THE REPUBLIC OF THE PHILIPPINES

BASIC DESIGN REPORT

ON

TERMINAL IRRIGATION FACILITIES PROJECT IN ILOCOS NORTE IRRIGATION PROJECT

AUGUST 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF THE PHILIPPINES

BASIC DESIGN REPORT

ON

TERMINAL IRRIGATION FACILITIES PROJECT IN ILOCOS NORTE IRRIGATION PROJECT

AUGUST 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

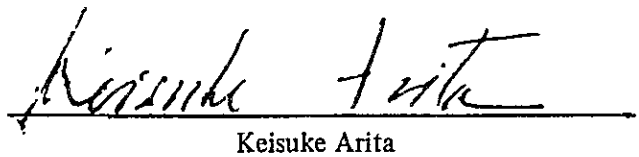
In response to the request of the Government of The Republic of the Philippines, the Japanese Government decided to conduct a survey on the Terminal Irrigation Facilities Project in Ilocos Norte Irrigation Project and entrusted the survey to the Japan International Cooperation Agency. The J.I.C.A. sent to Philippines a survey team headed by Mr. Susumu Takamine from February to March, 1980.

The team exchanged views with the officials concerned of the Government of the Republic of the Philippines and conducted a field survey in Ilocos region, Philippines. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

August, 1980



Keisuke Arita
President
Japan International Cooperation Agency

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND GLOSSARY

Agencies

ACA:	Agricultural Credit Administration
ADB:	Asian Development Bank
AMC:	Area Marketing Cooperatives
BAEcon:	Bureau of Agricultural Economics
BAEx:	Bureau of Agricultural Extension
BAI:	Bureau of Animal Industry
BPI:	Bureau of Plant Industry
BS:	Bureau of Soils
BPW:	Bureau of Public Works
CB:	Central Bank of the Philippines
FPA:	Fertilizer and Pesticide Authority
FaCoMa:	Farmers Cooperatives Marketing Association
IBRD:	International Bank for Reconstruction and Development
IDA:	International Development Association
INECO:	Ilocos Norte Electric Cooperation
ISECO:	Ilocos Sur Electric Cooperation
JICA:	Japan International Cooperation Agency
MA:	Ministry of Agriculture
MANR:	Ministry of Agriculture and Natural Resources
MAR:	Ministry of Agrarian Reform
MF:	Ministry of Finance
MLGCD:	Ministry of Local Governments and Community Development
MPH:	Ministry of Public Highways
NACIAD:	National Council of Integrated Area Development
NCSO:	National Census and Statistics Office
NFAC:	National Food and Agricultural Council
NEA:	National Electrification Administration
NEDA:	National Economic and Development Authority
NGA:	National Grains Authority

Abbreviations and Glossary (cont'd.)

NIA:	National Irrigation Administration
NISIS:	National Irrigation System Improvement Study
NPC:	National Power Corporation
OECF:	Overseas Economic Cooperation Fund
PNB:	Philippine National Bank
PAGASA:	Philippines Atmospheric Geophysical and Astronomical Services Administration
PVTA:	Philippine Virginia Tobacco Association
RB:	Rural Bank
SN:	Samahang Nayon
UPIP:	University of the Philippines, Institute of Planning
USAID:	United States Agency for International Development
USBR:	United States Department of Interior, Bureau of Reclamation

Unit of Measurement

mm:	millimeter
cm:	centimeter
m:	meter
km:	kilometer
sq.cm, cm^2:	square centimeter
sq.m, m^2:	square meter
sq.km, km^2:	square kilometer
MSM, $10^6 m^2$:	million square meter
ℓ, lit:	liter
cu.m, m^3:	cubic meter
MCM, $10^6 m^3$:	million cubic meter
lit/sec:	liter per second
m/sec:	meter per second
cu.m/sec	cubic meter per second
PPM:	part per million

Unit of Measurement (cont'd.

g:	gram
kg:	kilogram
ton, m.t.:	metric ton
cavan:	50 kg
EL:	elevation above mean sea level
MSL:	mean sea level
FWL:	full water level
HWL:	high water level
LWL:	low water level
sec:	second
min.:	minute
hr:	hour
min:	minimum
max :	maximum
%:	percent
No.:	number
^{o}C:	degree centigrade
^{o}F:	degree fahrenheit
Cl:	chlorine
HP:	horse power
GWH:	gigawatt hour
ET:	evapotranspiration
N:	nitrogen
P:	phosphorous
K:	potassium
HYV:	high yielding variety
O & M:	operation and maintenance
IRR:	internal rate of return
B/C:	benefit cost ratio
FY:	fiscal year
₱:	Peso, ₱1.00 = approx. US$0.135
$:	Dollar, US$ = approx. ₱7.40

Conversion Factors

Unit	Comparison	English Equivalents
Units of Length		
Millimeter (mm)	0.001 meter	0.0394 inch
Centimer (cm)	0.01 meter	0.3937 inch
Meter (m)		3.2800 feet
Kilometer	1,000 meters	0.6213 mile
Units of Area		
Square centimer (cm^2)	0.0001 m^2	0.155 square inch
Square meter (m^2)		10.764 square feet
Hectare (ha)	10,000 m^2	2.471 acres
Square kilometer (km^2)	1,000,000 m^2	0.3861 square mile
Units of Volume		
Cubic centimeter (cm^3)		0.061 cubic inch
Liter (1,000 cm^3)	0.001 m^3	1.0567 quarters (liquid)
Cubic meter (cu.m)	1,000 liters	35.3145 cubic feet
Unit of Weight		
Gram (g)		0.0353 ounce
Kilogram (kg)	1,000 grams	2.2046 pounds
Metric Ton (mt)	1,000 kg	2,204.6 pounds

Miscellaneous

1 cu.m per sec.	=	1,000 liters per second (ℓ/s)
	=	35.3145 cu.ft per second (cfs)
	=	15,850 gallons per minute (gpm)
1 liter per second for 1 day	=	8.64 mm depth over one hectare
10 mm depth over 1 hectare	=	1.157 liters per second for 1 day
	=	3,532 cu.ft
1 horsepower (metric)	=	75 kg-m per second
1 horsepower (English)	=	550 ft-lb per second
1 cu.m of water per second under 1 m head	=	9.81 kw @ 100% efficiency
1 x 10^6 cu.m of water per hour under 1 meter head	=	2,724 kwh @ 100% efficiency

