(i) Maintenance of pump facilities, (ii) service roads, (iii) inlet channel to the pump, (iv) irrigation/drainage canal, (v) sub-station and (vi) transmission line.

The number and kind of O&M equipment were determined from the standpoint of operation efficiency, ease of operation and low operation cost taking account of the width of canals and service roads, and the locations of pump stations.

Reinforcement of spareparts for elements of the existing and newly purchased equipment was planned for increasing their workability.

The number and kind of the proposed equipment for each irrigation system are summarized in Table 5.

4.4.6 Training Programme

In the framework of reinforcing institutional aspects, quality improvement of O&M staff and farmers in the systems is one of the most important factors to improve system management of the irrigation systems. Details are explained in ANNEX-E.

(1) Objectives

The O&M training programmes were planned to expand the knowledge, understanding and practical ability of the O&M staff and farmers. For O&M staff emphasis was put on training for (i) understanding of duty and responsibility of the job, (ii) meteo-hydrological measurements and (iii) understanding of the basic knowledge and skill of O&M staff, in water management. For farmers the training would focuse on (i) leadership of directors of the irrigator's association and (ii) basic knowledge and self-reliance on water management.

(2) Training Methods

The training methods to be used in the programmes would include (i) lectures and field practice, (ii) workshops and (iii) field visit. It was planned to organize field visits to the existing pump irrigation systems of Bustos-Pandi, Buenavista and Tibagan in the Angat-Maasim River Irrigation System which are one of the most successful irrigation systems in water management among the pump irrigation systems in the country.

(3) Training Modules and Materials

The training materials to be used will include (i) trainer's handbook, (ii) training modules, (ii) trainer/trainee note and (iv) practical exercises.

(4) Trainers and Trainees

Trainers to be engaged in the training of O&M staff and farmers will be composed of professional members of the NIA central office. Foreign and local consultants will assist these trainers.

The proposed number of trainers and trainees in O&M staff training and farmer's training are summarized below:

Name of System	O&M Staff's Training Trainee WM	DT	PO	Trainer	Farmer's Training Trainee	Trainer
Bonga Pump #1 IS	1	0	1	2	451	15
Bonga Pump #2 IS	1	0	1	2	530	18
Bonga Pump #3 IS	1	0	1	2	22	1
Alcala-Amulung Pump IS	2	6	2	3	643	22
Solana Pump IS	-	-	-	-	438	15
Libmanan-Caubsao Pump IS	3	11	1	3	370	13

WM: watermaster, DT: ditchtender, PO: pump operator

(5) Training Curriculum and Programmes

Training curriculum for O&M staff was prepared to meet the requirement of the training objectives.

The standard curriculum for watermasters, ditchtenders and pump operators is shown in Tables 6, 7 and 8, respectively. The curriculum for farmer's training comprises three kinds as shown in Tables 9, 10 and 11.

The training programmes will be undertaken during the first year of the implementation period. The curriculum for each O&M staff requires one week. Each of the curriculum for the farmers needs four days.

These trainings are recommended to be carried out in the following training institutions:

Name of System	Training Institutions
Bonga #1, #2, #3	Mariano Marcos University
Solana/Alcala-Amulung	Agricultural Training Institute, RTC
Libmanan-Cabusao	PCAR Training Center, Camarines Sur State Agricultural College

4.5 Farm Management Plan

4.5.1 Basic Concept

The basic concept of farm management for the pump systems is to increase farm income through full utilization of land and water resources for increase of agricultural production. Considering the above basic concept, the strategies of farm management plan for the pump systems were worked out on the following basis:

1) The unit yield and production of crops should be increased and stabilized through introduction of improved irrigated farming, and

2) The year-round irrigation area should be expanded as much as possible and thereby the cropping intensity be increased.

4.5.2 Land Use and Cropping Pattern

The irrigation project will provide a base for increasing the unit yield of crops and crop production through completion of pump, irrigation, drainage and related facilities. After implementation of the project, the present land use conditions will change considerably as follows:

(Unit: ha)

Name of System	"With Project"					"Without Project"				
	Paddy Field				SC	Paddy Field				SC
	Wet		Dry			Wet		Dry		
	I	R	I	R		I	R	I	R	
Bonga Pump #1 IS	426	0	426	0	0	0	426	0	0	0
Bonga Pump #2 IS	634	0	634	0	40	0	634	0	0	40
Bonga Pump #3 IS	187	0	187	0	15	0	187	0	0	15
Alcala-Amulung Pump IS	2,158	0	2,158	0	0	803 *	1,355	1,006 *	0	0
Solana Pump IS	1,960	0	1,960	0	0	0	1,960	0	0	0
Libmanan-Cabusao Pump IS	3,085	0	3,085	0	0	0	3,085	0	0	0

Remarks: * = After expiration of the useful life of pump equipment, these lands will become rainfed lands.
I = Irrigated, R = Rainfed, SC = Sugar cane

In formulation of the proposed cropping pattern for each irrigation system, the following basic principles were applied:

(i) The cropping pattern must create maximum benefits for the farmers as well as the nation as a whole,

(ii) The cropping pattern should be practical in view of the number of available labor force in each system, and

(iii) The cropping pattern must conform to the existing social tradition and be acceptable to the farmers.

In consideration of the above basic principles, paddy is selected as the main crop for the proposed crópping pattern of all pump systems. In addition to paddy, garlic and tomato were selected as diversified crops for the Bonga #1, #2 and #3 pump systems taking account of the farmers' intention, soils, marketability of crops, profitability of crops and farmers' ability in cultivation of crops. The sugar cane farmers in the Bonga #2 and #3 pump systems intend to continue the present cropping pattern even the project will be implemented.

The proposed cropping patterns for each irrigation system are shown in Fig. 8.

4.5.3 Proposed Farming Practice

Proper farming practice is the most essential factor for realizing full exploitation of the agricultural potential in the systems. For this purpose high-yielding and/or improved varieties will be introduced. Proper amounts of fertilizer and chemicals will be applied through proper farming practices under "with project" condition. It is, however, expected that there will be no substantial changes in farming practices and farm inputs for future "without project" conditions.

The recommended farm inputs per ha in future "with project" condition are shown below. Details of farming practices are described in section 3.4, ANNEX-D

Items		Paddy		Tomato	Garlic
		Wet	Dry		
Seed (kg)		50	50	0.3	500
Fertilizer:	N (kg/ha)	75	80	100	120
	P (kg/ha)	35	35	85	100
	K (kg/ha)	35	35	85	100
Chemicals	(liter/ha)	13	13	8	5
Labor	(man-day)	125	135	209	206
Animal	(animal-day)	10	10	0	0
Machine	(machinery-day)	0.5	0.5	0.5	0.5

4.5.4 Anticipated Yield and Production of Crops

After completion of the project, the yield of crops will increase and attain the anticipated level through supply of sufficient irrigation water and application of proper farming practices. The anticipated yield of crops under "with project condition" was estimated on the basis of the experimental data obtained from the authorities concerned as well as from the farm economic survey on the assumption of proper operation of governmental agricultural support services such as extension, agricultural credit, and so on. The yield of crops under "without project" condition was estimated to be as same as in the present condition. The anticipated yields of crops under both "with and without" project conditions are summarized as follows:

(Unit: ton/ha)

Crops	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
"With Project"						
Irrigated Paddy						
Wet	4.5	4.5	4.5	4.5	4.5	4.5
Dry	5.0	5.0	5.0	5.0	5.0	5.0
Garlic	4.5	4.5	4.5	-	-	-
Tomato	10.0	10.0	10.0	-	-	-
Sugar cane	-	40.0*	27.0*	-	-	-
"Without Project"						
Irrigated Paddy						
Wet	-	-	-	3.3**		-
Dry	-	-	-	3.5**		-
Rainfed Paddy	2.3	2.4	2.3	1.8	2.0	2.0
Garlic	-	-	-	-	-	-
Sugar cane	-	40.0	27.0	-	-	-
Corn	-	-	-	-	1.0	-

Remarks: * = Because the same farming practices and farm inputs are proposed due to intention of the sugar cane farmers

** = After expiration of the useful life of pump equipment, these yields will become as the same as those under rainfed condition.

The anticipated production of crops in the systems was estimated on the basis of proposed land use, cropping pattern and the anticipated yield of crops as follows:

(Unit: ton)

Crops	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
Paddy	3,550	5,350	1,580	20,500	18,620	29,310
Garlic	45	180	68	-	-	-
Tomato	900	950	250	-	-	-
Sugar cane	-	1,600	410	-	-	-
(Basi)	-	(600)	(150)	-	-	-

4.5.5 Marketing and Price Prospect

The market surplus of agricultural crops at the full development stage in the municipalities related to each irrigation system was estimated. Details are shown in section 3.6, ANNEX-D.

The surplus of paddy marketed from municipalities related to the systems under the present and future "with project" conditions is shown on the next page:

(Unit: ton)

Name of System	Present	"With Project" Condition
Bonga Pump #1 IS	-3,660	-2,110
Bonga Pump #2 IS	-7,010	-7,070
Bonga Pump #3 IS	-5,070	-6,320
Alcala-Amulung Pump IS	900	10,830
Solana Pump IS	-510	8,470
Libmanan-Cabusao Pump IS	15,700	29,560

It is considered that such surplus of paddy in future "with project" condition can be consumed by the existing market in Region IV (including Metro Manila). The average demand for paddy to be provided to this region from outside was estimated to be 1.21 million tons. The project surplus would represent only a few percent of the demand in Region IV, and this fact suggests the big potential for outlet of this surplus.

Production of garlic in Region II (including Bonga Pump #1, #2 and #3) represents about 60% of the total production of the country. The price of garlic is so sensitively affected by production that overproduction might bring about a decline in price.

Production of garlic under future "with project" conditions was planned to remain at the same level as at present in the irrigation systems. Garlic production is expected to outflow in the future through the existing market channel.

Tomatoes produced in the Bonga pump #1, #2 and #3 systems were planned to be supplied to the 480 tons/day processing plant in Sarrat. It was conservatively estimated that 15% of the processing capacity of the plant would be covered by the above three systems.

For evaluation of the project, the economic prices of farm inputs and outputs at farm gate were estimated as follows. Details are shown in ANNEX-G.

(Unit: Peso)

Item	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
Outputs						
Paddy (kg)	3.77	3.77	3.77	3.85	3.85	3.76
Garlic (kg)	14.81	14.81	14.81	-	-	-
Tomatoes (kg)	3.42	3.42	3.42	-	-	-
Basi (liter)	-	1.32	1.32	-	-	-
Corn (kg)	-	-	-	-	4.08	-
Inputs						
Seed (kg)						
Paddy	6.23	6.23	6.23	5.41	5.41	5.14
Garlic	41.50	41.50	41.50	-	-	-
Tomato	2,916	2,916	2,916	-	-	-
Fertilizers (kg)						
Nitrogen (N)	13.52	13.52	13.52	13.55	13.55	13.49
Phosphate (P)	25.47	25.47	25.47	25.13	25.13	25.40
Potassium (K)	7.06	7.06	7.06	6.91	6.91	7.03
Agro-chemicals (liter)						
Insecticide	109.10	109.10	109.10	111.42	111.42	122.26
Weedicide	98.79	98.79	98.79	105.58	105.58	111.22
Rodenticide	125.3	125.3	125.3	106.00	106.00	111.03
Labor (man-day)	18.00	18.00	18.00	12.00	12.00	15.00
Animal (animal-day)	49.80	49.80	49.80	41.50	41.50	41.50
Machine (machine-day)	332.00	332.00	332.00	224.10	215.80	273.90

4.5.6 Crop Income and Irrigation Benefit

Irrigation benefit to be expected is defined as the difference of primary profit from crops between future "with" and "without project" conditions. On the basis of the estimated production cost and gross income, primary profit per ha of crop was calculated both under "with" and "without project" conditions as follows:

(Unit: Pesos/ha)

Crops	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
With Project						
Paddy						
- Wet	10,184	10,184	10,184	11,464	11,469	10,542
- Dry	11,821	11,821	11,821	13,202	13,206	12,205
Diversified Crop						
- Garlic	36,600	36,600	36,600	-	-	-
- Tomatoes	24,408	24,408	24,408	-	-	-
- Sugar cane	-	14,037	9,083	-	-	-
Without Project						
Paddy						
Irrigated						
- Wet	-	-	-	9,548	-	-
- Dry	-	-	-	10,236	-	-
Rainfed	5,286	5,598	5,297	4,753	5,291	4,997
Diversified Crop						
- Sugar cane	-	14,037	9,083	-	-	-
- Corn	-	-	-	-	3,272	-

Applying the primary profit per crop estimated to crop area, the total primary profits accrued from agricultural production by the project were estimated both under "with" and "without project" conditions. Based on this result the irrigation benefit at the full development stage was calculated as summarized below:

(Unit: 1,000 Pesos)

Crops	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
With project	10,755	16,700	4,938	53,226	48,363	70,174
Without project	2,252	4,111	1,127	10,257	9,579	10,968
Irrigation benefit	8,503	12,589	3,811	42,972	38,784	59,206

4.5.7 Farmer's Income

After completion of the project, perennial irrigation will become available for farmers, resulting in an increase in unit yield of crops and cropping condition. Under such situation, a significant increase of farm income can be expected for the farmers in the systems. The income of typical farmer under "with" and "without project" conditions is presented below: Details are explained at Table 3.10, ANNEX-D.

(Unit: 1,000 Pesos)

	Bonga #1	Bonga #2	Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
Farm Size (ha)	0.21	0.27	0.49	0.82	0.99	2.04
Tenurial Status	Owner	Tenant	Tenant	Owner	Tenant	Tenant
"With Project"						
Net income	16.5	18.2	22.3	22.3	26.5	37.8
farm income	8.9	9.8	15.1	18.0	21.4	34.4
non-farm income	7.7	8.5	7.2	4.3	5.2	3.4
Living expense	13.6	14.5	15.3	17.8	16.0	18.4
Tenant fee/Land tax	0.0	1.8	3.2	0.1	3.7	2.8
Net reserve	2.9	1.9	3.8	4.3	6.8	16.6
Irrigation fee (IF)	0.7	0.9	1.7	2.2	4.9	4.3
Difference (Net reserve-IF)	2.2	1.0	2.1	2.1	1.9	12.3
"Without Project"						
Net income	12.8	14.2	13.5	12.7	13.7	14.6
farm income	4.6	4.6	5.4	7.3	6.9	8.8
non-farm income	8.3	9.6	8.0	5.5	6.8	5.8
Living expense	11.9	13.6	10.8	12.5	12.7	12.3
Tenant fee/Land tax	0.0	0.4	0.7	0.0	0.8	1.9
Net reserve	0.9	0.2	2.0	0.1	0.1	0.4

Net farm income of an average size farmer in each system under "with project" condition is expected to be around 2 to 4.5 times that under "without project" condition. The annual net reserve or capacity-to-pay under "with project" condition will, therefore, be much larger than that under "without project" condition. However the rate of irrigation service fee is extremely high as compared with net reserve, especially in case of a small size farmer.

4.6 Mini-Hydropower Development Plan

4.6.1 General

The mini-hydropower development plans were studied for Site No.1, Site No.2 and a combination of site No.1 and No.2. The location of the sites is shown on the location map.

The basic concept of the mini-hydropower development projects at the sites is:

(i) to generate economic electric power and

(ii) to sell all the electric power generated to NAPOCOR through the existing Tabuk sub-station.

4.6.2 Optimum Development Plan

In order to determine the optimum scale of the mini-hydropower development plant at sites No.1 and No.2, the least construction cost per kWh of each site was examined for four alternative discharges with consideration of fluctuation in canal discharge as shown in Table 12.

As a result, the optimum scale of the installed capacity was decided at 700 kW and 770 kW for Site No.1 and No.2, respectively.

4.6.3 Mini-Hydropower Development Plan

(1) Arrangement of Power Distribution System

The electric power generated by the mini-hydropower plant at No.1 and No.2 sites was planned to be sent to Tabuk sub-station via 13.8 kV transmission line to be installed by NIA and can be consumed in the service area of CAGELCO and Tuguegarao through NAPOCOR's 69 kV transmission line.

