIREMENT, RICE DIRECT SEEDED

(Unit: man-day/ha)

Operation	W/Project, Future 1/ Man-day	W/Project, Future 1/ Animal-day	W/Project, Future 2/ Man-day	W/Project, Future 2/ Machinery
1. Seed-bedding				
a. Land Preparation/ Sowing	-	-	-	-
b. Care of Seedings	-	-	-	-
Sub-total	-	-	-	-
2. Land Preparation				
a. Cleaning/dike Mending	3.0	-	3.0	-
b. Plowing	(1x)1.6	1.6	(2x)0.4	0.4
c. Breaking/Harrowing	(1x)1.3	1.3	(2x)0.4	0.4
d. Final Harrowing/ Leveling	(3x)2.8	2.8	(3x)2.8	2.8
Sub-total	8.7	5.7	6.6	3.6
3. Planting				
a. Pulling/Deliver of Seedlings	-	-	-	-
b. Furrowing/Planting/ Thinning	4.0	0.5	4.0	0.5
Sub-total	4.0	0.5	4.0	0.5
4. Fertilizing				
a. Basal Fertilizers	1.5	0.4	1.5	0.4
b. Top-dressing	1.5	0.4	1.5	0.4
Sub-total	3.0	0.8	3.0	0.8
5. Pest Control	3.5	2.0	3.5	2.0
6. Cultivation/Weeding	5.0	-	5.0	-
7. Irrigation/Drainage	7.0	-	7.0	-
8. Harvesting				
a. Reaping/Plucking/ Bundling	17.7	-	17.7	-
b. Hauling/Piling	3.8	1.9	3.8	1.9
c. Threshing/Winnowing	6.3	2.1	6.3	2.1
Sub-total	27.8	4.0	27.8	4.0
9. Post Harvesting				
a. Drying	1.2	2.2	1.2	2.2
b. Saching/Piling/ Delivery	3.0	1.0	3.0	1.0
Sub-total	4.2	3.2	4.2	3.2
10. Total 3/	63.2	16.2(8.0)	61.1	14.1(8.0)

Remarks: 1/ ..... Semi-mechanized by power tiller
2/ ..... Semi-mechanized for four wheel tractor
3/ ..... The figures in the parenthesis; Draft animal

TABLE I.5.6 FARM INPUT REQUIREMENT FOR LONG TERM TARGET

Crop	Seeds (kg/ha)	Fertilizers 16-24-12 (kg/ha)	Fertilizers 46-0-0 (kg/ha)	Pesticides Quantity	Pesticides Chemicals	Herbicides Quantity	Herbicides Chemicals
1. HYV, transplanted	45	231	76	W.P 0.5 kg G 41.5 kg	Benlate Fradan 5G	E.C 2.5 lit.	Butachlor + 2,4D Amine
2. HYV, direct-seeded	100	218	76	W.P 0.5 kg G. 21.5 kg	Benlate Fradan 5G	E.C. 2.5 lit. E.C. 2.0 lit.	Butachlor + 2,4D Amine 2,4D, Amine 40%
3. Local, transplanted (Ratooning)	50	203	82	W.P 0.5 kg G. 31.5 kg	Benlate Fradan 5G	E.C. 2.0 lit.	2,4D, Amine 40%

Note: Application of calcium carbonate at the rate of 1,000 kg/ha will be required once every two croppings to grow rice in A3 or the lower classes land area besides above inputs.