Terminology

Arable land:	Land identified in the land classification investigation as having adequate productivity to warrant consideration for irrigation.
Bamboo:	Bambusa Spinosa Roxb. a woody grass with a big hollow in the center of internodes, growing in groves or clumps reaching a height of 25 meters or more.
Barrio:	A political subdivision of a town
Sitio:	Sub-division of Barrio
Carabao:	The animal that most farmers use for plowing and other farm work. It is about the size of an ox and is similar to the water buffalo in other Asian countries.
Ganta:	Common unit of volume for rice equivalent to 2.24 kilograms of milled rice.
Hectare:	A metric measure containing 10,000 square meters equivalent to 2.471 acres
IR-8, IR-5, IR-20:	High yielding rice varieties from the IRRI, Los Banos, Laguna, Philippines
Irrigable land:	That portion of the arable land which is included in the irrigation service plan
Monsoon:	Periodic wind that blows from the sea to the continent and oppositely in winter
Nipa:	Heavy-leafed type of reed used in thatching huts
Province:	A political subdivision of a country comprising several towns
Share tenancy:	A practice where operators rent the land they work and pay as rent, a share of the cash or crops grown.
Trade wind:	One of the three Philippine air currents, comprising from a generally easternly direction reaching the islands during the period from February to April.
Typhoon:	A storm or system or winds occurring in the Philippines and China Sea regions, known as hurricane in the West Indies and South Pacific, cyclone in the Indian Ocean.

CHAPTER I. BACKGROUND

1. Ilocos Norte Province is located in the north-western part of the Luzon Island, the Philippines, and is one of the provinces which are left behind others in their economic development. Though agriculture plays the most important role in the regional economy, only 17 percent of paddy field is irrigated in the dry season. Those existing irrigation facilities are considerably deteriorated and not equipped with measurement devices, not functioning properly in spite of water management by Communal Irrigation System.

Under the circumstances, the per capita income in 1975 in this region is only 955 pesos, which is much lower than that of the national average, 1,601 pesos per annum. Due to the above situations, a considerable number of population has transmigrated to the Greater Manila and other urban areas to reduce the population growth rate of the region. To cope with such an unfavorable situation in terms of economic development in rural areas, the Government of the Philippines has drawn up a plan to promote an economic development in the region.

2. The National Irrigation Administration (NIA) made a study and conceived a plan for possible irrigation projects in the region in early 1975. The plan was then developed to an Integrated Rural Area Development Project in 1976, putting emphasis on the agricultural development, which would be promoted and implemented under the direct supervision of the Government. As the agricultural development under the said Integrated Development Project, the NIA conducted further studies and formulated the Palsiguan River Multi-Purpose Project in March 1977 under close cooperation of the National Economic Development Authority (NEDA).

3. In May 1977, the NEDA made a request for technical assistance in the study on the subject project of the Japanese Government's Mission which was dispatched to the Philippines by the Ministry of Foreign Affairs, Japan. In August 1977, the request was officially made by the Government of the Philippines to the Government of Japan through the Embassy of Japan in Manila. In response to this request, the Japan International Cooperation Agency (JICA) dispatched a Preliminary Survey Team for the Ilocos Norte Irrigation Project to the Philippines in October 1977. As a result of preliminary survey, the following phased development plan has been recommended to be promoted to comply with the strong desire of the Philippine Government for early implementation of the Project.

Phase I Development: Development of partial area where early effect can be expected.

Phase II Development: Overall development including the Palsiguan Dam and hydropower generation.

4. For the feasibility study of Phase I Development, a survey team was dispatched for the period of three months from August 1978 and submitted the report in May 1979. In this study, the following development plan has been made for Phase I Area.

i) Formulation of an overall development plan for the whole Project Area including Palsiguan Dam as irrigation water resources based on the fundamental data collected.

ii) Within the framework of the overall plan, the feasibility study of a provisional water supply plan for the area of about 10,200 ha located on the right bank of the Bonga river.

The Philippine Government is requesting Yen-credit from the Economic Cooperation Fund (OECF) for the development of Phase I Area.

5. For the feasibility study of Phase II Development, the survey was conducted for the period of three months from January 1980, the report will be submitted by December 1980.

6. At the start of development in this area, the Philippine Government requested the Japanese Government technical assistance to level up the terminal water management techniques among farmers, which is one of the important factors to lead the project to the full target.

This basic design report has been submitted to comply with the request from the Philippine Government.

CHAPTER II. EFFECTS OF THE PROJECT

It is impossible to evaluate quantitatively by economic indexes the effects of this project aiming at levelling up the terminal water management techniques. Thus, the project was evaluated in qualitative manner considering the impacts that can be expected.

The expected impacts and its meanings are as follows:

Quick Improvement of Terminal Irrigation Efficiency

In the irrigation system from intake to terminal facilities, conveyance control from intake to terminal facilities will be managed by NIA and distribution control in terminal facilities will be managed by farmers. Since the water conveyance will be controlled by NIA which has sufficient techniques and experiment, a target conveyance efficiency will be achieved in early stage. However, it will take long time to achieve a target distribution efficiency in the terminal facilities because of management by farmers. Therefore, the quick improvement of terminal irrigation efficiency will cause the significant effect of the irrigation project in the economic point of view.

Impacts to the Whole Ilocos Norte Irrigation Area

Desirable impacts can be expected not only in the Project Area but also the whole Ilocos Norte Irrigation Area, which covers an area of 23,000 ha. It will be required to extend these desirable impacts actively through extension works.

Acceleration of Organization of Farmers' Association

Terminal water management cannot be achieved without cooperative water usage by farmers. Thereby, the terminal irrigation facilities will be managed by the Famrers Irrigators' Association (FIA) which will be newly organized. FIA will be expected

to perform not only terminal water management but necessary input material supply, credit, marketing and processing as supporting services for farm management, and will hence work as one of the important factors in the Ilocos Norte Irrigation Project. The organization of FIA will be accelerated through levelling up of terminal water management techniques aimed for this Project and thus FIA is expected to be expanded in order to have higher functions.