(2) Features of the Mini-Hydropower Plants

The features of the mini-hydropower plants at sites No.1 and No.2 are summarized in the next page:

Features	Site No.1	Site No.2
Maximum discharge (m^3/sec)	4	12
Effective height of drop (m)	22.10	8.55
Expected output (kW)	700	770
Annual possible power generation (MWh)	4,500	5,062

(3) Specification of Mini-Hydropower Plants

Specifications of the main mini-hydropower plants are summarized below:

Item	Site No.1	Site No.2	Combination
A. Water turbine			
1. type	HF-1RS*	HF-1RS*	-
2. effective head (m)	22.1	8.55	-
3. discharge (m^3/sec)	4.0	12.0	-
4. output (kW)	736	845	-
5. speed (rpm)	600	165	-
B. Generator			
1. type	SG**	SG**	-
2. output (kVA)	778	855	
3. output (kW)	700	770	-
4. speed (rpm)	600	900	-
5. voltage (kV)	3.3	3.3	-
6. power factor	0.9	0.9	-
7. frequency (Hz)	60	60	-
8. increaser ratio	N/A	5.5	-
C. Transformer			
1. rated capacity (kVA)	800	900	1,600
2. rated frequency (Hz)	60	60	60
3. rated voltage 1st (kV)	3.3	3.3	13.8
4. rated voltage 2nd (kV)	13.2	13.2	69
5. cooling	ONAN***	ONAN***	ONAN***

*: horizontal shaft Francis type one runner
**: synchronous generator with salient pole revolving field type
***: oil immersed natural air cooled

(4) Arrangement of Mini-Hydropower Plants

The arrangement of the mini-hydropower plant for No.1 and No.2 sites with plan and profile is shown on Fig. 9 for No.1 site and Fig. 10 for No.2 site. These drawings show power house, penstock, intake facilities, tailrace and existing irrigation facilities.

(5) Arrangement of Tabuk Sub-station

The transmitted electricity is received by 13.8 kV switchgear and transformed to 69 kV voltage level by transformer and connected to 69 kV bus of the existing switchgear. The arrangement of equipment is shown in Fig. 11.

(6) Arrangement of 13.8 kV Transmission Line

The transmission line between No.2 site and Tabuk sub-station is joined by a branch from No.1 site 2.5 km from Tabuk sub-station. The transmission line is 18.5 km in total route length and passes along the Chico Main Diversion Canal for 16 km of its length and then 2.5 km across pasture. The route of the transmission line is shown in ANNEX-H.

(7) Proposed Works

The proposed works of the mini-hydropower developments are shown in Table 13.

CHAPTER 5

COST ESTIMATE

5.1 Basic Conditions and Assumptions for Cost Estimate

The project cost was estimated on the basis of preliminary design of the project facilities with the following assumptions:

(i) The exchange rate used in the estimate is:
US$ 1.00 = Peso 21 = Yen 135

(ii) Construction works will be executed on the contract basis. The construction machinery and equipment required for the construction will be provided by the contractors themselves.

(iii) The standard unit costs at April 1988 price level were applied.

(iv) The engineering and administration costs were assumed to be respectively 10% and 5% of the total sum of direct construction, procurement, compensation and training cost.

(v) Physical contingency was assumed to be 10% of the total sum of direct construction, procurement, compensation, training and engineering and administration cost, and

(vi) The price contingency was taken into account on the basis of an annual escalation rate of 10% for the local currency portion and 5% for the foreign currency portion.

5.2 Project Cost

The project cost of the irrigation systems comprises direct construction cost, cost of procurement of pumps, electrical equipment, operation and maintenance equipment, compensation cost, cost for training of O&M staff and farmers, engineering and administration cost and physical contingency.

The project cost of the mini-hydropower projects consists of cost of procurement of generating equipment, transformer and substation, penstock, intake gate, civil works, engineering and administration cost and physical contingency.

The project cost of each of the irrigation systems and the mini-hydropower development projects was estimated as shown in Tables 14 and 15 and summarized below:

(Unit: 10^3 peso)

Name of System	Project Cost	
	Direct Tapping from NAPOCOR	Tapping from Local Electric Cooperative
Bonga Pump #1 IS	25,288	19,430
Bonga Pump #2 IS	30,874	23,545
Bonga Pump #3 IS	14,375	12,911
Alcala-Amulung Pump IS*	30,100	-
Solana Pump IS	76,627	68,658
Libmanan-Cabusao Pump IS	63,596	51,215

* Power supply to this system was already made from NAPOCOR's grid.

(Unit: 10^3 peso)

Name of Sites	Project Cost
Site No. 1	52,844
Site No. 2	64,514
Combination	110,166

5.3 Fund Requirement

The estimated fund requirement for implementation of each of the systems as shown in Table 16 takes into account price escalation and the implementation schedule.

5.4 Operation, Maintenance and Replacement Costs

The annual operation and maintenance costs (O&M costs) for the project comprise personnel expenses, pump energy costs, fuel and lubricant cost and other expenses. The pump energy costs were estimated by applying the power rates of Peso 1.15/kWh in case of direct tapping from NAPOCOR and Peso 2.10/kWh in case of power supply from the local electricity cooperatives.

Pump and electrical equipment, gates/attachments, and O&M equipment have to be replaced at a certain period within 50 years of the project life. The economic useful life was assumed to be 35 years for sub-station and electrical equipment of pump facilities, 25 years for gates, 15 years for pump equipment and 10 years for O&M, monitoring and communication equipment.

The estimated annual cost of operation, maintenance and replacement for each of the systems is shown in Table 17. Details are presented in ANNEX-C. The estimated annual operation and maintenance cost for the mini-hydropower development projects are Peso 793×10^3 for Site No.1, Peso 968×10^3 for Site No.2 and Peso $1,652 \times 10^3$ for the combination.

CHAPTER 6

IMPLEMENTATION SCHEDULE AND EXECUTING ORGANIZATION

6.1 Implementation Schedule

The project works for each of the irrigation systems and mini-hydropower development were planned to be implemented over 3 years from 1990 to 1992 and over 2 years from 1990 to 1991, respectively. In 1990 detailed design, preparatory works for financial arrangements for implementation and training of O&M staff and farmers will be carried out for the irrigation projects. The actual construction works will be executed from 1991 to 1992. Details are explained in ANNEX-F. With respect to the mini-hydropower development, construction work will commence in 1990.

The basic consideration in implementing the project is that interruption of irrigation during the implementation period should be minimized. Replacement of the pumping facilities would be made during the irrigation cutoff period in the third year. Rehabilitation and/or improvement of the irrigation and drainage facilities would be carried mainly during the dry seasons in the second and third years.

6.2 Organization for Project Implementation

Implementation of the Project will be administrated by the National Irrigation Administration (NIA). It will be responsible for design, construction works and supervision of the project. A special project group will be organized under the Assistant Administrator for Systems Operation and Equipment Management, who will be responsible for execution of overall project works, and will undertake coordination among relevant government agencies in connection with implementation of the project. No new project execution office will be established in the field, but the relevant Regional Irrigation Offices will act as field offices in each case.

During the implementation of the project, the "System" status will be changed to "Project" status, under administration of NIA headquarters.

After completion of the project, the Bonga Pump #1, #2 and #3 systems will be turned over to the Ilocos Norte Irrigation Service office, the Alcala-Amulung system to the Iguig-Alcala Amulung Pump Irrigation System office, and the Libmanan-Cabusao system to the Libmanan-Cabusao Pump Irrigation System office, for their operation and maintenance. The Solana system will however, be directly turned over to the Irrigator's Association.

With respect to the mini-hydropower developments, the project will be turned over the Chico River Irrigation system Office.

CHAPTER 7

PROJECT EVALUATION

7.1 General

For the irrigation projects, project evaluation was carried out for the alternative areas of (i) the firmed-up service areas and (ii) the maximum service areas. The results of the evaluation indicate that economic viability of the irrigation area with the maximum service area is higher than that of the firmed-up service area. Details are shown in ANNEX-G.

In this chapter the economic evaluation of the irrigation systems is presented for the maximum service area under the following two conditions.

(i) Direct power supply from NAPOCOR (Direct tapping) and

(ii) Power supply from the existing local electricity cooperatives (Indirect tapping)

The evaluation of the mini-hydropower development projects was undertaken for three cases; (i) Site No.1, (ii) Site No.2 and (iii) a combination of Sites No.1 and No.2.

The project evaluation for the irrigation systems and mini-hydropower project has involved making an assessment of project feasibility from economic, financial and socio-economic aspects. The economic feasibility was first evaluated by calculating the internal rate of return. A sensitivity analysis was also made in order to elucidate the economic viability of the project against changes in the benefit, and project cost.

Financial evaluation was carried out by analysing the effect of the project on the farm economy of a typical farmer and by preparing the repayment schedule of the project capital cost.

The socio-economic impacts of implementation of the project were also briefly studied.

7.2 Economic Evaluation

7.2.1 Basic Assumption

The economic evaluation was made on the following basic assumptions:

(i) The economic useful life of the project is 50 years for the irrigation systems and 35 years for the mini-hydropower development.

(ii) All prices are expressed as constant 1988 prices.

(iii) The exchange rate of US$1.00 = Peso 21 = Yen 135 is applied.

(iv) The construction period of the irrigation project will be three years including one year for preparatory works, detailed design and training for O&M staff and farmers. The construction period of the mini-hydropower development project will be two years.

7.2.2 Evaluation of Economic Factors

(1) Standard Conversion Rate (SCR)

Traffic and trade restrictions introduce a distortion in the price relationship between trade goods and non-traded goods. In order to evaluate the project costs and benefits with respect to world market prices, a standard conversion rate (SCR) of 0.83 computed by NEDA was applied to the price of non-trade goods and services.

(2) Transfer Payment

Transfer payments such as tax were excluded from the project cost as far as economic analysis is concerned.

(3) Economic Prices of Agricultural Outputs and Inputs and Opportunity Cost of Farm Labor

Economic prices of tradable agricultural outputs (paddy and corn) and farm inputs (nitrogen, phosphate and potash) were estimated on the basis of IBRD projections of world market prices for 1995 in constant 1985 terms. The IBRD forecast prices were adjusted to constant 1988 price levels using the factor of 1.403 based on manufacturing unit value (MUV) index computed by IBRD. The domestic cost elements such as transport, handling and processing down to the farm gate level are multiplied by the SCR of 0.83. Economic prices of tradable agricultural outputs and inputs are shown in Table 18. Farm labour was evaluated by a shadow wage rate (SWR) of 0.6 calculated by NEDA.

7.2.3 Economic Benefit

The irrigation benefit to be expected is defined as the difference of primary profit from crops between future with and without project. The irrigation benefit is expected to increase year by year and will reach the full benefit in and after the 5th year after the completion of the project facilities. The irrigation benefit at the full stage were estimated as follows:

(Unit: 10^3 Peso)

Name of System	Annual Irrigation Benefit
Bonga Pump #1 IS	8,503
Bonga Pump #2 IS	12,589
Bonga Pump #3 IS	3,811
Alcala-Amulung Pump IS	42,972
Solana Pump IS	38,784
Libmanan-Cabusao Pump IS	59,209

The power benefit of the mini-hydropower development project was estimated as the cost savings by supplying electric power from mini-hydropower plant instead of supply from alternative diesel power plant with equivalent power output.

The power benefit is estimated as follows:

(Unit: 10^3 Peso)

Project	Annual Benefit
Site No.1	8,169
Site No.2	9,156
Combined project (No.1 and No.2)	17,325

7.2.4 Economic Cost

(1) Economic Capital Cost

The economic project cost was estimated by applying the conversion factor for transfer payment (0.9) and standard conversion rate (0.83) to local currency portion of the project cost. The economic cost is shown as follows: Details are explained in ANNEXES-G and H.

(i) Irrigation Project

(Unit: 10^3 Peso)

Name of System	Direct Tapping	Indirect Tapping
Bonga Pump #1 IS	24,005	18,306
Bonga Pump #2 IS	29,607	22,478
Bonga Pump #3 IS	13,786	12,363
Alcala-Amulung Pump IS	26,391	-
Solana Pump IS	71,717	63,869
Libmanan-Cabusao Pump IS	58,277	46,053

(ii) Mini-hydropower Project

(Unit: 10^3 Peso)

Project	Cost
Site No.1	49,308
Site No.2	59,913
Combination project (No.1 and No.2)	102,018

(2) Economic Annual Operation, Maintenance and Replacement Cost

The economic annual operation and maintenance cost was estimated taking account of SCR to local currency portion of the financial annual operation and maintenance cost, as shown below: Details are explained in ANNEXES-G and H.

(i) Irrigation Project

(Unit: 10^3 Peso)

Name of System	Direct Tapping	Indirect Tapping
Bonga Pump #1 IS	784	1,265
Bonga Pump #2 IS	1,027	1,657
Bonga Pump #3 IS	410	626
Alcala-Amulung Pump IS	4,794	-
Solana Pump IS	3,870	6,604
Libmanan-Cabusao Pump IS	2,895	4,636

(ii) Mini-hydropower Project

(Unit: 10^3 Peso)

Project	
Site No.1	793
Site No.2	968
Combination project (No.1 and No.2)	1,652

7.2.5 Internal Rate of Return

The economic internal rates of return (EIRR) were calculated from the economic project benefits and costs. The results may be summarized as follows:

Project	EIRR (%)	
	Direct Tapping	Indirect Tapping
A) Irrigation Project		
Bonga Pump #1 IS	19.4	22.1
Bonga Pump #2 IS	22.2	25.4
Bonga Pump #3 IS	15.6	15.9
Alcala-Amulung Pump IS	33.7	-
Solana Pump IS	27.4	27.4
Libmanan-Cabusao Pump IS	39.5	44.1
B) Mini-hydropower Project		
Site No.1	13.7	
Site No.2	12.5	
Combination (No.1 & No.2)	14.0	

7.2.6 Sensitivity Analysis

A sensitivity analysis was carried out to evaluate the soundness of the project against possible adverse changes in the future in the following three cases; Case 1: cost overrun by 10%, Case 2: reduction of benefit by 10% and Case 3: combined effect of Case 1 and Case 2.

The results of sensitivity analysis are presented below:

Project	EIRR (%)		
	Case 1	Case 2	Case 3
A) Irrigation Project			
Direct Tapping			
Bonga Pump #1 IS	17.8	17.6	16.1
Bonga Pump #2 IS	20.4	20.3	18.6
Bonga Pump #3 IS	14.2	14.1	12.7
Alcala-Amulung Pump IS	30.1	29.8	26.5
Solana Pump IS	25.3	25.1	23.1
Libmanan-Cabusao Pump IS	36.7	36.4	33.7
Indirect Tapping			
Bonga Pump #1 IS	20.1	19.9	18.1
Bonga Pump #2 IS	23.3	23.0	21.0
Bonga Pump #3 IS	14.3	14.2	12.6
Alcala-Amulung Pump IS	-	-	-
Solana Pump IS	25.1	24.8	22.6
Libmanan-Cabusao Pump IS	40.8	40.4	37.4
B) Mini-hydropower project			
Site No.1	12.3	12.2	10.9
Site No.2	11.2	11.1	9.9
Combination (No.1 & No.2)	12.6	12.5	11.2

7.2.7 Result of Economic Evaluation

From the above results, all the projects for both the irrigation systems and the mini-hydropower development projects could be economically feasible. The sensitivity analysis indicates that the economic viability of the projects is rather insensitive to the possible adverse changes.

7.3 Financial Analysis

7.3.1 Farm Budget Analysis and Capacity to Pay

In order to evaluate the irrigation project from the financial viewpoint of the farmers, the farm budget analyses on an average size of farm were made under both with and without project conditions.

The payment capacity is recognized as the ability of the benefitiary farmers to bear the present irrigation fee of each irrigation system.

After implementation of the project, the project will provide the basis for introduction of improved irrigation farming through year round irrigation. As a result, a considerable increase in unit yield of crops and cropping intensity may be expected under the with project condition. Under such situation, a substantial increase in farm income under the with project condition can be expected for the farmers in each pump system. On the other hand, no substantial increase in farm income may be expected under the without project condition.