CHAPTER III. THE PROJECT AREA

3.1. Location and Roads

The Project Area is located in the Ilocos Norte province, which is in the north-western region of Luzon Island. It is about 480 km far from Manila and about 25 km south-east of Laoag City, the capital of the province. Ilocos Norte province has a population of aobut 371,700 as of May 1, 1975 and land area of 3,400 sq. km bordered on the north and west by the South China Sea and on the north-east by the Cordillera Central Range and on the south-east by the Ilocos Range. The province belongs to the Region I.

The Project Area is situated at the north edge of Phase I Area of 10,200 ha in the Palsiguan River Multi-Purpose Project. The Project Area covers an irrigation area of 1,000 ha within Labugaon Area (land area: 2,290 ha) bounded by Labugaon River on the north and by Solsona River on the south.

The Project Area is connected to Laoag City by the national road Route 2, completely paved through the bridge of the length about 1 km across the Bonga River; thereby, the Area has a good transportation road. Laoag City is connected to Manila by national road Route 3 and ocean & air routes are available as alternative course.

In the Area, village roads are paved with gravels and have no crossing drainage facilities. Therefore, the transportation is cut-off often due to the flooding on the roads during wet season and is obstruction causes the difficulties on transportation of living necessities and products and on communication among villages.

3.2. Topography and Rivers

The Project Area is located on the complicated alluvial fan of width 2.5 km and length 10 km developed by the rivers of Labugaon and Solsona having the sources in the Ilocos Range and by the Bonga

flowing along the lower edge of fan. The land slope ranges from 1:100 at higher area to 1:250 at lower area. The elevation is from 25 m above the mean sea level to 100 m, thus, the difference is 75 m.

Irrigation water is taken from the Labugaon and the Solsona rivers by the brush dams. The brush dam is so weak that it is often scoured by several foods in a year. Since the Bonga river flows in the lower reaches, it is not used as water resource to the Area. The important rivers in the Phase I Area are shown in Table 1 below.

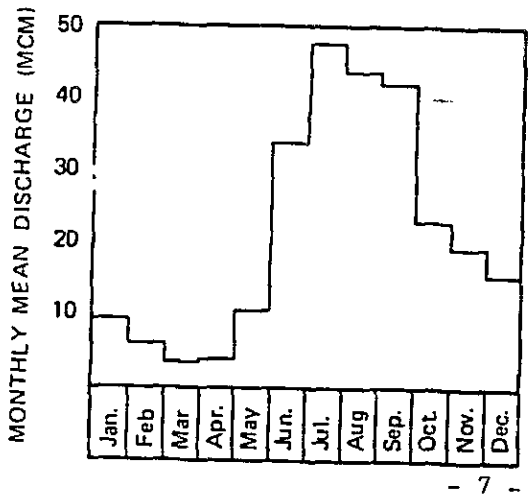
TABLE-1. RIVERS IN PHASE I AREA

Elements	Labugaon River	Solsona River	Madongan River	Papa River	Nueva Era River	Total
Catchment Area (sq km)	100.5	79 0	153.8	51.4	57.0	441.7
Annual Run-off (MCM)	258.8	203 5	301 2	132 3	146 8	) 1960-1970
Annual Run-off Depth (mm)	2,576.0	2,576.0	1,958 0	2,576.0	2,576 00	) Mean Value
Design Flood (cu.m/sec)	1,310 0	1,030 0	2,000.00	670.0	750 0	1/50 Year
Data Source: Feasibility Report on Ilocos Norte Irrigation Project, May 1979, JICA						

- Monthly Mean Run-off

Monthly mean run-off of the Labugaon river which will be expected to be the water resource for the Project Area is shown in Figure 1 below. Based on this figure, it is indicated that the monthly mean run-off becomes minimum from March to April and maximum in July.

FIGURE-1. MONTHLY MEAN RUN-OFF OF THE LABUGAON RIVER



MONTHLY MEAN RUN-OFF (1960 - 1970)

Jan.	9.45 MCM	3.53 cu.m/sec
Feb.	6.03	2.47
Mar.	3.56	1.33
Apr.	3.73	1.44
May	10.63	3.97
Jun.	33.83	13.05
Jul.	47.59	17.77
Aug.	43.73	16.33
Sep.	42.07	16.23
Oct.	23.25	8.68
Nov.	19.38	7.48
Dec.	15.57	5.81
Total	258.82 MCM	

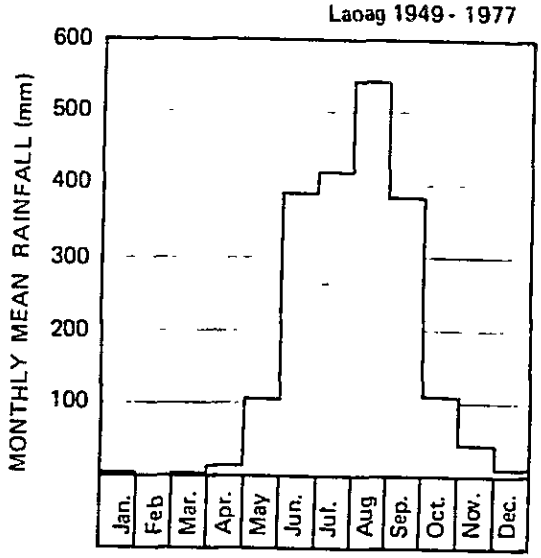
3.3. Climate

The climate in the Project Area is clearly separated into two pronounced seasons, namely, the dry season from November to April and the wet season from May to October, and it belongs to the Tyep I climate-zone among the four climate-zones in the Philippines.

- Rainfall

Annual rainfall which is shown in Table 2), is about 2,030 mm, of which 96 percent concentrates in the wet season, May to October. The maximum monthly rainfall is 540 mm in August as shown in Figure 2 below.

FIGURE-2. MONTHLY MEAN RAINFALL



- Temperature and Relative Humidity

Mean annual temperature is 26.8°C and January is the coolest at 24.4°C and May is the warmest at 29.0°C; hence, the annual range of temperature is small. Similarly, seasonal variation of relative humidity is slight and annual mean value is 77 percent.