Net reserve of the average farm under the with project condition will be expected to become larger. Net farm incomes of the average farm under the with project condition may be expected to increase 2 to 4.5 times that of farmers in the without project condition. The annual net reserve or capacity to pay of average farm under the with and without project conditions in each pump system are summarized in section 4.5.7.

These increased net reserves will offer incentives to farmers in the irrigated area. However the present high irrigation service fee still burdens the small scale farmer's economy with very heavy production costs.

7.3.2 Financial Analysis of the Systems

After completion of the projects, the operation and maintenance cost of the irrigation systems is expected to decline. The financial status of the systems is also expected to be much improved.

The financial status was examined as the balance between revenue and outgoings. The revenue is irrigation service fee. The outgoings are the annual operation and maintenance costs. The revenue was estimated based on the present irrigation fee under 100% collection efficiency.

The results are as shown below:

(Unit: 10^3 Peso)

Name of System	Revenue	Outgoing	Balance
A) Direct Tapping			
Bonga Pump #1 IS	1,491	812	679
Bonga Pump #2 IS	2,359	1,061	1,298
Bonga Pump #3 IS	707	434	273
Alcala-Amulung Pump IS	5,665	4,944	721
Solana Pump IS	9,604	3,953	5,651
Libmanan-Cabusao Pump IS	6,479	3,016	3,463
B) Indirect Tapping			
Bonga Pump #1 IS	1,491	1,293	198
Bonga Pump #2 IS	2,359	1,691	668
Bonga Pump #3 IS	707	649	58
Alcala-Amulung Pump IS	-	-	-
Solana Pump IS	9,604	6,688	2,916
Libmanan-Cabusao Pump IS	6,479	4,757	1,722

7.3.3 Repayment of Fund Requiremen=945

The repayment capacity for the capital cost (fund requirement) of the project was examined by a preparing cash flow statement for each of the irrigation systems and mini-hydropower projects:

On the basis of fund requirements, cash flow statements were prepared on assumption of the following conditions.

1) The foreign currency portion will be financed by the Government through a financing institution at an assumed interest rate of 2.7% per annum for a repayment period of 30 years including a grace period of 10 years.

2) The local currency portion will be financed by the Government from its own resources with no interest and 25 years repayment period.

3) Irrigation service fee is assumed to by the present irrigation fee with 100% collection efficiency.

The cash flow statements for each irrigation system and the mini-hydropower project are shown in ANNEX-G and ANNEX-H.

The cash flow statements for the irrigation systems indicate that repayment of the capital project cost under the above loan conditions will not be realized without subsidy. The deficit at the end of a repayment period of 30 years may be summarized below:

(Unit: 10^3 Peso)

Name of System	Direct Tapping	Indirect Tapping
Bonga Pump #1 IS	-37,343	-40,318
Bonga Pump #2 IS	-37,393	-41,877
Bonga Pump #3 IS	-24,338	-27,640
Alcala-Amulung Pump IS	-221,694	-
Solana Pump IS	-6,915	-67,051
Libmanan-Cabusao Pump IS	-76,237	-101,918

In the case of the mini-hydropower developments the capital cost will be repayable.

7.3.4 Result of Financial Justification

The irrigation projects will bring about a great improvement in farm budgets and provide incentives to the farmers with respect to payment of the irrigation fee. The irrigation projects could be justified from the farmer's viewpoint.

Since the only source of revenue in the irrigation projects will be the irrigation service fee from the farmers, which is limited, repayment of the capital project cost should be subsidized by the Goverment. The irrigation systems under direct tapping from NAPOCOR will require less subsidy than those under indirect tapping.

Financial status of the systems is expected to be much improved and moves into the black.

7.4 Impacts of the Project

In addition to the direct benefits counted in the economic evaluation, various secondary and intangible benefits and/or favourable socio-economic impacts are expected from implementation of the project. The principal socio-economic impacts are described hereunder.

(1) Increase in Employment Opportunities

It is estimated that the project will generate employment opportunities totaling about 0.9 million man-days of unskilled labour during the construction period. Most of the manpower will be supplied by the farmers in and around the project area. Furthermore, the employees will be able to gain additional experience and skill in various working fields. Accumulation of this experience should be very useful in future O&M work to be undertaken by the farmers. In addition, the project will create a demand for farm labour accrued from increased farming activities due to intensive use of the land. The incremental farm requirement is estimated at 1.1 million man-days annually. The ratio of labor absorbed in farming activities to total available labor force is expected to increase from 3.4% at present to about 7.1% in the future with project condition.

(2) Increase in Production of Agricultural Crops

The increase in agricultural production of paddy (40,560 tons) will improve self-sufficiency in the project area and will help to meet the shortage of food grain such as in Region IV. Furthermore the increase in such crop production will increase the profits to rice millers and merchants in processing and marketing.

(3) Increase in Farmer's Income

The farmer's incomes is expected to improve, mainly due to the increased production of rice. Their net farm incomes will become about 2 to 4.5 times of that at present, which will function to provide motivation for improvement of standards of living as well as for regional economic development.

(4) Improvement of Local Transportation

Local transportation will be much improved by the construction of operation and maintenance roads along the irrigation canals. The expanded road system will not only enhance economic activities but will also contribute to inter-regional accessibility and communication.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

All the selected projects of irrigation systems are technically sound and economically feasible, whether with electric power from NAPOCOR or from the local electricity cooperatives. The sensitivity analysis indicates that the economic viability of the projects is rather insensitive to the possible adverse changes.

All the irrigation projects will bring about great improvement in farm budgets and will give incentives to the farmers with respect to paying the irrigation service fee. While irrigation projects could be justified from the farmer's viewpoint, the present high irrigation service fee is still a great burden on the small scale farmer's economy.

Since the only source of revenue in the irrigation projects will be the irrigation service fee from farmers, which is limited, repayment of the capital project cost for all the projects should be subsidized by the Government.

The amount of subsidy for the irrigation projects under direct tapping would in any case be smaller than that for the projects under indirect tapping.

Financial status of all the irrigation systems is expected to be much improved and to move into credit due to reduced operation and maintenance costs. The financial status of the systems under direct tapping will be more attractive than that under indirect tapping.

All the selected mini-hydropower developments are technically sound and economically feasible. Financially, repayment of the capital costs of all the developments could be repayed under soft loan conditions.

A combination of sites of No.1 and No.2 is the most attractive project because one substation can serve both developments.

These irrigation and the mini-hydropower development projects will also provide substantial and sustainable socio-economic benefits not only within the project areas but also in their regions and for the nation as a whole.

Thus it is recommended that the irrigation projects with direct tapping and the combination plan for mini-hydropower development should be implemented as early as possible.

For successful implementation of these projects, it is also strongly recommended that the agricultural support systems be strengthened.

Table 1 MEMBER LIST OF JICA ADVISORY COMMITTEE, JICA STUDY TEAM AND COUNTERPART GROUP

Name	Position
JICA Advisory Committee	
Mr. Takeshi ISHIDA	Chairman of the Committee (1st Stage)
Mr. Kazuo KIMURA	Chairman of the Committee (2nd Stage)
Mr. Tadayoshi TOKO	Advisor on Agriculture
Dr. Teruyuki NISHIJIMA	Advisor on Geology & Groundwater
Mr. Shigeaki UCHIMURA	Advisor on Irr. & Drainage
Mr. Masami MIZUNO	Advisor on Project Economy
Mr. Takashi SHINO	Coordinator
Mr. Hidero OSAWA	Coordinator
JICA Study Team	
Mr. Masashi SHONO	Team Leader
Mr. Seiji KOYANAGI	Irrig. & Drainage Engineer
Mr. Shozo INOUE	Design Engineer
Mr. Ryuji ICHINOSE	Mechanical Engineer
Mr. Masao HIGUCHI	Hydrologist
Mr. Hiroshi TANAKA	Mini-hydropower Engineer
Mr. Kuninobu NODA	Water Management Expert
Mr. Kenjiro ONAKA	System Management Engineer
Mr. Yojiro SEKIGUCHI	Agronomist
Ms. Mihoko URAMOTO	Agro-economist
Counterpart Group	
Mr. Leonardo E. Balite	Chief Counterpart
Mr. Reinecio E. Irinco	Irrig. & Drainage Engineer
Mr. Virgilio S. Miguel	Irrig. & Drainage Engineer
Mr. Othelo L. Razon	Irrig. & Drainage Engineer
Mr. Gregorio S. Dumandan	Mechanical Engineer
Mr. Theodore C. Calma	Hydrologist
Mr. Vicente C. Tolentino	Mini-hydropower Engineer
Mr. Vicente E. Santos, Jr.	Inst./Water Regulation Expert
Mr. Jose F. Mallari	Water Management Expert
Mr. Felimon C. Montano	Farmer's Association Expert
Mr. Enrique A. Sabio, Jr.	Farmer's Association Expert
Mr. Herminigildo S. Tabares	Soil/Land Use Expert
Mr. Guillermo C. de Guzman	Agronomist
Mr. Carlito D. Herreria	Agronomist
Mr. Jose R. Castillo	Agro-economist
Mr. Candido L. Raquepo	Agro-economist

Table 2 PRESENT CONDITION OF THE PUMP IRRIGATION SYSTEMS

Name of Systems	Generated Area (ha)	Service Area (ha)	No. of Lots in Service Area	No. of Farmers in Service Area	No. of Farmers in Generated Area	Farm Size (1) (ha)	Irrigation Facilities: Length of Canal (km) Main	Irrigation Facilities: Length of Canal (km) Lateral	Irrigation Facilities: No. of Structure	Irrigation Facilities: Length of Service Road (km)	Pump Facilities: Date of Install.	Pump Facilities: No. of Units	Pump Facilities: Presently Operated Units	Pump Facilities: Design Capacity (m3/m)	Pump Facilities: Actual Capacity (m3/m)	Pump Facilities: Source of Power	Pump Facilities: Power Rate (peso/kWh)	Length of Drainage Canal (km)	Irrigated Area 1987 (ha) Wet	Irrigated Area 1987 (ha) Dry	Annual Irri. Water Supplied by Pumps in '87 (million m3/year)	Estimated Water Consumption (mm/day)
1. Bomga Pump #1	426	298	3,630	1,420	2,030	0.21	3.38	6.08	102	-	1975	2	2	75.7	32.7	INECO(2)	2.17	0	165	57	2.5	9.4
2. Bonga Pump #2	-	674	5,900	1,361	-	0.27	14.18	21.80	382	21.82	1975	3	2	208.2	107.7	INECO	2.14	0	375	208	5.2	7.4
3. Bonga Pump #3	218	202	1,660	420	450	0.48	4.75	3.32	91	-	1975	2	1	68.1	31.0	INECO	2.17	0	140	62	2.6	10.5
4. Alcala/Amulung	2,350	1,840	-	2,190	2,000	0.84	9.87	21.96	140	18.15	1982	4	4	291.5	(6)	NAPOCOR (4)	1.40	45.86	1,030	996	28.1	11.5
5. Solana	2,865	1,320	1,890	1,250	2,700	1.06	18.36	25.62	181	32.86	1975	4	2	408.8	163.7	CAGELCO(3)	1.90	19.10	847	0	12.8	12.6
6. Libmanan Cabusao	4,102	2,195	1,680	1,050	1,960	2.09	11.17	52.99	297	40.50	1979	4	2	366.4	172.3	CA.SUR 1 ELEC.COOP (5)	2.10	56.75	1,118	0	8.3	6.2

Name of Systems	Irrigation Fee Rate per Ha: Wet Season (Cavan)	Irrigation Fee Rate per Ha: Dry Season (Cavan)	Collected Irrigation Fee Amount in '87 (1,000 peso)	Efficiency of Irrigation Fee Collection in '87	Total O&M Cost in '87 (1,000 peso)	% of Pump Energy Cost to Total O&M Cost	Balance of Irrigation Fee Minus O&M Cost (1,000 peso)	Unit O&M Cost per Ha/Crop in '87 (peso/ha)	Work Load of O&M Staff: WM (7) (ha/person)	Work Load of O&M Staff: DT (8) (km/person)	Major Cropping Pattern: Wet	Major Cropping Pattern: Dry	Cropping Intensity (%): Service Area	Cropping Intensity (%): Irrigated Area (9)	Unit Yield of Paddy (ton/ha): Wet Season	Unit Yield of Paddy (ton/ha): Dry Season	Unit Yield of Paddy (ton/ha): Rain-fed	Farm Income in Service Area (peso/household)	Gross Domestic Product per Capita (peso)
1. Bonga Pump #1	8.0	12.0	283	83	529	75	-246	2,383	298	-	Paddy	Paddy or Div. Crop or Fallow	117	187	3.3	3.5	2.3	2,100	6,970
2. Bogna Pump #2	8.0	12.0	509	60	790	79	-281	1,355	674	-	Paddy	Paddy or Div. Crop or Fallow	108	161	3.5	4.0	2.4	3,650	6,970
3. Bonga Pump #3	8.0	12.0	100	32	313	59	-213	1,547	202	-	Paddy	Paddy or Div. Crop or Fallow	101	142	3.8	4.1	2.3	7,040	6,970
4. Alcala/Amulung	7.5	7.5	1,572	63	2,450	62	-877	1,209	660	6.6	Paddy	Paddy or Fallow	96	-	3.3	3.5	1.8	7,560	7,055
5. Solana	14.0	14.0	11,659	60	2,227	78	-1,061	2,629	-	-	Paddy	Paddy or Fallow	45	60	3.1	3.3	2.8	13,700	7,055
6. Libmanan Cabusao	6.0	6.0	182	16	667	55	-485	597	1,098	-	Paddy	Paddy or Fallow	60	117	2.8	3.3	2.0	9,330	5,292

Remarks: (1): Service area/No. of farmers in the service area (2): Ilocos Norte Electric Cooperative Inc. (3): Cagayan Electric Cooperative Inc.
(4): National Power Corporation (5): Camarines Sur 1 Electric Cooperative Inc. (6): Actual discharge capacity was not measured
(7): Water master (8): Ditch tender
(9): Annual benefited area/higher value of the irrigated area within wet and dry seasons in 1986

Table 3 NECESSITY FOR IMPROVEMENT IN THE PUMP IRRIGATION SYSEMS

Name of Pumping System	Rehabilitation of Irrigation/Drainage Facilities: Canal System	Rehabilitation of Irrigation/Drainage Facilities: On-farm Facility	Rehabilitation of Pump: Pump Equip-ment	Rehabilitation of Pump: Electric Equip-ment	Direct Power Supply from NPC: Trans-mission Line	Direct Power Supply from NPC: Sub-station	Supply of O&M Equip-ment	Increase of Nos. of OM Staff	Reinforce-ment and Improvement of Monitoring System	Reinforce-ment of Communi-cation System	Special Training of Farmers	Special Training of OM Staff
1. Bonga Pump #1	O	O	O	O	O	O	O	X	O	X	O	O
2. Bonga Pump #2	O	O	O	O	O	O	O	X	O	X	O	O
3. Bonga Pump #3	O	O	O	O	O	O	O	X	O	X	O	O
4. Alcala-Amulung	O	O	X	X	X	X	O	X	O	X	O	O
5. Solana	O	O	O	O	O	O	O	X	O	X	O	X
6. Libmanan-Cabusao	O	O	O	O	X	O	O	O	O	O	O	O

Remarks: O: Improvement or reinforcement is needed.
X: No improvement is needed

Table 4 PROPOSED REHABILITATION AND IMPROVEMENT WORKS FOR THE IRRIGATION SYSTEMS

Name of System	Replacement of Pumping Facilities: Pump (Unit)	Replacement of Pumping Facilities: Pump Unit Capacity (m3/m)	Replacement of Pumping Facilities: Motors (Unit)	Power Supply System: System	Power Supply System: Sub-station (kVA)	Power Supply System: Trans-line (km)	Irrigation Facilities: Irrigation Canal Rehab. (km)	Irrigation Facilities: Irrigation Canal New (km)	Irrigation Facilities: Turnout (nos.) Replacement of Gate	Irrigation Facilities: Turnout (nos.) New Turnout	Irrigation Facilities: Replace./Install. of Other Gate (nos.)	Drainage Facilities: Drainage Canal Rehab. (km)	Drainage Facilities: Drainage Canal New (km)	Drainage Facilities: Replace-ment of Flapgate (nos.)	Service Road: Improve-ment (km)	Service Road: New Road (km)	On-Farm Facilities: New Farm Ditch (km)	On-Farm Facilities: New Farm Drain (km)
(I) Direct Tapping																		
Bonga Pump #1	2	35.1	2	Tripartite*	5000 *	8.8 *	5.4	0.0	31	2	2	0.0	9.0	0	2.4	0.8	12.9	28.8
Bonga Pump #2	3	37.0	3	Tripartite*			6.2	0.0	24	0	0	0.0	14.6	0	0.0	0.0	18.6	47.2
Bonga Pump #3	2	15.9	2	Tripartite*			4.0	0.3	41	0	0	0.0	4.5	0	0.0	1.0	0.0	14.1
Alcala-Amulung	0	-	0	**	**	**	27.8	0.0	6	7	0	12.7	1.1	0	0.0	0.0	31.3	133.7
Solana	4	82.1	4	direct NIA-NPC	1750	0.2	16.5	0.0	38	25	2	18.5	0.0	0	0.0	0.0	92.0	176.3
Libmanan Cabusao	0	-	0	Tripartite	5000	0	32.4	1.9	45	9	7	44.6	0.0	9	6.3	10.4	20.9	171.6
(II) Indirect Tapping																		
Bonga Pump #1	2	35.1	2				5.4	0.0	31	2	1	0.0	9.0	0	2.4	0.8	12.9	28.8
Bonga Pump #2	3	37.0	3				6.2	0.0	24	0	0	0.0	14.6	0	0.0	0.0	18.6	47.2
Bonga Pump #3	2	15.9	2				4.0	0.3	41	0	0	0.0	4.5	0	0.0	1.0	0.0	14.1
Alcala-Amulung	0	-	0				27.8	0.0	6	7	0	12.7	1.1	0	0.0	0.0	31.3	133.7
Solana	4	82.1	4				16.5	0.0	38	25	2	18.5	0.0	0	0.0	0.0	92.0	176.3
Libmanan Cabusao	0	-	0				32.4	1.9	45	9	7	44.6	0.0	9	6.3	10.4	20.9	171.6

Remarks: * Power supply system would be shared by Bonga Pump #1, #2 and #3.
** Power for the Alcala-Amulung pump station is being supplied directly from NAPOCOR.

Table 5 PROPOSED OPERATION AND MAINTENANCE FACILITIES

Item	Unit	Bonga #1 Bonga #2 Bonga #3	Alcala-Amulung	Solana	Libmanan-Cabusao
I. O & M Equipment					
1. Heavy Equipment					
1. Backhoe-Crawler, 0.4cum	unit	1	0	1	1
2. Loader with Backhoe Wheeled, 0.5cum	unit	1	1	0	0
3. Dump Truck, 6t	unit	0	0	1	1
4. Spare Parts *	L.S.	1	1	1	1
2. Light Equipment					
1. Pick-up, 3/4 ton	unit	1	1	1	0
2. Cargo Truck, 6 ton	unit	1	1	1	0
3. Motorcycle	unit	9	19	8	12
4. Spaire Parts *	L.S.	1	1	1	1
3. Miscellaneous Equipment					
1. Portable Compactor	unit	1	1	1	1
2. Centrifugal Pump, 100mm	set	1	1	1	1
3. Sand Pump, 100mm	set	1	1	1	1
3. Chain Block, 5 ton	unit	3	2	2	2
5. Maintenance Tools	set	1	1	1	1
6. Measurement Instrument	set	1	1	1	1
7. Spare Parts	L.S.	1	1	1	1
II. Monitoring Facilities					
1. Rain Gage (Standard Type)	nos	0	0	0	0
2. Staff Gage	nos	20	18	11	32
III. Communication Facilities					
1. Radio set	set	0	0	0	1
2. spare Parts	L.S.	0	0	0	1

Remark; * = Spareparts for the proposed and existing equipment.

Table 6 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR WATER MASTERS

Goal of Training	Training Item	Aims	Contents	Training Method
1. training orientation			- registration	lecture/discussion workshop
			- raising of expectations	-do-
2. to acquire knoeledge of the irrigation plan	on-farm irrigation requirement	to understand approx. amount, constituent factors, seasonal variation of water requirement for paddy and diversified crops	- evapotranspiration	lecture
			- percolation	-do-
			- effective rainfall	-do-
			- irrigation efficiency	-do-
	irrigation requirements for teriary block, major diversion structure and pump	to understand irrigation method such as rotational and simultaneous irrigation	- rotational irrigation and simultaneous irrigation	lecture/discussion
			- farming practice and irrigation method	-do-
		to understand diversion requirement	- seasonal diversion requirements	-do-
	hydrology	to understand regional hydrological characteristics	- general climate	lecture
			- rainfall/available water sources	-do-
		to understand available water sources of the river	- water balance in the river system	-do-
			- data bank system	-do-
		to understand water balance in the river system		
3. to acquire knowledge of facilities	kind and function of irrigation facilities	to gain knowledge about the kind and function of irrigation facilities	- design criteria for canal and canal	lecture
			- hydraulic features of structures	lecture/field practice
			- movable structures such as gate and check structures	-do-
		to gain knowledge about water management facilities		
	operation method of water management facilities	to learn how to measure discharge	- measuring device	lecture/field practice
		to learn how to operate water management facilities	- operation rule of water management facilities	-do-
4. to acquire knowledge of organization and responsibilities	organizationl structure, function and responsibilities	to obtain knowledge about organizational structure and function	- organizations of the IA	lecture
			- organization of NIA	-do-
			- other organization	-do-
		to make clear the responsibilities of water master at various level of management	- responsibilities of each level staff	lecture
5. to learn procedures for water management and reporting system	procedure for water management	to obtain knowledge about administrative procedure to determine the irrigation plan	- irrigation committees at various levels if available	-do-
			- determination of annual irrigation plan	-do-
	reporting system	to make clear reporting system	- reporting system for water management	-do-
			- form of reports/communication	-do-
6. to acquire knowledge about monitoring and evaluation	monitoring on practice of water management	to obtain knowledge about monitoring and evaluation on water management	- monitoring and evaluation on water management at main system	lecture/field practice
			- monitoring and evaluation on water management at tertiary block level	-do-
		to obtain knowledge about monitoring and evaluation on economic benefit	- monitoring and evaluation system on economic beneftis of project	lecture
			- survey method and forms	lecture, exercise
7. to acquire knowledge on maintenance of project facilities	maintenance of project facilities	to understand the whole aspect related to maintenance of facilities	- maintenance system	lecture
			- maintenance method	-do-
			- responsibility of organization	-do-
			- budget	-do-
8. to acquire Knowledge on the overall management of the irrigation system	overall management	to understand an overall system management	- system management	field visit/lecture
9. to evaluate effect of training		to evaluate effect of training	- Evaluation	lecture/exercise

Table 7 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR DITCHTENDERS

Goal of Training	Training Item	Aims	Contents	Training Method
1. training orientation			- registration	lecture/workshop
			- raising of expectation	-do-
2. to acquire knowledge of facilities	kind and function of facilities	to gain knowledge about function of irrigation facilities	- hydraulic features of structures	lecture/field practice
	operation method of water management facilities	to learn how to measure discharge and climate data	- measuring rainfall, evaporation, temperature, discharge, etc.	-do-
		to learn how to operate water management facilities	- operation rule of water management facilities	-do-
3. to acquire knowledge about organization and responsibilities	organizational structure, function and responsibilities	to obtain knowledge about organizational structure and function	- organization of the IA	lecture
			- organization of NIA	-do-
			- other organization	-do-
		to make clear the responsibilities of dichtender at various level of management	- responsibilities of ditchtender	-do-
4. to learn procedures for water management and reporting system		to obtain knowledge about procedure for determination of the irrigation plan	- determination of annual irrigation plan	-do-
	reporting system	to make clear reporting system	- reporting system for water management - form of report/communication	-do-
5. to acquire knowledge on maintenance of the project facilities	maintenance of facilities	to understand the whole aspect of maintenance	- maintenance system	lecture
6. to acquire knowledge of overall management of the irrigation system	overall management	to understand the overall system of management	- system management	field visit/lecture
7. to evaluate effect of training		to evaluate effect of training	- evaluation	lecture/exercise

Table 8 OUTLINE OF STANDARD CURRICURUM OF TRAINING FOR PUMP OPERATORS

Goal of Training	Training Item	Aims	Contents	Training Method
1. training orientation			- resistration - raising of expectation	lecture/ workshop -do-
2. to acquire with irrigation plan	on-farm irrigation requirement	to develop understanding the role of pump facilities on irrigation system	- role of pump facilities	lecture/workshop
3. to learn basic knowledge on pump facilities	basic electrical knowledge	to develop basic electrical knowledge about pump facilities	- principle of electricity - function of sub-station, transformer, pump panel, motor - pump starting methods	-do- -do- -do- -do-
		to develop basic mechanical knowledge of pump facilities	- naming of parts and devices in pump equipment - mechanical knowledge of pump equipment - function of pump equipment	-do- -do-
4. to acquire operation method on pump equipment	direction and supervision of pump operation	to develop skill in direction and supervision of pump operation in system	- direction and supervision - starting time, operating hours	-do- -do-
	procedure for pump operation	to develop skills in inspection of electrical and mechanical items and their operation	- operation manual of manufacturers - visual inspection - inspection of gages, vibration, temperature, oil level, leaks - inspection of intake, discharge channel	lecture/field practice -do- -do- -do-
		to learn how to operate pump equipment	- starting methods - check items in starting, during running	-do- -do-
	reporting and recording	to learn reporting & recording of pump operation for effective operation and maintenance	- purpose of reporting and recording - form for reporting and recording	-do- -do-
	safety work	to learn the safety work to prevent the labor accidents	- electric shock - mechanical accidents - case study	lecture -do- -do-
5. to acquire knowledge of maintenance work on pump facilities	maintenance	to learn how to maintain pump facilities	- daily, weekly, monthly maintenance - preventive maintenance - maintenance tools - replacement of spareparts	lecture/field practice -do- -do- -do-
6. to acquire knowledge overall management of the irrigation system	system management	to learn an overall system management	- system management	field visit/lecture
7. to evaluate effect of training		to evaluate effect of training	- evaluation	lecture/exercise

Table 9 OUTLINE OF CURRUCULUM OF TRAINING FOR FARMERS (LEADERSHIP)

Training Item	Aims	Contents	Training Method
1. training orientation		- registration	lecture/workshop
		- raising of expectation	-do-
		- training design orientation	-do-
2. NIA and institutional development programmes	to understand NIA organization	- NIA and its objectives, powers and structures	lecture
			-do-
		- farmers participation irrigation development	-do-
		- theoretical framework	-do-
3. irrigation association	to understand famers' organization	- farmers association	-do-
		- IA objectives, function and benefits	-do-
		- IA organizational structure	-do-
		- IA standards and indications	-do-
4. leadership	to understand leadership	- leadership styles	-do-
		- IA leadership function and qualities	-do-
		- organizational discipline	-do-
5. basic knowledge and skills in IA leadership	to improve quality for leadership	- communicatin/group mobilization	-do-
		- problem solving/decision making	-do-
		- facilitating meeting	-do-
		- action reflection	-do-
		- roles and function of ICO/FID at different stages of IA development	-do-
6. training evaluation		- evaluation	lecture/exercise

Table10 OUTLINE OF CURRICULUM OF TRAINING FOR FARMERS (SYSTEM MANAGEMENT)

Training Item	Aims	Contents	Training Method
1. training orientation		- registration	lecture/workshop
		- levelling of expectation	-do-
2. overview of irrigation system management	to understand an overall system management	- irrigation facilities	lecture
		- irrigation schedule (pre-, normal- and post-irrigation)	-do-
3. operation method of water management on facilities	to learn how to measure discharge	- measuring devices	lecture/field practice
	to learn how to operate water management of facilities	- operation rule of water management facilities	-do-
		- cropping pattern	-do-
		- water distribution plan	
4. maintenance of facilities	to maintain project facilities	- maintenance system	lecture
5. monitoring system	to obtain knowledge of procedure of monitoring	- reporting system	-do-
		- form of reports/communication	-do-
6. irrigation sevice fee collection	to collect fee efficiently	- procedure of fee collection	-do-
		- incentive of fee collection	-do-
		- fee collection plan	-do-
7. conflict of management	to solve conflict of water management	- sample exercise	lecture/exercise
8. organizational structure, function and responsibilities	to obtain knowledge about organizational structure and function	- organizations of IA and NIA	-do-
		- other organizations	-do-
			-do-
	to make clear the responsibilities of IA farmers and NIA staff	- responsibility of farmers and NIA staff	-do-
9. training evaluation	to evaluate training	- training exercise	lecture/exercise

Table 11 OUTLINE OF CURRICULUM OF TRAINING FOR FARMERS (FINANCIAL MANAGEMENT)

Training Item	Aims	Contents	Training Methods
1. training orientation		- registration	lecture/workshop
		- raising of expectation	-do-
2. theories and concept of financial management	to develop understanding of overall financial management	- concept of financial management tool	lecture
		- importance of financial management	-do-
		- component of IA-financial management	-do-
3. accounting	to simplify accounting system	- accounting as a financial management tool	-do-
		- function of accounting	-do-
		- simplified accounting	-do-
4. recording system	to understand recording system	- form and use	-do
		- recording of IA transaction	-do-
5. book of accounts	to improve book of account	- book of accounts and use	-do-
		- accomplishment of each of book of accounts	-do-
6. method of fee collection	to improve collection method	- steps in ISF collection	-do-
		- steps in ccash disbursement	-do-
		- steps in auditing	-do-
		- systems and procedures in collection, cash disbursement and auditing	-do-
7. reporting system	to understand and improve reporting systems	- importance and components of financial report	-do-
		- preparation of cash statement	-do-
		- preparation of balance sheet	-do-
8. NIA amortization scheme and financial planning	to understand amortization	- concept of amortization	-do-
		- calculation of amortization	-do-
		- financial planning	-do-
9. duties and responsi-bilities of IA personnel	to understand duties and responsibilities	- responsibilities	-do-
10. evaluation	to evaluate training	- training exercise	lecture/exercise

Table 12 STUDY OF OPTIMUM DEVELOPMENT PLAN

Item	Site No. 1				Site No. 2			
	Case 1	Case 2	Case 3	Case 4	Case 1	Case 2	Case 3	Case 4
Net Head (m)	22.1	22.1	22.1	22.1	8.55	8.55	8.55	8.55
Discharge (m3/s)	3.5	3.75	4.0	4.5	10.0	11.0	12.0	12.5
Output (kW)	612	656	700	787	642	706	770	802
Annual Energy (1,000 kWh)	4,284.16	4,402.44	4,510.80	4,642.56	4,487.04	4,790.16	5,061.67	5,092.92
Construction Cost* (1,000 US$)	2,403.70	2,477.06	2,516.39	2,699.13	2,899.34	2,974.93	3,072.10	3,123.32
Cost per kWh (US$)	0.561	0.563	0.558	0.581	0.646	0.621	0.607	0.613
Priority	2	3	1	4	4	3	1	2

Remark : * = not including price contingency

Table 13 PROPOSED WORKS FOR THE MINI-HYDROPOWER DEVELOPMENT PROJECT

Items of Works	Unit	Site 1	Site 2	Combination
1. Generating Equipment				
a) Water turbine				
- Type		HF-1RS*	HF-1RS*	
- Effective head	m	22.1	8.55	
- Discharge	m3/s	4.0	12.0	
- Output	kw	736	845	
- Speed	rpm	600	165	
b) Generator				
- Output	kVA	778	855	
- Output	kW	700	770	
- Speed	rpm	600	900	
- Voltage	kV	3.3	3.3	
- Frequency	Hz	60	60	
- Increaser ratio		N/A	5.5	
- No. of poles		12	8	
2. Substation & Transmission Line				
a) Transformer				
- Rated capacity	kVA	800	900	1600
- Rated frequency	Hz	60	60	60
- No. of phases		3	3	3
- Connection		Yd1 **	Yd1 **	Yd1 **
- Rated voltage 1st	kV	3.3	3.3	13.8
- Rated voltage 2nd	kV	13.8	13.8	69
- Tap voltage	kV	F14.5-F13.8-R13.2-F12.5-F12.0	F14.5-F13.8-R13.2-F12.5-F12.0	F72 -F69 -R66 -F63 -F60
b) Transmission line				
- 13.8 kV line	km			18.5