- Wind

The wind direction over the area tends to be north or northeasterly during the period of October to February. With the

incoming of the wet season, the winds blow from north-west. In the wet season, specially in June to September, the area is influenced by south-east monsoon. Maximum wind speed extending over June to September ranges from 18 to 56 kilometers per hour (30 to 90 miles per hour).

- Evaporation

Annual evaporation (see Table 2 below) is 2,292 mm and seasonal variations of mean monthly evaporation range from 167.5 mm in July to 213.9 mm in October.

TABLE-2. CLIMATE IN THE PROJECT AREA

Monthly Mean	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Rainfall (mm)	3.4	1.1	1.8	12.7	106.7	387.3	418.0	543 1	386.5	112.2	45 7	12.3	2,030 8
Temperature (^{o}C)	24.4	24.9	26.3	28 0	29.0	28.3	27.2	27.4	27.3	27.3	26.6	25 4	26 8
Relative Humidity (%)	73 2	72.0	71.1	71.5	74.6	81.4	83.7	86.0	84.9	78.3	75 7	74.0	77.2
Evaporation (mm)	199.5	168.3	205.1	201.0	202 2	194 2	167.5	181 8	170.3	213.9	181.8	206.2	2,291.8

- Typhoons

The Project Area is located in the northern part of Luzon island where typhoons visit frequently in June to October. According to the data, about 50 major storms passes through the region from 1968 to 1975.

3.4. Soil and Land Classification

The soils of the Project Area are predominantly composed of alluvial deposits coming from adjacent hills and mountains. The soils can be classified into three main groups, as follows:

1) Soils of the alluvial fan and alluvial flat which constitute the alluvial plain.

2) Soils of the higher lands which comprise the rolling and hilly areas.

3) Soils of the river wash.

The soils consist mainly of silt and clay and partly of sandy soil in higher land at the foot of the hills as shown in Figure 3.

The Project Area is classified into three categories of land classification (Table 3 refers) considering the suitability of soils, as follows:

TABLE-3. LAND CLASSIFICATION

Category	Area (ha)
1) Rice land - 1R	160
2) Dual-class land - 1R(2)	2,130
Arable land	2,290
3) Non-arable land	604
TOTAL	2,894

Note: Rice land 1R: highly suitable for irrigated paddy rice
Dual-class land 1R(2): highly suitable for irrigated paddy rice and moderately suitable for diversified crops

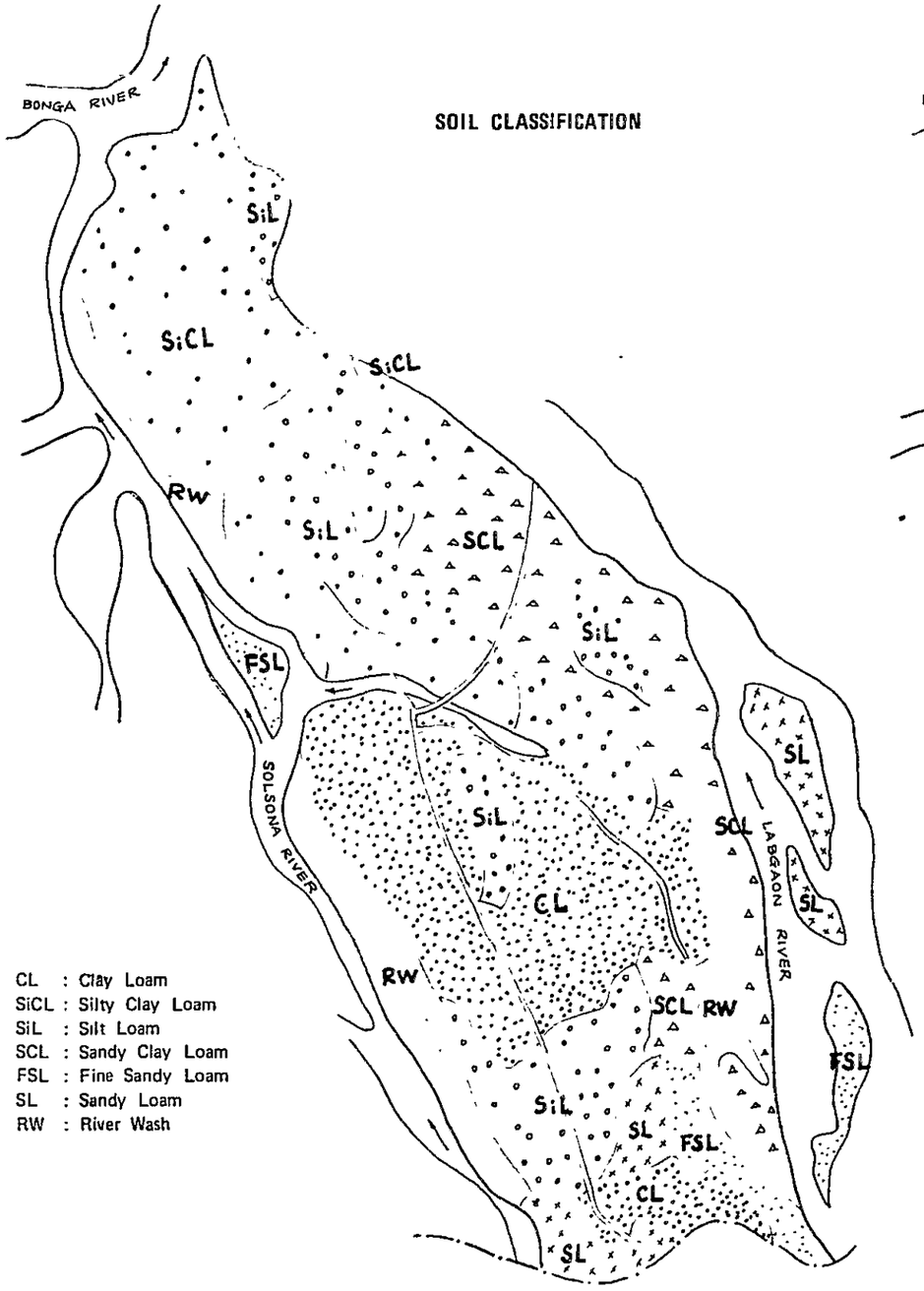
As shown in the above table, almost all parts of the Project Area are covered by the dual-class land. The land classification of the Project Area is shown in Figure 3 (refer to next page).

3.5. Population and Living Condition

The population of the Phase I Area is about 34,000 persons, of which 29,000 persons belong to agricultural population, as of May 1, 1975. Since the population census of the Project Area is not available, the population of the Labugaon Area including the Project Area was estimated as shown in Table 4.

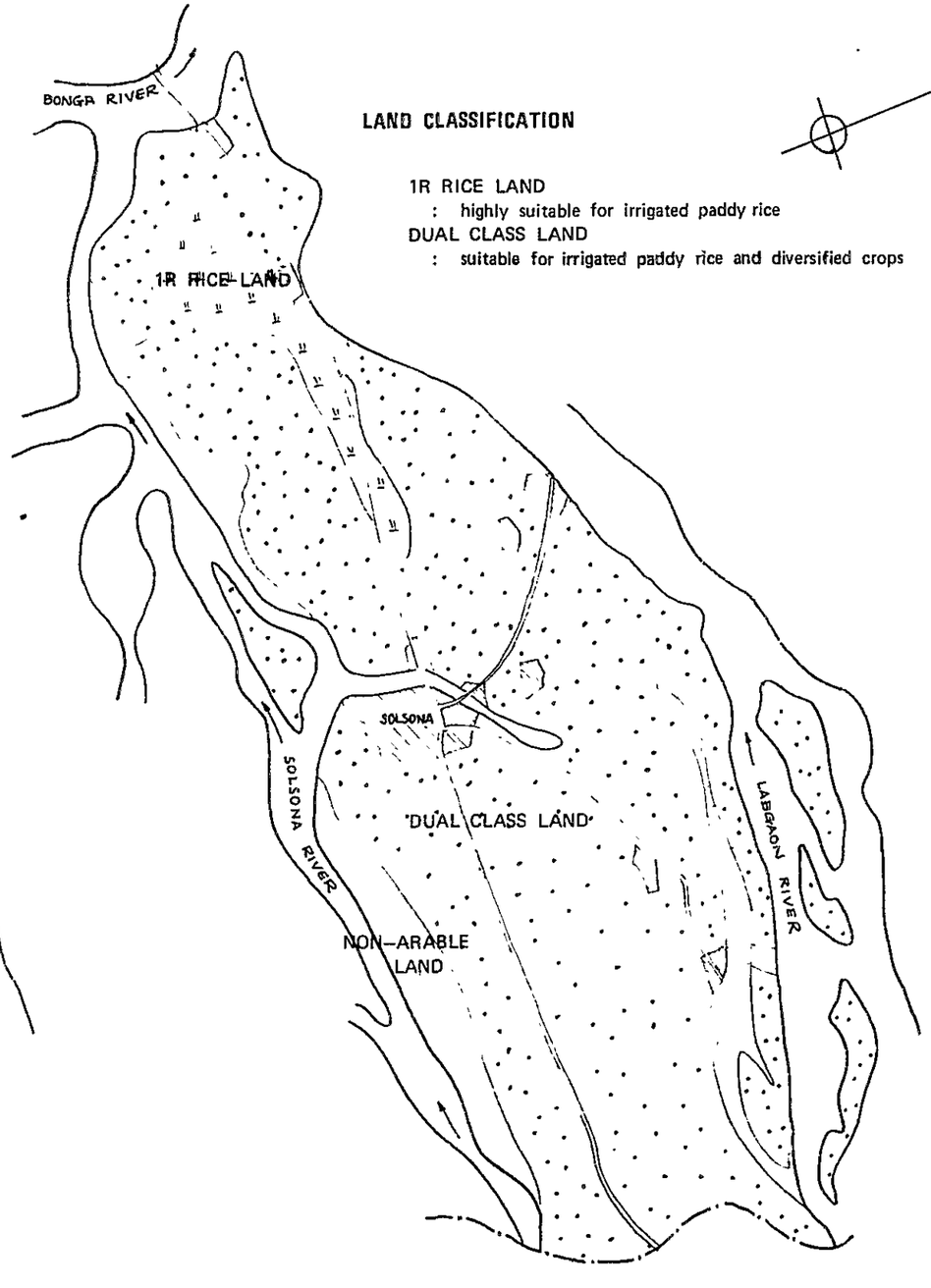
The average farm size of the Project Area is about 1.53 ha, which is almost similar to the average size of 1.50 ha in the Phase I Area. Thereby, the Project Area can be defined as standard area in the Phase I Area.

SOIL CLASSIFICATION



CL : Clay Loam
SiCL : Silty Clay Loam
SiL : Silt Loam
SCL : Sandy Clay Loam
FSL : Fine Sandy Loam
SL : Sandy Loam
RW : River Wash

LAND CLASSIFICATION



1R RICE LAND
: highly suitable for irrigated paddy rice
DUAL CLASS LAND
: suitable for irrigated paddy rice and diversified crops

0 1 2 KM

1 : 50,000

THE REPUBLIC OF PHILIPPINES NATIONAL IRRIGATION ADMINSTRATION
TERMINAL IRRIGATION FACILITIES PROJECT IN ILOCOS NORTE IRRIGATION PROJECT
SOIL AND LAND CLASSIFICATION
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) — FIGURE 3

TABLE-4. POPULATION AND FARM SIZE

(1975 Census)

	Phase I Area	Labugaon Area
1) Cultiviated Area	10,200 ha	2,290 ha
2) Population	34,000 persons	8,400
3) Agricultural Population	29,200 persons	6,760/3
4) Farm Families /1	5,432 families	1,276 families
5) Farm Families /2	6,774 families	1,498 families
6) Farm Size ---- 1)/5)	1.50 ha/family	1.53 ha/family
7) Farm Family Size:	5.3 persons/family	