* Horizontal shaft francis type one runner
** Delta star connection

Table 14 PROJECT COST FOR THE IRRIGATION PROJECTS

(Unit: 1,000 Peso)

	Improvement of pump facilities including power supply system	Improvement of Irrigation & Drainage Facilities	Reinforcement of O&M Equipment	Improvement of Monitoring & Communication Facilities	Training Programme	Sub Total	Engineering and Administration	Sub Total	Physical Contingency	Grand Total
Direct tapping										
Bonga #1	13,117	4,549	1,914	0	412	19,992	2,997	22,989	2,299	25,288
Bonga #2	17,293	3,614	3,014	0	484	24,405	3,662	28,067	2,807	30,874
Bonga #3	7,966	2,494	877	0	27	11,364	1,704	13,068	1,307	14,375
Alcala-Amulung	0	18,911	4,281	0	601	23,793	3,570	27,363	2,737	30,100
Solana	32,096	22,568	5,516	0	394	60,574	9,086	69,660	6,967	76,627
Libmanan-Cabusac	16,625	28,477	4,687	120	364	50,273	7,541	57,814	5,782	63,596
Total	87,097	80,613	20,289	120	2,282	190,401	28,560	218,961	21,899	240,860
Indirect tapping										
Bonga #1	8,484	4,549	1,914	0	412	15,359	2,304	17,663	1,767	19,430
Bonga #2	11,501	3,614	3,014	0	484	18,613	2,792	21,405	2,140	23,545
Bonga #3	6,808	2,494	877	0	27	10,206	1,530	11,736	1,175	12,911
Alcala-amulung	0	18,911	4,281	0	601	23,793	3,570	27,363	2,737	30,100
Solana	25,798	22,568	5,516	0	394	54,276	8,140	62,416	6,242	68,658
Libmanan-Cabusao	6,838	28,477	4,687	120	364	40,486	6,073	46,559	4,656	51,215
Total	59,429	80,613	20,289	120	2,282	162,733	24,409	187,142	18,717	205,859

Table 15 PROJECT COST FOR THE MINI-HYDROPOWER DEVELOPMENT PROJECTS

(Unit: 1,000 US$)

Item	Site No. 1			Site No. 2			Combination		
	FC	LC	Total	FC	LC	Total	FC	LC	Total
(1) Generating Equipment									
- Water trubine	496	-	496	646	-	646	1,142	-	1,142
- Generator	323	-	323	280	-	280	603	-	603
- Increaser	N/A	-	0	108	-	108	N/A	-	0
- Indoor switchgear	200	-	200	200	-	200	400	-	400
- DC supply	46	-	46	46	-	46	92	-	92
- Transformer	29	-	29	32	-	32	61	-	61
- Outdoor switchgear	67	-	67	67	-	67	133	-	133
(1) Sub-total:	1,161	-	1,161	1,378	-	1,378	2,539	-	2,539
(2) 13.8 kV Transmission Line & 69 kV Sub-station									
- Transformer	40	-	40	43	-	43	63	-	63
- 69 kV & 13.8 kV sub-station	251	-	251	251	-	251	251	-	251
- 13.8 kV T/L	11	14	25	70	89	160	81	103	185
(2) Sub-total:	302	14	316	365	89	454	396	103	499
(3) Penstock	-	60	60	-	63	63	-	123	123
(4) Intake Gate	-	26	26	-	26	26	-	51	51
(5) Civil Work	-	427	427	-	507	507	-	934	934
(6) Sub-total of (1) to (5)	1,463	526	1,989	1,743	685	2,429	2,935	1,212	4,147
(7) Engineering and Administration Cost	219	79	298	262	103	364	440	182	622
(8) Sub-total of (6) to (7)	1,682	605	2,288	2,005	788	2,793	3,376	1,393	4,769
(9) Contingency	168	61	229	200	79	279	338	139	477
(10) Project Cost (8) to (9)	1,850	666	2,516	2,205	867	3,072	3,713	1,533	5,246

Remarks: FC: Foreign currency, LC: Local currency

Table 16 FUND REQUIREMENT

(Unit: 1,000 Peso)

	1st. Year			2nd. Year			3rd. Year			Total		
	F C	L C	Amount	F C	L C	Amount	F C	L C	Amount	F C	L C	Amount
I. Fund Requirement for 6 Pump Irrigation Systems												
(1) Direct tapping												
Bonga #1	1,453	949	2,402	19,917	2,178	22,095	2,054	3,887	5,941	23,424	7,014	30,438
Bonga #2	1,859	1,039	2,898	26,158	1,883	28,041	1,922	4,007	5,929	29,939	6,929	36,868
Bonga #3	865	220	1,085	11,852	1,086	12,938	1,245	1,947	3,192	13,962	3,253	17,215
Alcala-Amulung	1,110	1,957	3,067	11,078	8,681	19,759	5,909	9,550	15,459	18,097	20,188	38,285
Solana	4,115	2,057	6,172	53,847	10,564	64,411	8,477	14,303	22,780	66,439	26,924	93,363
Libmanan-Cabusao	3,061	2,144	5,205	36,150	12,204	48,354	10,413	14,764	25,177	49,624	29,112	78,736
Total	12,463	8,366	20,829	159,002	36,596	195,598	30,020	48,458	78,478	201,485	93,420	294,905
(2) Indirect tapping												
Bonga #1	1,078	899	1,977	14,460	2,151	16,611	1,846	3,050	4,896	17,384	6,100	23,484
Bonga #2	1,390	976	2,366	19,333	1,847	21,180	1,662	2,959	4,621	22,385	5,782	28,167
Bonga #3	773	208	981	10,488	1,079	11,567	1,192	1,736	2,928	12,453	3,023	15,476
Alcala-Amulung	1,110	1,957	3,067	11,078	8,681	19,759	5,909	9,550	15,459	18,097	20,188	38,285
Solana	3,575	2,018	5,593	46,023	10,543	56,566	8,180	13,675	21,855	57,778	26,236	84,014
Libmanan-Cabusao	2,216	2,095	4,311	23,866	12,177	36,043	9,946	13,947	23,893	36,028	28,219	64,247
Total	10,142	8,153	18,295	125,248	36,478	161,726	28,735	44,917	73,652	164,125	89,548	253,673
II. Fund Requirement for Mini-Hydropower Development												
(1) Site No.1	25,704	10,164	35,868	17,997	7,434	25,431	-	-	-	43,701	17,598	61,299
(2) Site No.2	30,639	13,230	43,869	21,441	9,681	31,122	-	-	-	52,080	22,911	74,991
(3) Combination	51,576	23,373	74,949	36,099	17,136	53,235	-	-	-	87,675	40,509	128,184

Remarks: F C; Foreign currency
L C; Local currency

Table 17 COST OF OPERATION, MAINTENANCE AND REPLACEMENT FOR THE IRRIGATION PROJECTS

(Unit: 1,000 Peso)

Year	Irrigation																						Mini-hydropower		
in	Bonga #1				Bonga #2				Bonga #3				Alcala-Amulung		Solana				Libmanan-Cabusao				Site No. 1	Site No. 2	Combination
Order	Direct		Indirect		Direct		Indirect		Direct		Indirect		Direct		Direct		Indirect		Direct		Indirect				
	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	Replace	O&M	O&M	O&M
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	798	966	1,659
4	812	1,366	1,293	1,366	1,061	2,152	1,691	2,152	434	621	649	621	4,944	6,349	3,953	0	6,688	0	3,016	20,760	4,757	20,760	798	966	1,659
5	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	3,898	4,757	3,898	798	966	1,659
6	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
7	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	76,120	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
8	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
9	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
10	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
11	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
12	812	1,914	1,293	1,914	1,061	3,014	1,691	3,014	434	877	649	877	4,944	4,281	3,953	5,516	6,688	5,516	3,016	4,807	4,757	4,807	798	966	1,659
13	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
14	812	1,366	1,293	1,366	1,061	2,152	1,691	2,152	434	621	649	621	4,944	6,349	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
15	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	3,898	4,757	3,898	798	966	1,659
16	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
17	812	5,347	1,293	5,347	1,061	7,857	1,691	7,857	434	3,783	649	3,783	4,944	0	3,953	20,952	6,688	20,952	3,016	2,421	4,757	2,421	798	966	1,659
18	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
19	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	20,760	4,757	20,760	798	966	1,659
20	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
21	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
22	812	1,914	1,293	1,914	1,061	3,014	1,691	3,014	434	877	649	877	4,944	82,401	3,953	5,516	6,688	5,516	3,016	4,807	4,757	4,807	798	966	1,659
23	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
24	812	1,366	1,293	1,366	1,061	2,152	1,691	2,152	434	621	649	621	4,944	6,349	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
25	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	3,898	4,757	3,898	798	966	1,659
26	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
27	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	9,310	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
28	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
29	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
30	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
31	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
32	812	7,261	1,293	7,261	1,061	10,871	1,691	10,871	434	4,183	649	4,183	4,944	4,281	3,953	26,466	6,688	26,466	3,016	7,228	4,757	7,228	798	966	1,659
33	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
34	812	1,366	1,293	1,366	1,061	2,152	1,691	2,152	434	621	649	621	4,944	6,349	3,953	0	6,688	0	3,016	20,760	4,757	20,760	798	966	1,659
35	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	3,898	4,757	3,898	798	966	1,659
36	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
37	812	7,770	1,293	3,137	1,061	9,436	1,691	3,644	434	6,886	649	3,025	4,944	78,120	3,953	11,024	6,688	4,864	3,016	14,204	4,757	4,417	798	966	1,659
38	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
39	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
40	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
41	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
42	812	1,914	1,293	1,914	1,061	3,014	1,691	3,014	434	877	649	877	4,944	4,281	3,953	5,516	6,688	5,516	3,016	4,807	4,757	4,807	798	966	1,659
43	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
44	812	1,366	1,293	1,366	1,061	2,152	1,691	2,152	434	621	649	621	4,944	6,349	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
45	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	3,898	4,757	3,898	798	966	1,659
46	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
47	812	5,347	1,293	5,347	1,061	7,857	1,691	7,857	434	3,783	649	3,783	4,944	0	3,953	20,952	6,688	20,952	3,016	2,421	4,757	2,421	798	966	1,659
48	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659
49	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	20,760	4,757	20,760	798	966	1,659
50	812	0	1,293	0	1,061	0	1,691	0	434	0	649	0	4,944	0	3,953	0	6,688	0	3,016	0	4,757	0	798	966	1,659

Table 18 ECONOMIC PRICES FOR CROPS AND INPUTS

Description	Unit	Operation	Region I	Region II	Region V
A. Rice (Import Parity)					
1) Projected 1995 International Market Price (FOB Bangkok, 5% broken rice)	US$/ton		293	293	293
2) Ajust Quarity to 25-35% Broken	US$/ton	x 0.86	252	252	252
3) Ocean Freight and Insurance	US$/ton	+	30	30	30
4) CIF Manila	US$/ton	=	282	282	282
5) Converted to Philippine Peso	Peso/ton	x 21.0	5,926	5,926	5,926
6) Cost for Port Charge, Handling and Warehousing	Peso/ton	+	360	360	360
7) NFA Administration Charge	Peso/ton	+	70	70	70
8) Wholesale Price of Rice in Manila	Peso/ton	=	6,356	6,356	6,356
9) Transportation Cost (Manila to Region Capital)	Peso/ton	−	326	231	308
10) Price of Rice at Ex-mill Gate	Peso/ton	=	6,030	6,125	6,048
11) Milling Cost	Peso/ton	−	147	148	178
12) Conversion to Price of Dried Paddy	Peso/ton	x 0.65	3,824	3,885	3,815
13) Cost for Transportation and Handling (Farm Gate to Mill)	Peso/ton	−	52	39	51
14) Farm Gate Price of Dried Paddy	Peso/ton	=	3,772	3,846	3,764
	(Peso/kg)		(3.77)	(3.85)	(3.76)
B. Corn (Import Parity)					
a) Projected 1995 International Market Price (FOB US Gulf, Corn, Bulk)	US$/ton		−	130	−
b) Ocean Freight and Insurance	US$/ton	+	−	39	−
c) CIF Price at Manila	US$/ton	=	−	169	−
d) Converted to Philippine Peso	Peso/ton	x 21.0	−	3,559	−
e) Cost for Port Charge, Handling and Warehousing	Peso/ton	+	−	220	−
f) Ex-warehouse Price	Peso/ton	=	−	3,779	−
g) Cost for Transportation, Handling and Retail Margin	Peso/ton	+	−	300	−
h) Farm Gate Price	Peso/ton	=	−	4,079	−
	(Peso/kg)			(4.08)	
C. Fertilizers (Import Parity)					
1) Nitrogen					
a) Projected 1995 International Market Price (FOB N.W. Europe, Urea, Bagged)	US$/ton		229	229	229
b) Ocean Freight and Insurance	US$/ton	+	33	33	33
c) CIF Price at Manila	US$/ton	=	262	262	262
d) Converted to Philippine Peso	Peso/ton	x 21.0	5,495	5,495	5,495
e) Cost for Port Charge, Handling and Warehousing	Peso/ton	+	220	220	220
f) Ex-warehouse Price	Peso/ton	=	5,715	5,715	5,715
g) Cost for Transportation, Handling and Retail Margin	Peso/ton	+	375	300	360
h) Farm Gate Price	Peso/ton	=	6,090	6,015	6,075
i) Conversion to Price of Nitrogen (N)	Peso/ton	x 2.22	13,521	13,354	13,488
	(Peso/kg)		(13.52)	(13.35)	(13.49)
2) Phosphorus					
a) Projected 1995 International Market Price (FOB US Gulf, TSP, Bulk)	US$/ton		199	199	199
b) Ocean Freight and Insurance	US$/ton	+	39	39	39
c) CIF Price at Manila	US$/ton	=	238	238	238
d) Converted to Philippine Peso	Peso/ton	x 21.0	5,003	5,003	5,003
e) Cost for Port Charge, Handling and Warehousing	Peso/ton	+	220	220	220
f) Ex-warehouse Price	Peso/ton	=	5,223	5,223	5,223
g) Cost for Transportation, Handling and Retail Margin	Peso/ton	+	375	300	360
h) Farm Gate Price	Peso/ton	=	5,598	5,523	5,583
i) Conversion to Price of Phosphorus (P)	Peso/ton	x 4.55	25,470	25,128	25,401
	(Peso/kg)		(25.47)	(25.13)	(25.40)
3) Potassium					
a) Projected 1995 International Market Price (FOB Vancouver, Muriate of Potash, Bulk)	US$/ton		114	114	114
b) Ocean Freight and Insurance	US$/ton	+	33	33	33
c) CIF Price at Manila	US$/ton	=	147	147	147
d) Converted to Philippine Peso	Peso/ton	x 21.0	3,080	3,080	3,080
e) Cost for Port Charge, Handling and Warehousing	Peso/ton	+	220	220	220
f) Ex-warehouse Price	Peso/ton	=	3,300	3,300	3,300
g) Cost for Transportation, Handling and Retail Margin	Peso/ton	+	375	300	360
h) Farm Gate Price	Peso/ton	=	3,675	3,600	3,660
i) Conversion to Price of Potassium (K)	Peso/ton	x 1.92	7,055	6,911	7,026
	(Peso/kg)		(7.06)	(6.91)	(7.03)

Remarks : Region I ; Bonga Pump #1, #2 and #3
Region II ; Alcala-Amulung, Solana
Region V ; Libmanan-Cabusao

Source : Half-Yearly Revision of Commodity Price Forecasts, IBRD, February 1, 1988
Data were obtained from following Authorities ;
National Food Authority (NFA),
National Economic and Development Authority (NEDA),
Philippine National Lines, and
Fertilizer and Pesticide Authority.