/1 --- Number of farm families which are living in the Area.
/2 --- Number of farm families which are cultivating in the Area.
/3 --- Derived from the data of items 4) and 7) above.
-- 1,276 families x 5.3 persons/family = 6,760 persons

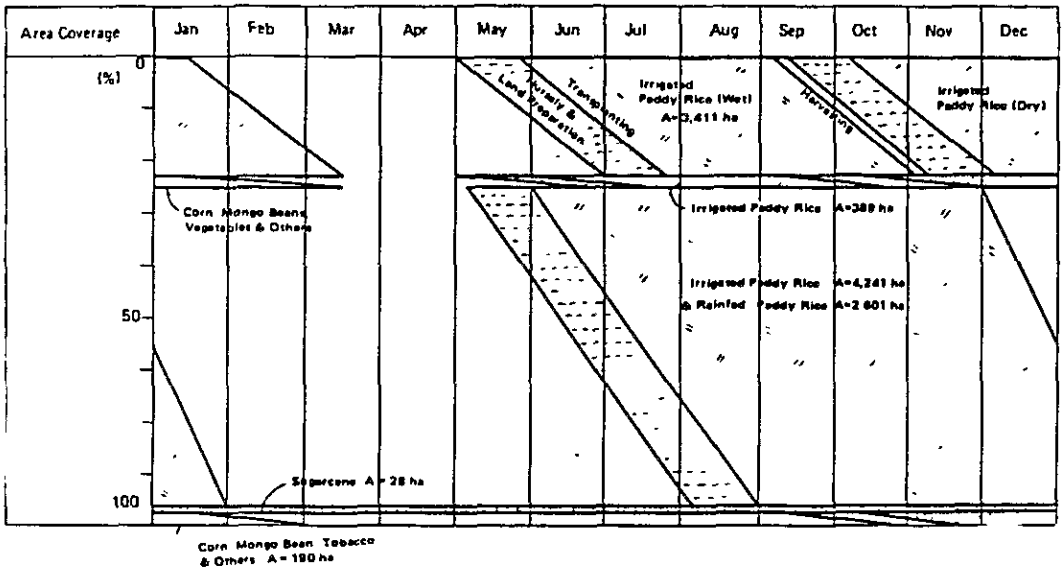
The Phase I Area excluding the Labugaon Area becomes an isolated land during the wet season because there are no bridges crossing the Bonga river. They are forced to cross the swelled Bonga river by using a bamboo raft. The domestic water supply works are not yet implemented, however, the electrification is rapidly progressing even in the small villages during these recent few years. The domestic water is supplied from the public wells or private wells.

The village people go the municipality office and/or stores at Solsona to buy their daily necessities. Whereas, in order to sell paddy to NGA and buy fertilizer at dealers' shop, farmers in the Project Area will have to go to Laoag City by private and public buses. Needless to say, they could go shopping and enjoy some recreation in Laoag City.

3.6. Present Cropping Pattern and Crop Production

Since the survey data in the Project Area is not available, the data of Phase I Area has been used and is shown in Table 5. Moreover, the present cropping pattern is classified into five types, which is illustrated in Figure 4 and also shown in said table (Table 5).

FIGURE 4 PRESENT CROPPING PATTERN



Total of Cultivated Area: 10,860 ha

Total of Cropping Area throughout year 14,660 ha (Cropping Intensity = 137%)

TABLE-5. PRESENT CROPPING PATTERN

(Phase I Area)

Pattern	CROPS		Cultivation Area		Remarks
	Wet Season	Dry Season	(ha)	(%)	
P-1	Paddy Rice + Paddy Rice		3,411	31	Cultivated in irrigated land
P-2	Paddy Rice		6,842	63	Irrigated land; 4,141 ha, Rainfed land; 2,601 ha.
P-3	Paddy Rice + Upland Crops		389	4	Cultivated in irrigated land
P-4	Upland Crops		190	2	Non-irrigated
P-5	Sugarcane		28	-	Non-irrigated

As mentioned in Table 5, the total cropping area is 14,660 ha and the cropping intensity per annum is 135 percent where the cultivated area is covered by crops with 100 percent during the wet season and only with 35 percent during the dry season.

In the area of about 3,410 ha, 42 percent of communal irrigation system area, the double cropping of rice with high yielding varieties. The wet season paddy rice is usually transplanted during June to July, and harvested in September to October. The dry season paddy rice is transplanted as early as possible in October to November since the possible irrigation period is limited and it is harvested in January to March.

In the area of about 6,840 ha inclusive of rainfed areas, 63 percent of the above mentioned area, paddy rice of traditional varieties has been platned once a year. Both varieties of paddy rice are transplanted at almost the same time as these of the above mentioned wet season paddy rice. The traditional varieties are harvested during January to March because of their photo-periodic

sensitive varieties with the growth period around 140 days to 180 days. After harvesting, almost all paddy fields are left as fallow lands throughout the dry season through such upland crops as corn, mongo beans and vegetables are planted in the area of about 390 ha without irrigation. The major reason of this extensive cropping might be the poor irrigation conditions, and another might be the fact that quite extensive farming has been made by a relatively big number of farmers who live in outside the Project Area. Some farmers grow vegetables in a part of paddy fields during the dry season in order to sell to local market. However, the area where this pattern can be applied is limited because stabilized irrigation water supply throughout the year is necessary to this pattern.

As for the upland crops in 190 ha of upland fields, they are usually planted once a year during the dry season, including about 23 ha of tobacco cultivation. Sugarcane is planted in some 28 ha of rainfed paddy field at relatively high land as annual crop.

The cropping calendars in the above mentioned cropping patterns as well as the ones for the wet and dry season crops in the communal irrigation system areas have about two month time lags from the start to the finishing of each cropping operation. The cropping time varies year by year due to the unstable irrigation conditions.

The planted area, average unit yield and total production of each crop are estimated as shown in Table 6 . The average yield of paddy in the irrigated area is about 1.7 ton/ha for the wet season crop. But the yield of the dry season paddy is about 1.4 ton/ha. The yield of wet season paddy in the rainfed areas ia bout only 1.3 ton/ha. Consequently, the total production of paddy per year is estimated at about 21,530 ton.