Fig. 1 Basic Approach to the Improvement of Operation and Maintenance of the National Pump Irrigation Systems

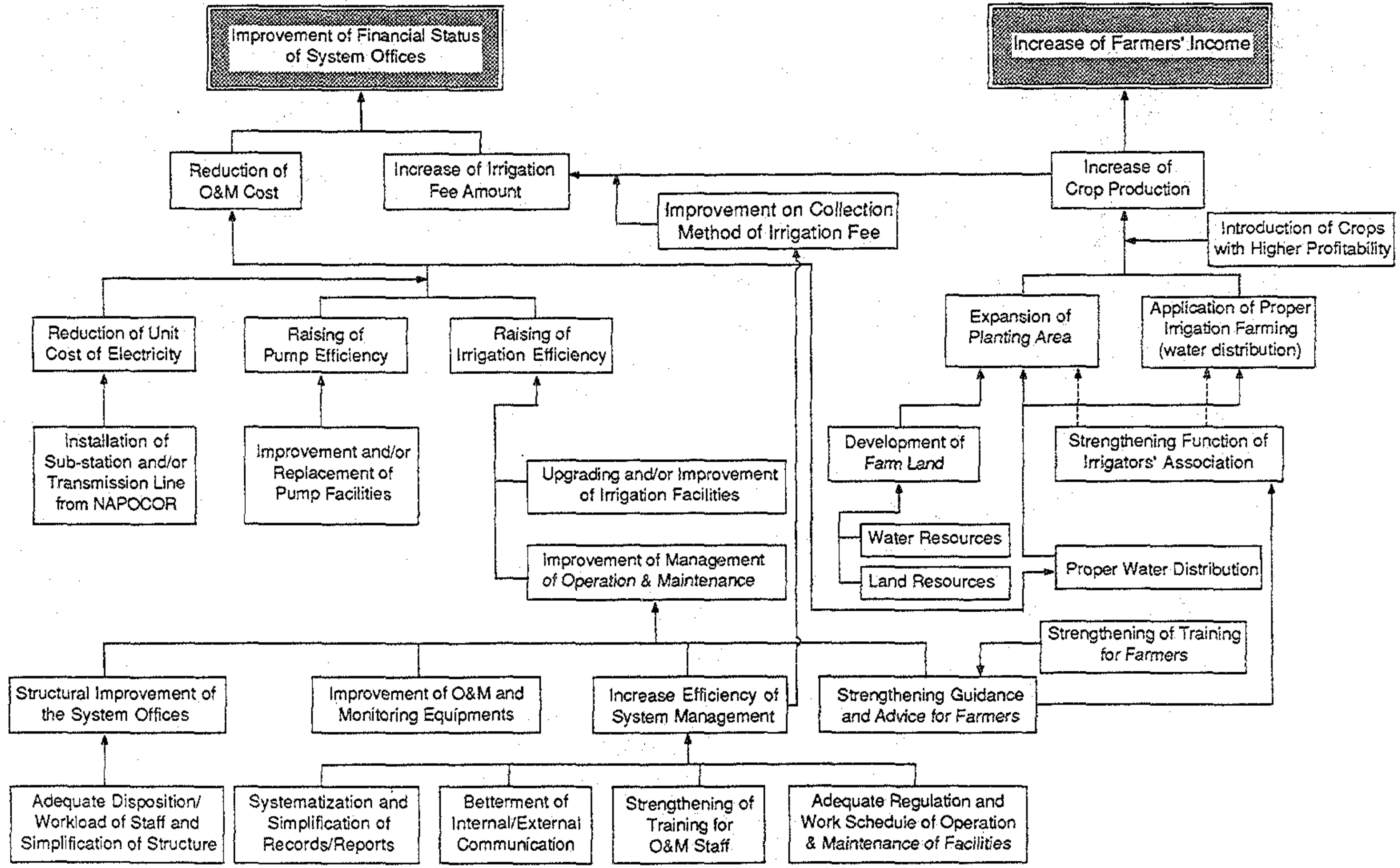


Fig.2 GENERAL LAYOUT OF BONGA PUMP #1 IRRIGATION SYSTEM

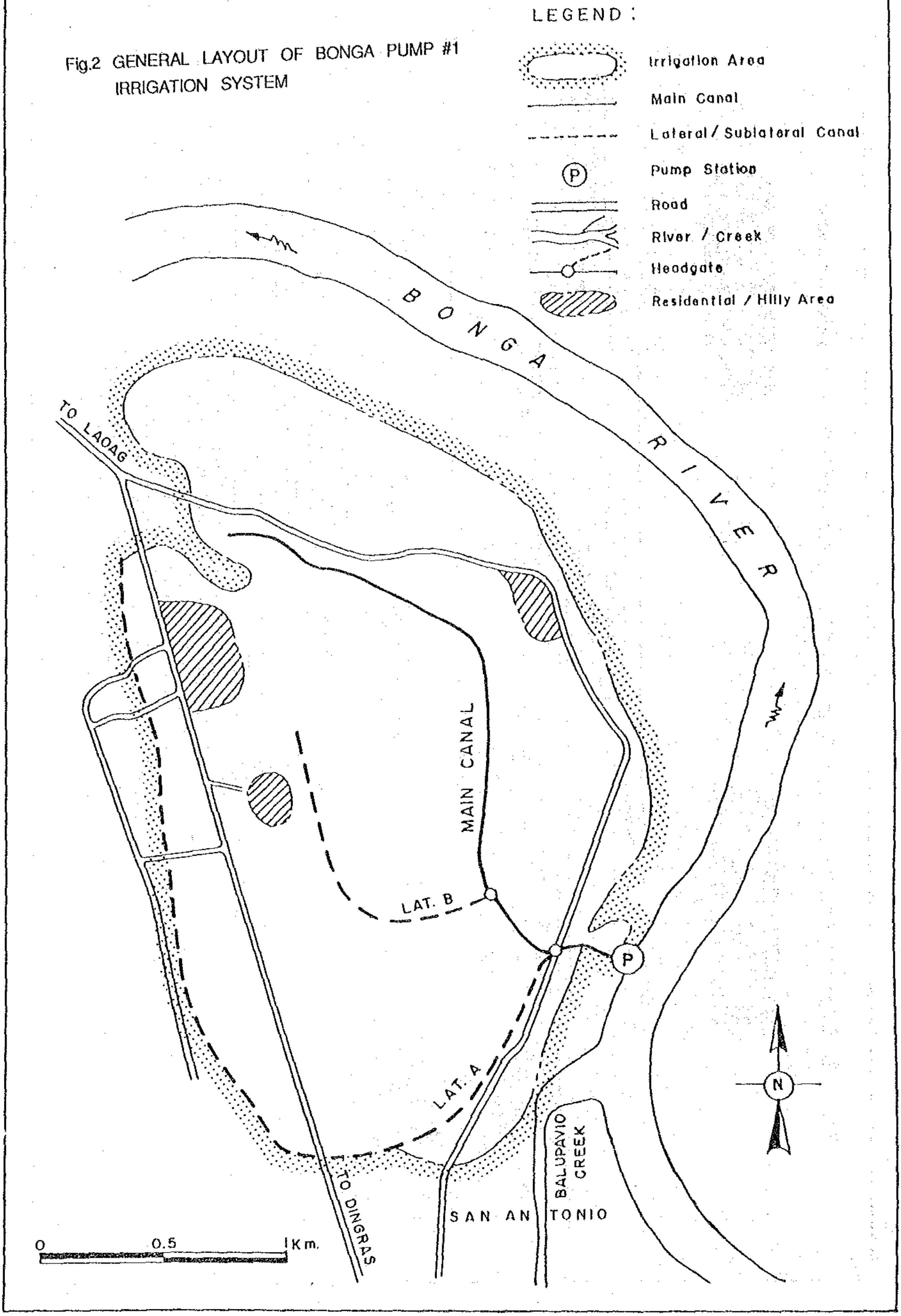


Fig.3 GENARAL LAYOUT OF BONGA PUMP #2 IRRIGATION SYSTEM

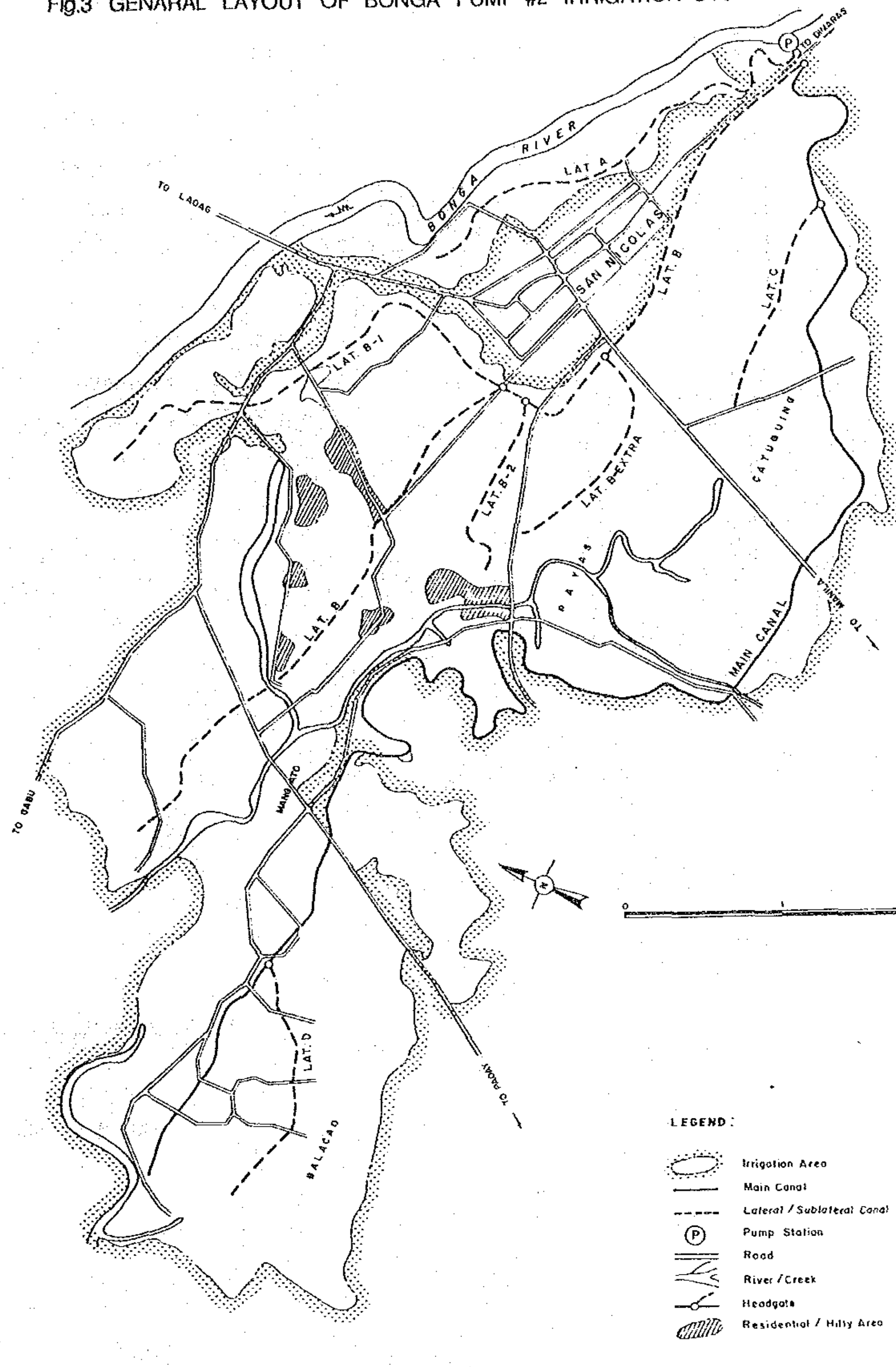


Fig.4 GENERAL LAYOUT OF BONGA PUMP #3 IRRIGATION SYSTEM

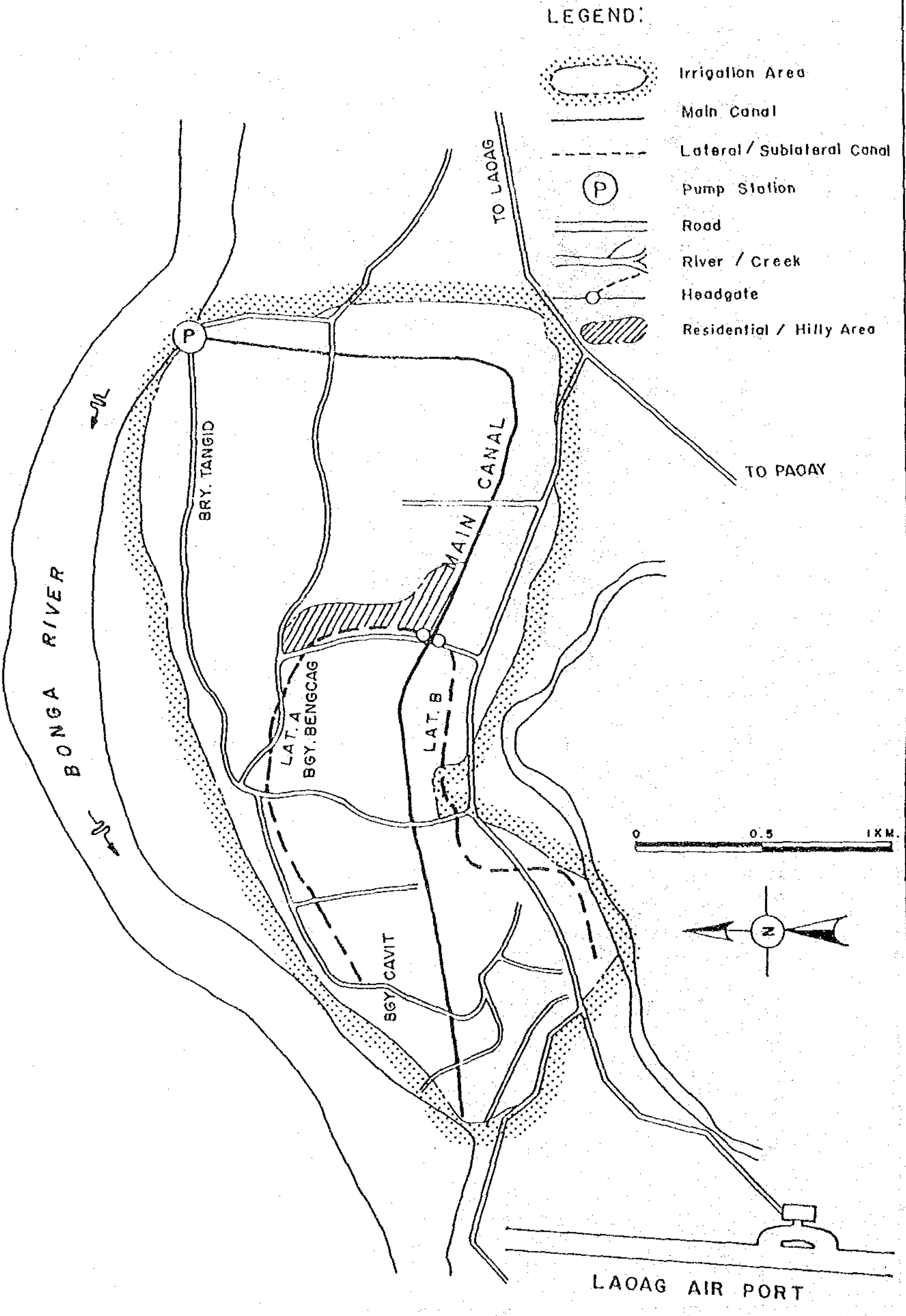


Fig.5 GENERAL LAYOUT OF ALCALA-AMULUNG PUMP IRRIGATION SYSTEM

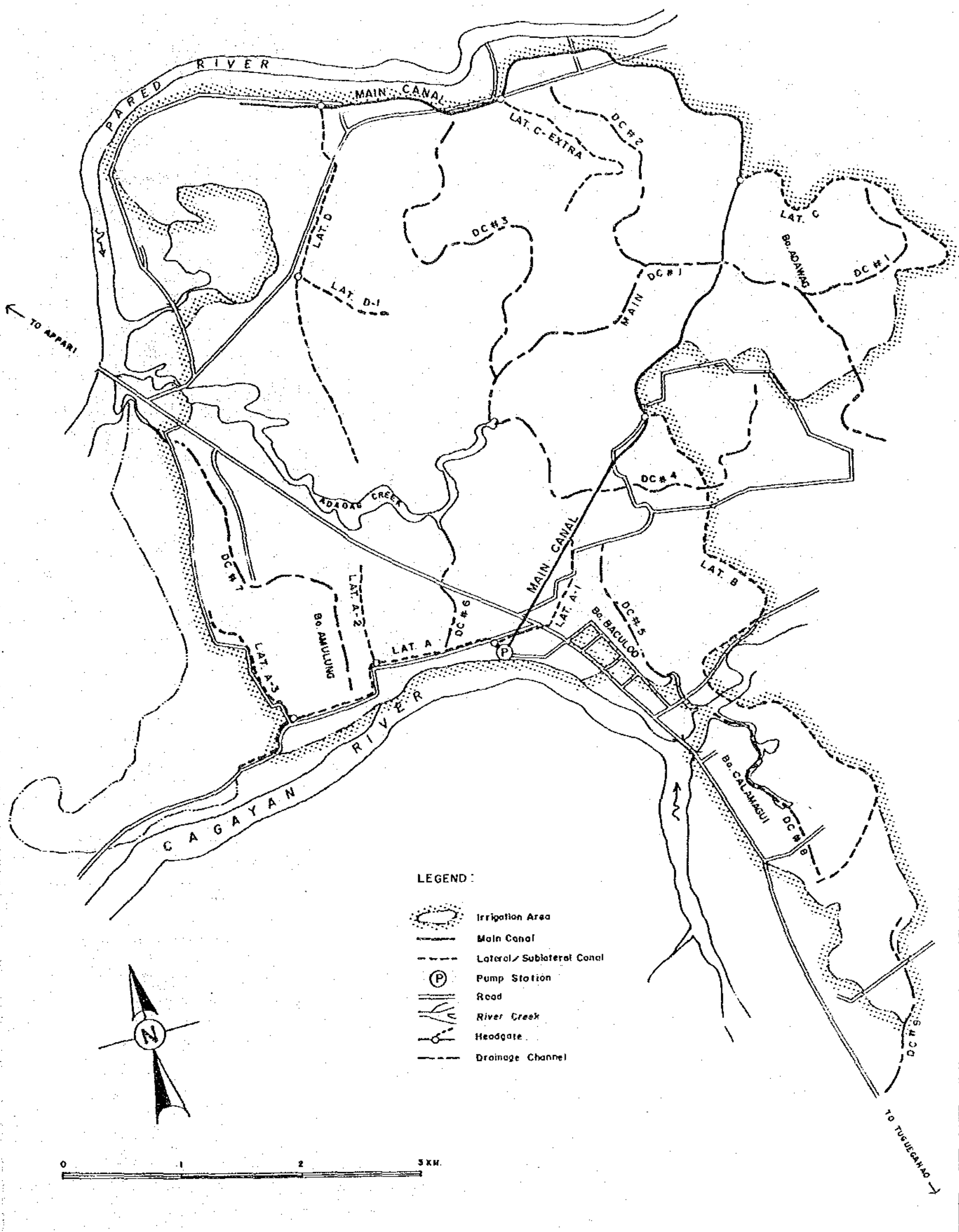


Fig.6 GENERAL LAYOUT OF SOLANA PUMP IRRIGATION SYSTEM

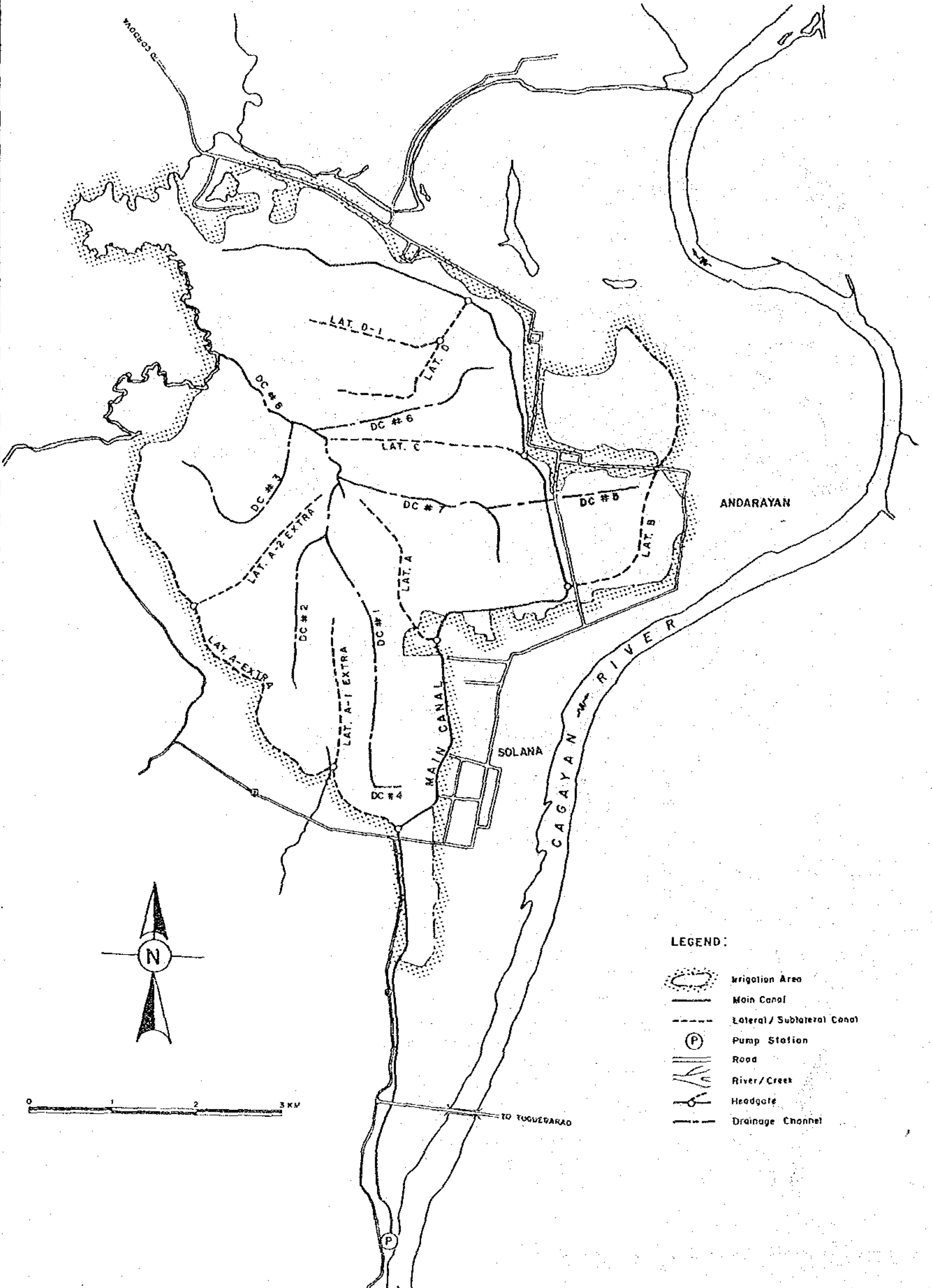


Fig.7 GENERAL LAYOUT OF LIBMANAN-CABUSAO PUMP IRRIGATION SYSTEM

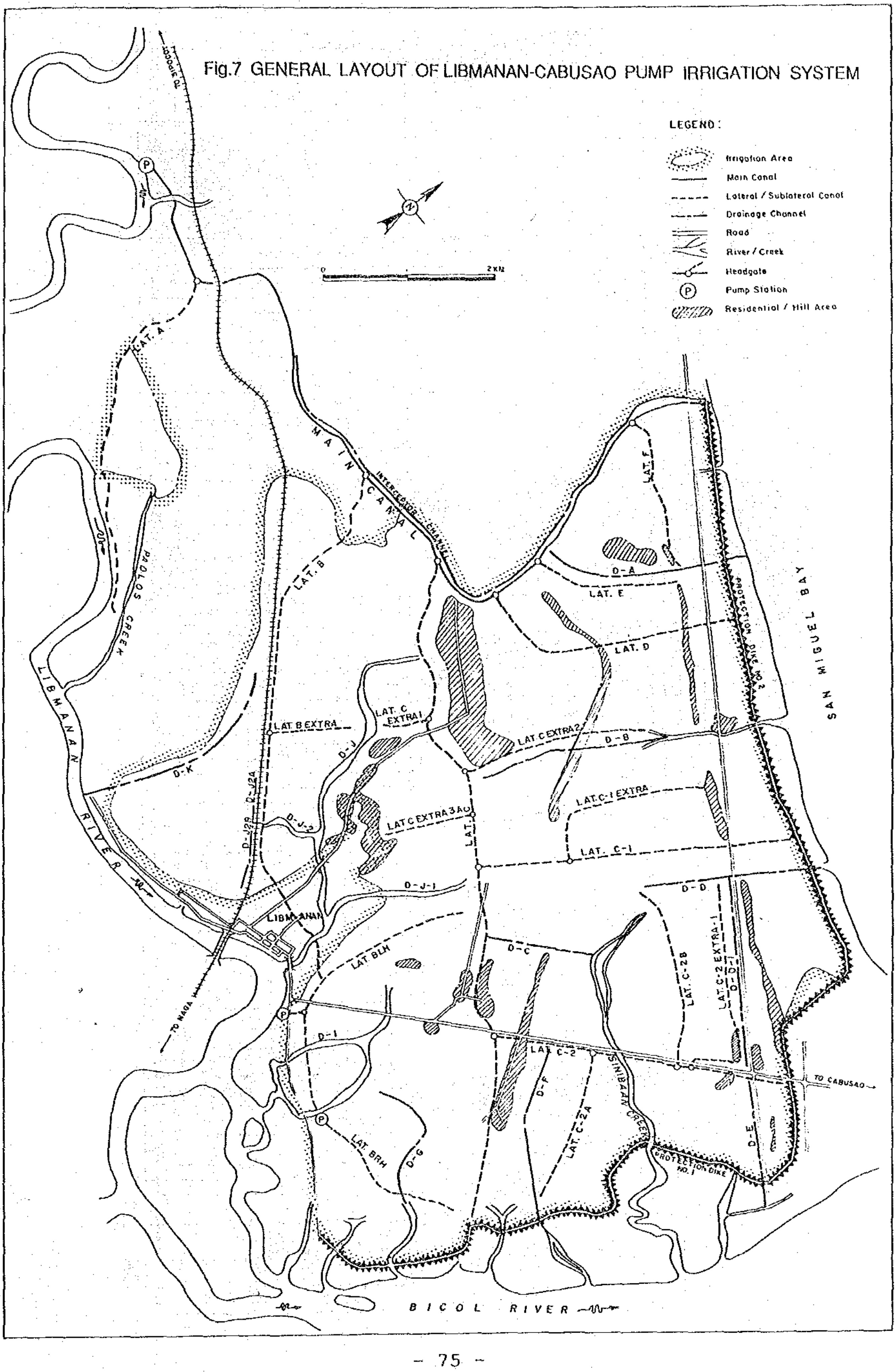


Fig. 8 (1/2) PROPOSED CROPPING PATTERN

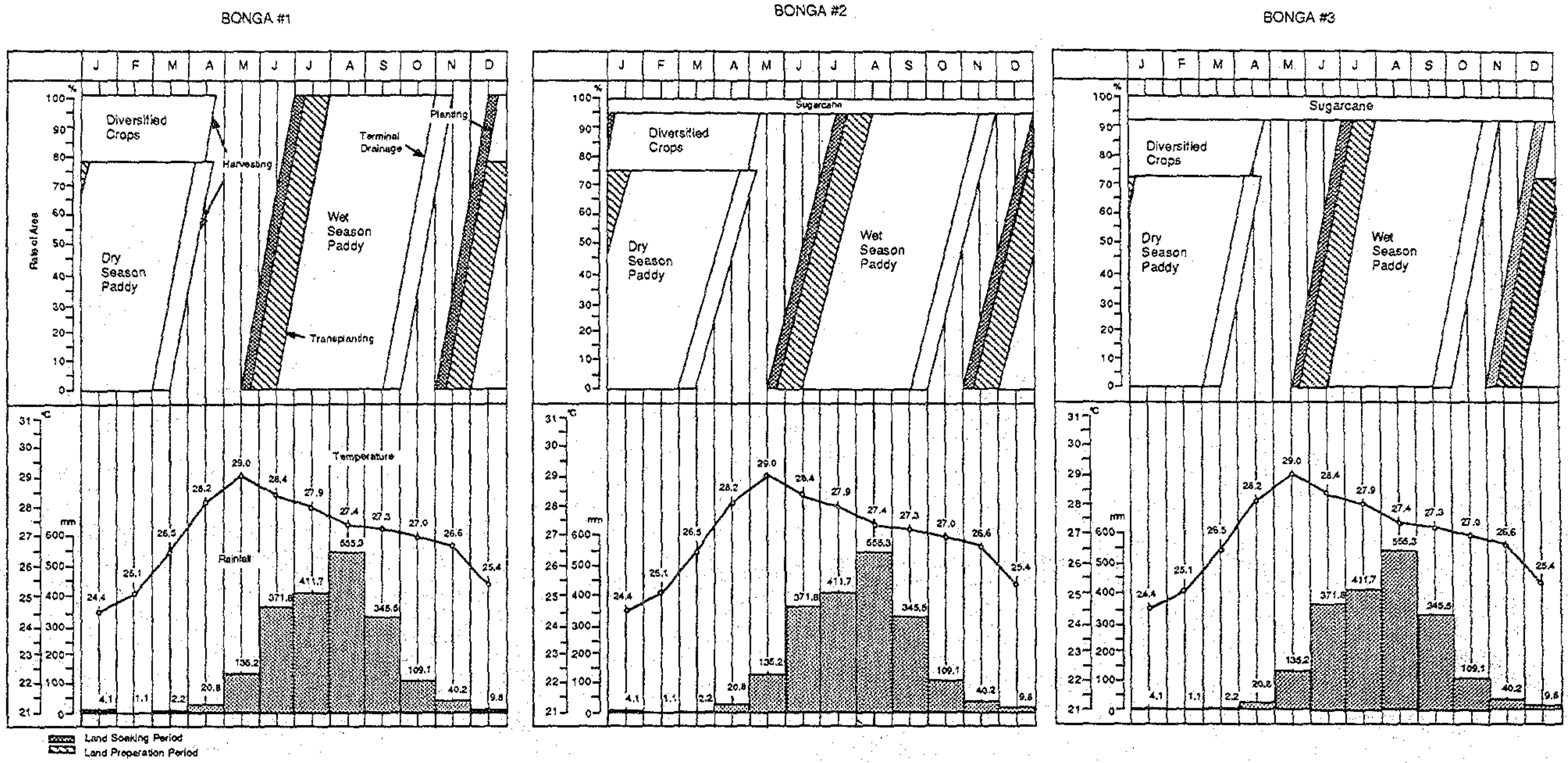
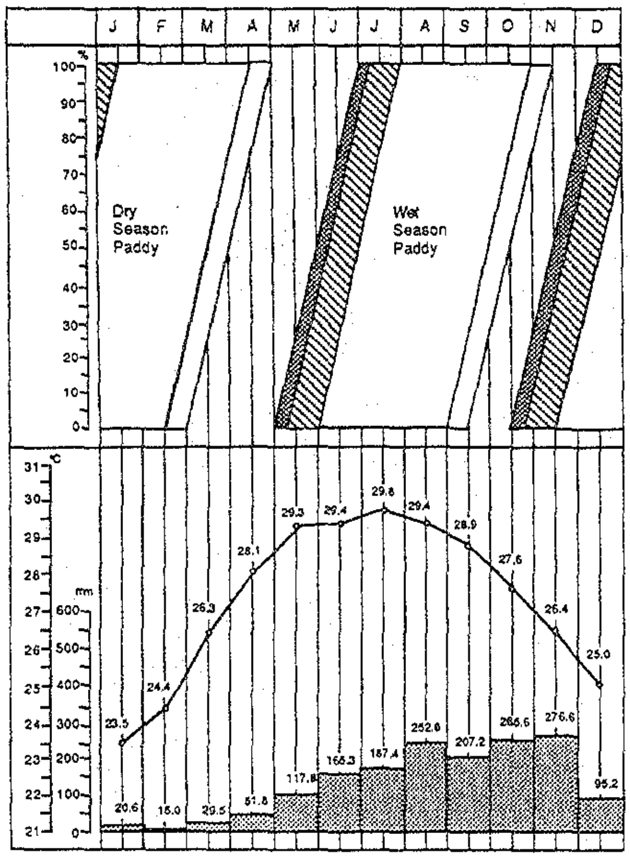
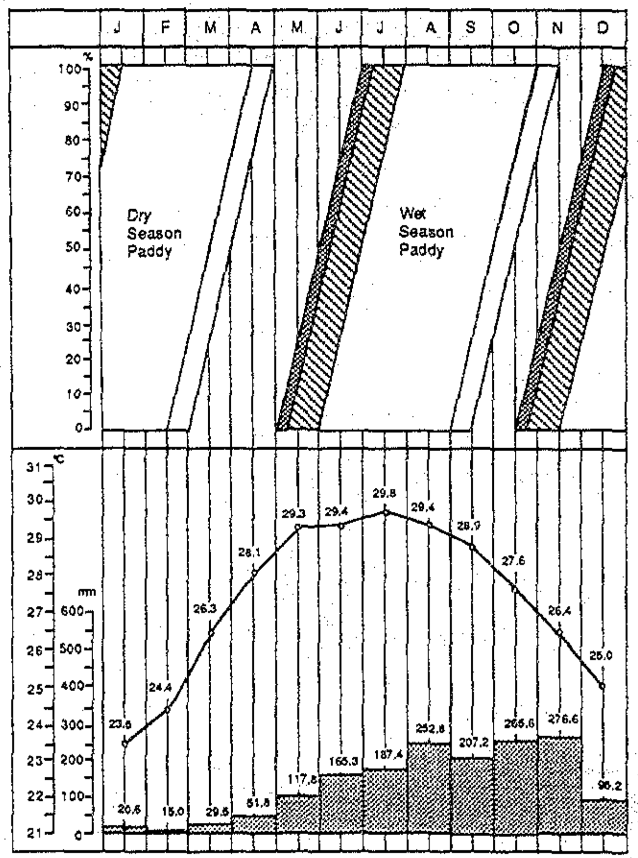