When the unit yield of the irrigated dry season paddy rice compared with the wet season rice, the dry season paddy has less

yield, which is caused by poor irrigation conditions with limited amount of irrigation water supply.

Average yield of paddy rice in the five municipalities under Masagana 99 program for latest three years is 3.7 ton/ha for the dry season crops and 3.6 ton/ha for the dry season crops respectively. However, according to the farm management survey, there were some sample farmers found out in getting more high yields. After the Project, these higher yields than those under Masagana 99 program will be expected to be attained because the soils in the most of the Project Area are blessed with high productivity for paddy rice cultivation.

The present yields of upland crops are also very low because of no irrigation. The total production of upland crops is quite small with only four percent of the total cropping area. From the aspect of weather conditions in the Project Area, almost all upland crop cultivations will be made during the dry season only, where irrigation will be prerequisite.

TABLE-6. PRESENT CROP PRODUCTION

(Phase I Area)

Crops	Yield (tons/ha)	Planted Area (ha)	Production (tons)
Paddy Rice			
Irrigated Wet Season Paddy	1.65	8,041	13,268
Irrigated Dry Season Paddy	1.43	3,411	4,878
Rainfed Wet Season Paddy	1.30	2,601	3,381
Sub-total		14,053	21,527
Tobacco	1.01	23	23
Corn & Others	0.49	584	286
Total		14,660	21,836

3.7. Farm Labor and Farm Mechanization

According to the farm labor balance, available labor sources always exceed the labor requirements not only in the ordinary period but also at the peak period. Therefore, such a small labor requirement should be considered due to the stagnated production activities caused by the inadequacy of the irrigation facilities.

Very small number of farm machines is employed in the Project Area, that is, the mechanized farming is carried out in only one percent of the cropped area for land preparation works by hand tractors or four wheel tractors and seven percent by pedal threshers. Therefore, most of cultivation works are carried out by manpower with animal power in most of the area.

3.8. Research and Extension Services

The research works have been promoted mainly by BPI (Bureau of Plant Industry), and the agricultural extension services have been promoted by BPI on the production techniques and by BAEx (Bureau of Agricultural Extension) on the farmign techniques through the farmers' organization.

- Research Institutes

BPI is promoting the research works in the national level networks of research institutes. Five research institutes shown in Table 7 are located around the Project Area. Dingras Experiment Station, which has 5 ha of foundation seed farm of rice, will be expected to support the levelling up of farming and production techniques in the Project Area, since this station is very close to the Project Area.

TABLE-7. RESEARCH INSTITUTES

Research Institutes	Promoted by	Location	Main Research Items
Dingras Experiment Station	BPI	Dingras	Paddy Rice, Diversified Crops
Ilocos Agricultural Research Center	BPI	Batac	Tobacco
Nangalisan Experiment Station	PVTA	Laoag	Tobacco
Animal Breeding Station	BAI	Dingras	Animal Breeding
Don Mariano Marcos Memorial College		Batac	Science & Technology

NOTE: PVTA--- Philippine Virginia Tobacco Association.
BAI ----- Bureau of Animal Industry.

- Extension Services

Extension services are promoted jointly by BPI and BAEx under Masagana 99 Program, which is a project aiming at national self-sufficiency by raising up the rice productivity up to 99 cavans per hectare.

In the Phase I Area, 16 production technicians under BPI and 57 extension workers under BAEx are engaged in the activities of levelling up the farming techniques and raising up the agricultural production by demonstration in two or three model farms borrowed from the farmers. Extension services are managed by the provincial offices of BPI and BAEx, which are located at Laoag City.

Allocation of technicians and extension workers is as follows:

- BPI: One production technician per 140 ha or 160 farmers;
- BAEx: One farm management technologist per 150 farmers, and one assistant farm technologist per 10 farmers each;
- Municipality: Engaging few extension workers to assist above technicians and workers.

Extension services have been enforced on the following items, through the Farmers' Association organized under Masagana 99 Program.

- BPI : Supplying the seeds, fertilizers and agri-chemicals and managing the loan for farm farm management, etc.
- BAEx : Selection of recommended varieties, technical guidance to application of fertilizers and agri-chemicals, and improvement of farming practices.

3.9. Farmers' Organization

In the Project Area, the following farmers' organizations have been organized.

- Association of Communal Irrigation System

The Phase I Area has 138 Communal Irrigation Systems, which were organized almost spontaneously more than 100 years ago and reorganized recently. The associations are covering the area of 8,097 ha, which is 75 percent of the whole area. Labugaon Area has 18 associations presently.

Management of the systems is made independently by the organization's officers/key personnel members such as President, Vice-President, Secretary, Treasurer, and Auditor selected among farmers under guidance of the provincial office of NIA located at Laoag City.

No water charges are collected in cash, but compulsory labor and materials for the repair of canals and brush dams are yearly appropriated by themselves.

- Samahang Nayon

Samahang Nayon is being organized at each barrio under the MLGCD to provide various functions such as rural development, campaign for Masagana 99 Program and establishment of agricultural cooperatives for fund and credit. There are presently 32 Samahang Nayons organized in the Phase I Area and assisted by the staff from MLGCD living in its municipalities.

- Farmers' Association

To promote the Masagana 99 Program, BPI and BAEx have cooperatively established Farmers' Associations at each barrio. BAEx has established Home Improvement Clubs for improvement of village life of housewives and 4-H Clubs.

At present, there are 131 farmers' associations, 28 Home Improvement Clubs and 30 4-H Clubs established in the Phase I Area.