Fig. 8 (2/2) PROPOSED CROPPING PATTERN

ALCALA-AMULUNG



SOLANA



LIBMANAN-CABUSAO

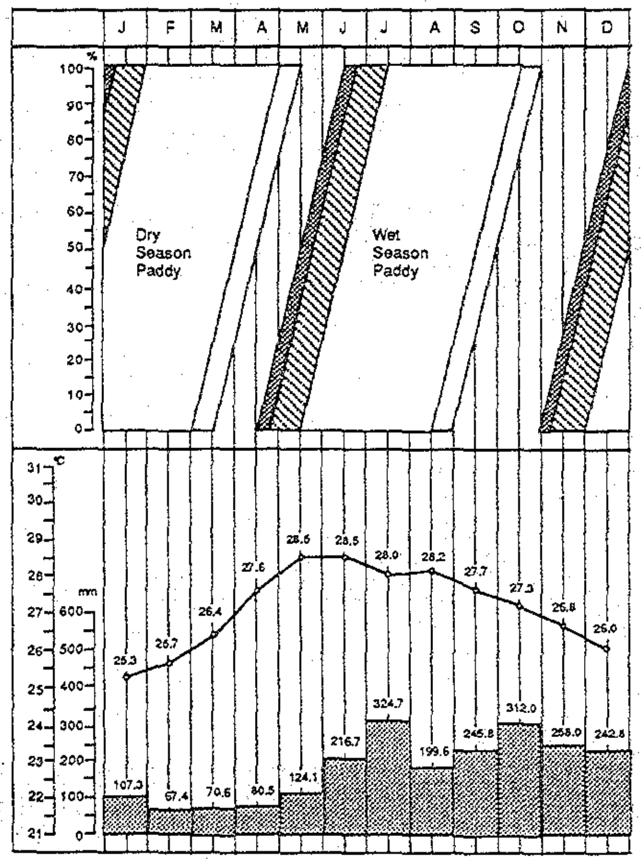


Fig.9 GENERAL LAYOUT AND PROFILE OF NO.1 SITE

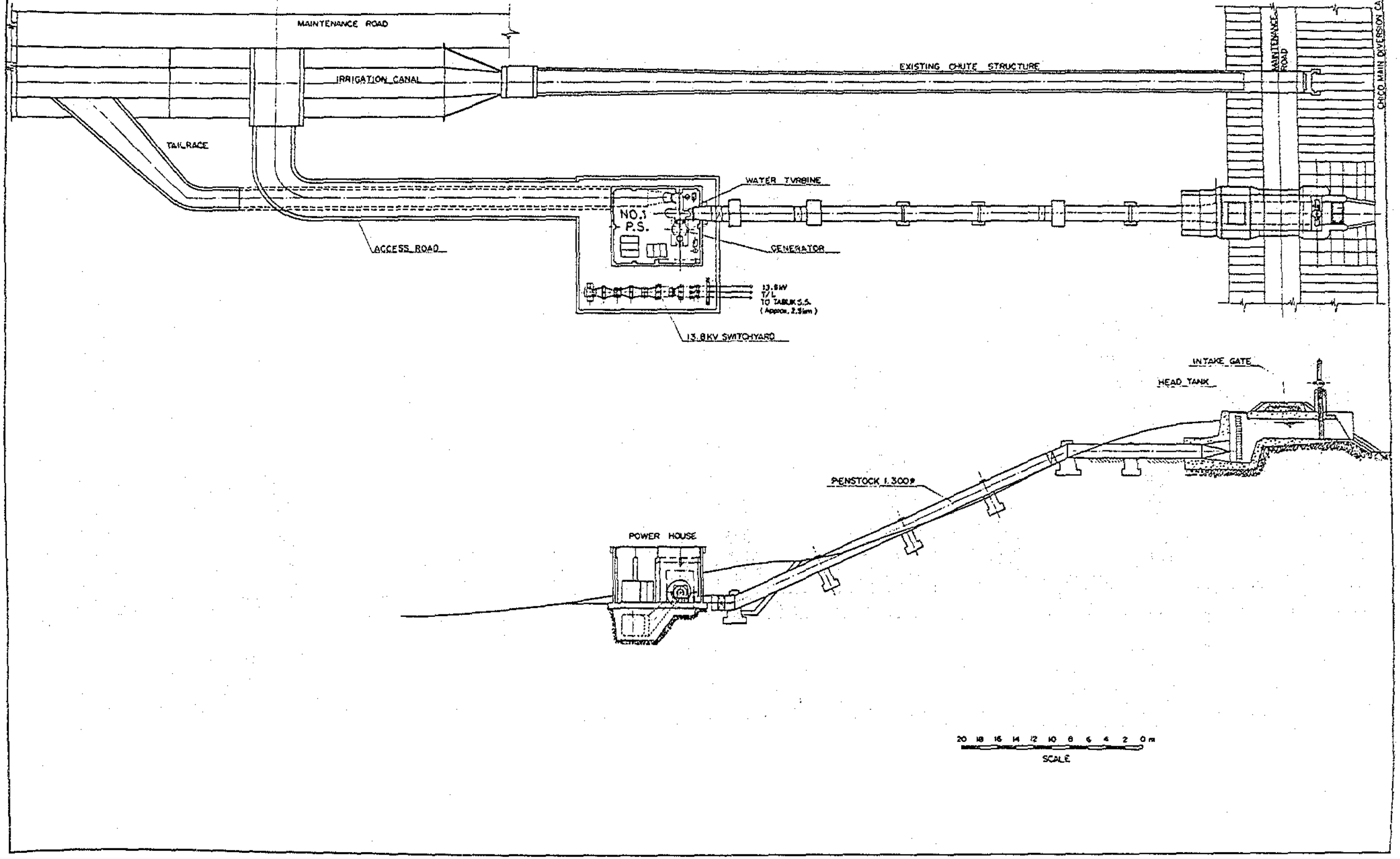


Fig.10 GENERAL LAYOUT AND PROFILE OF NO.2 SITE

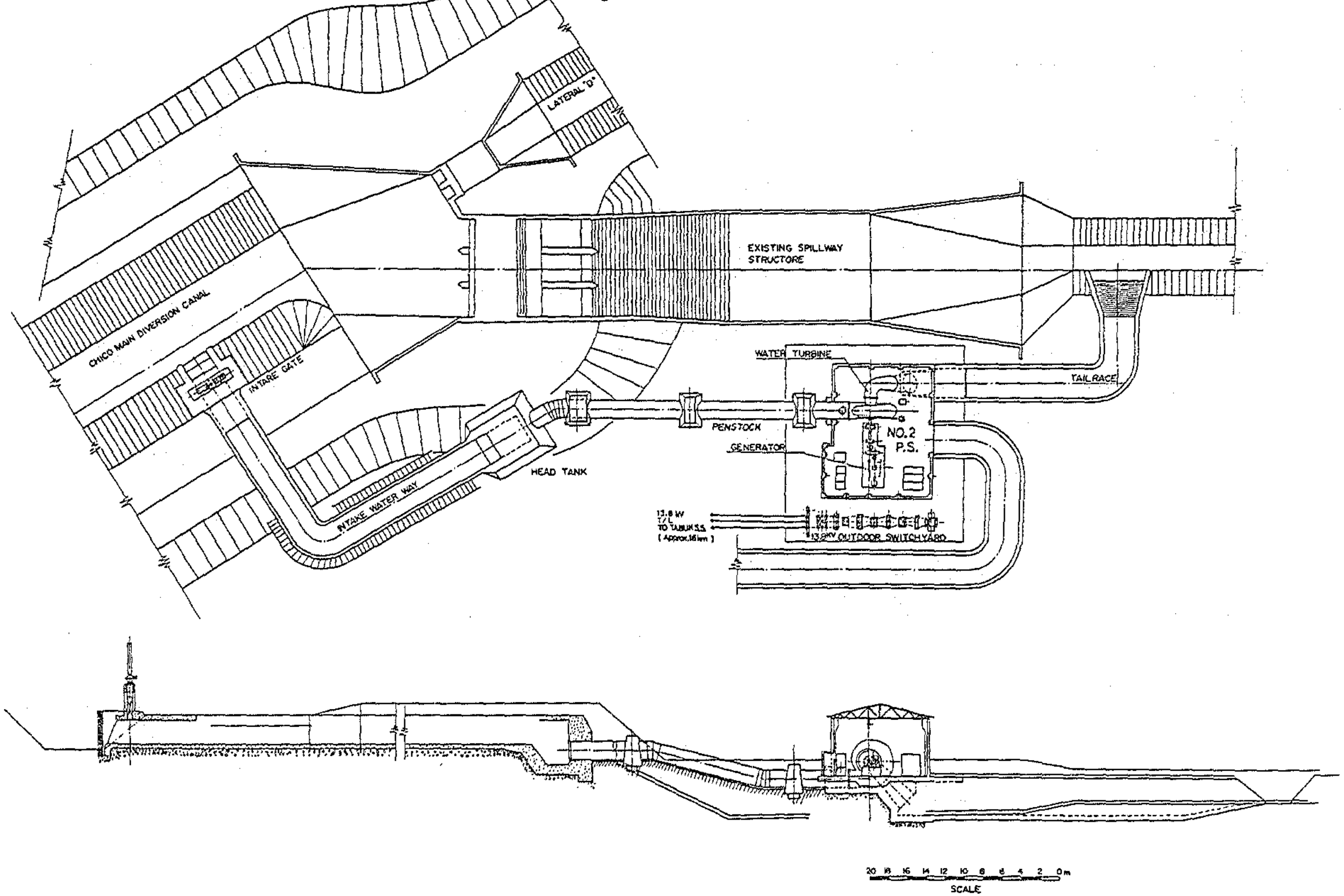
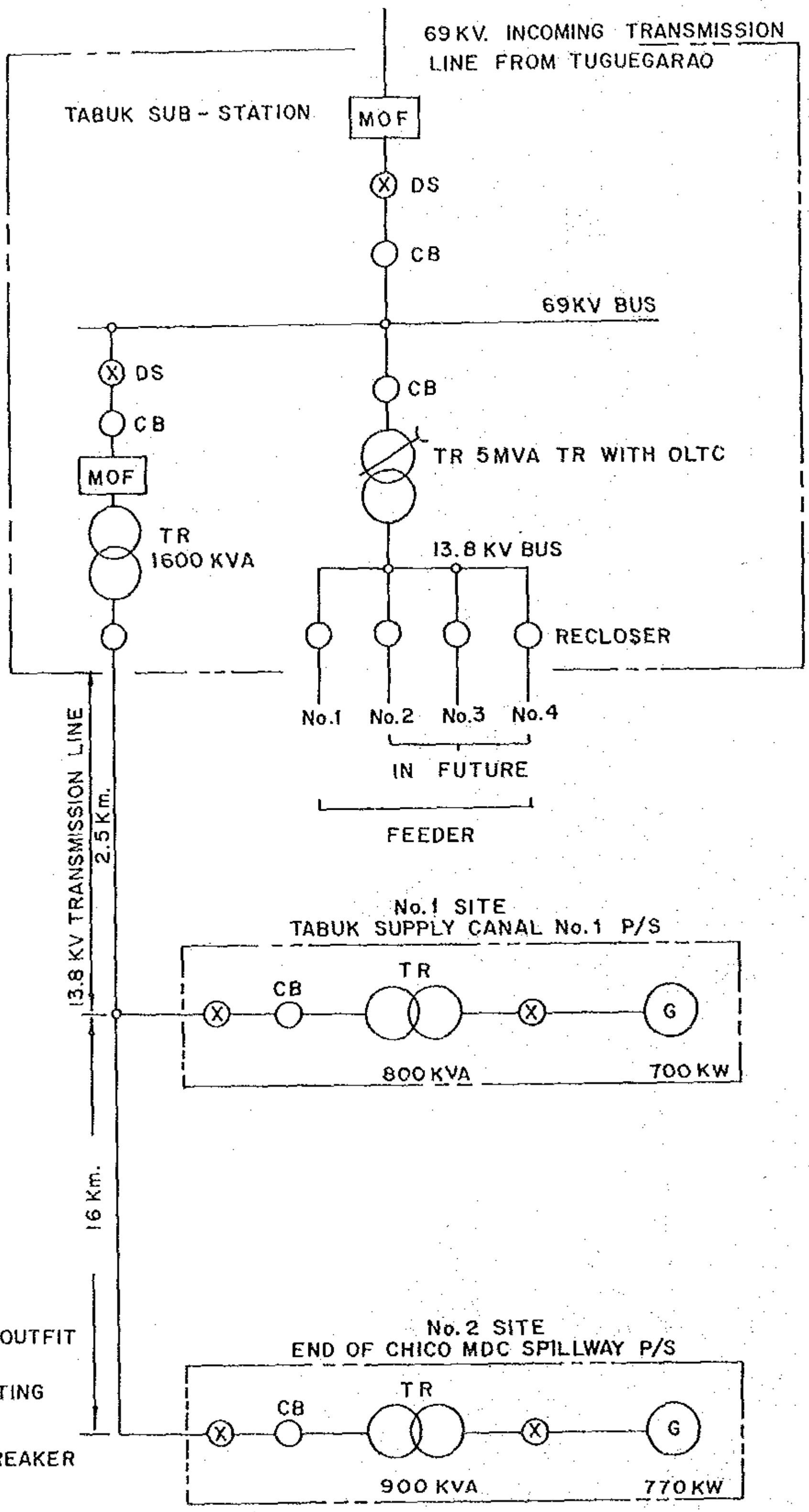


Fig.11 SINGLE LINE DIAGRAM FOR MINI-HYDRO SYSTEM IN CHICO RIS



LEGEND:

MOF = METERING OUTFIT

DS = DISCONNECTING SWITCH

CB = CIRCUIT BREAKER

TR = TRANSFORMER

G = HYDRO-GENERATOR