3.10. Irrigation, Drainage and Terminal Conditions

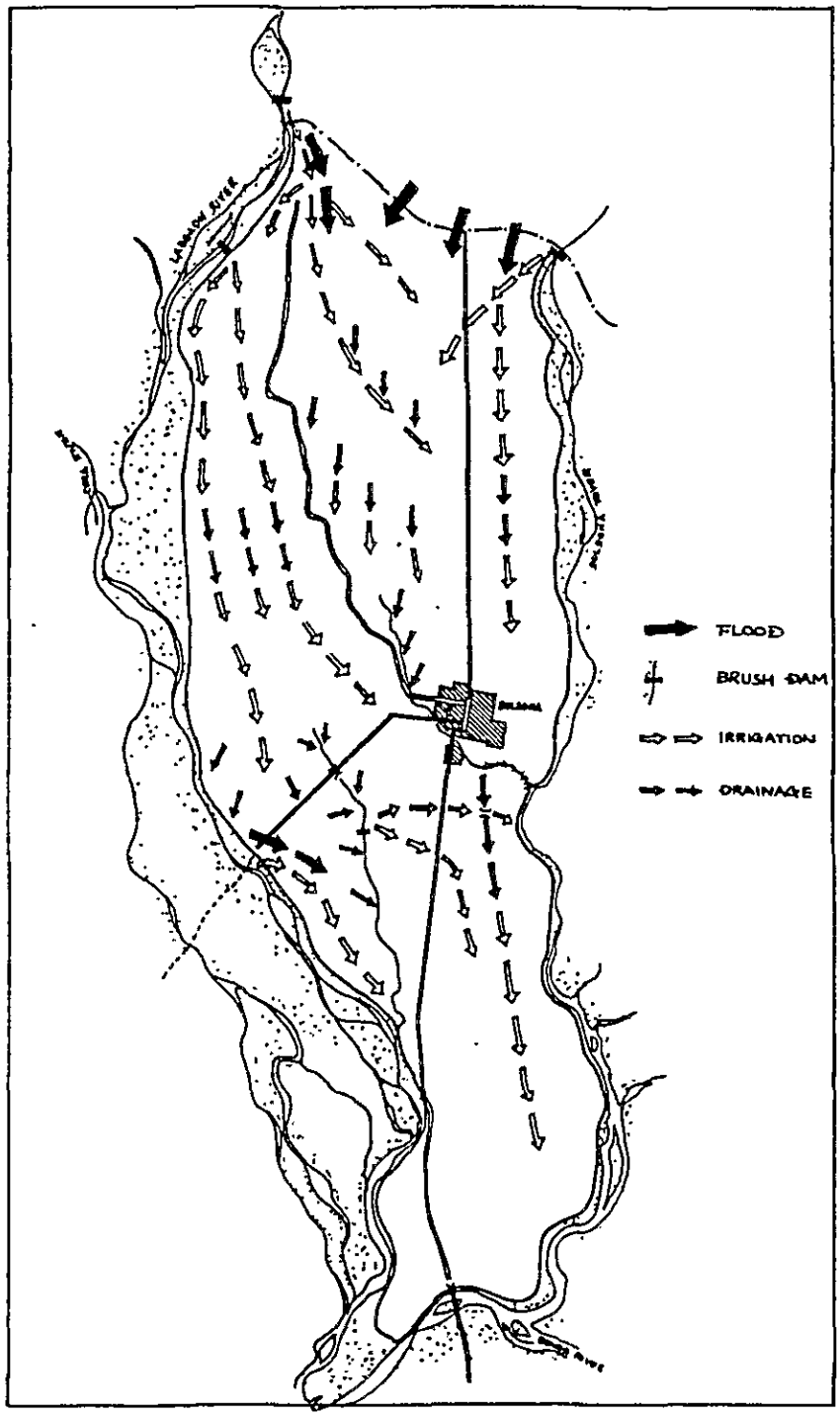
The Project Area is utilizing the Labugaon and Solsona rivers, which run along both sides of the Area, not only as the water resources but also as the drainage rivers to drain the excess water. Figure 5 shows the overall water flows in the Project Area (refer to succeeding page).

3.10.1. Irrigation Condition

The Labugaon Area has 18 communal irrigation systems, which are taking irrigation water from the Labugaon and Solsona rivers. A part of the Area is irrigated with return-flow taken from the creeks and small rivers.

In each communal irrigation system, water distribution and operation and maintenance of irrigation facilities are controlled by association which has been organized in each system. However, the water management condition is not satisfied due to deterioration

FIGURE-5. OVER-ALL WATER FLOWS IN THE PROJECT AREA



of the facilities and no facilities for control and measurement. Furthermore, a decrease in yield is caused by deep standing water in a paddy plot, due to the long distance of plot-to-plot irrigation and lack of drainage facilities.

Irrigation water is taken from rivers by means of brush dams. Since the brush dams have no regulating facilities, the quantity of intake is heavily influenced by the fluctuation of river flow. Thereby, water distribution work becomes haphazard due to the no-control in irrigation system caused by heavy fluctuation of river flow during wet season. Meanwhile, in dry season, the irrigation water can be secured in the communal areas close to brush dam. However, in the downstream communal areas where they use the return-flow as irrigation water, they are facing instability in ensuring the irrigation water. This instability is cuased not only by small river flow during dry season but also by lack of communication among the communal irrigation systems. Thus, due to this instability of water distribution, the cultivated area will be reduced in the dry season.

3.10.2. Drainage Condition

Excess water drains to the Labugaon and Solsona rivers. In the area, no terminal drainage systems are provided, therefore, communal irrigation canals and existing creeks are used for drainage purpose.

As mentioned before, the Project Area is flooded due to the intrusion of much water from communal irrigation canals during wet season, because of no provision of regulating structures at intake dams. Furthermore, run-off from hill side also cuases the flood in the area.

These floods do not only affect the agricultural production but also give serious problems on transportation among the villages.

3.10.3. Terminal Condition

- Water Distribution and Drainage Systems

In the service areas, there are at present many communal canals, which have dual purpose of water supply and drain of surplus water to and from the paddy fields. These communal canals run across the contour lines and irrigate plots on both sides. Each plot is irrigated with so-called plot-to-plot irrigation method which supplies each plot with water from the higher plots to the lower plots with help of topographical gradient. Excess water from plot-to-plot irrigation flows into downstream communal canals and is used again as irrigation water. However, as mentioned above, these terminal distribution systems are not working well because of deterioration, no terminal drainage canals and lack of regulating and measurement facilities, etc.

- Farm Roads

Present farm fields have been scarcely provided with terminal farm roads. Hence, farming practices and transportation of agricultural inputs and outputs are mostly done by manpower or carabao.

However, more terminal farm roads should be provided for raising the productivity and severe water management.

- Size and Shape of Farm Plots

Existing farm plots range from 100 sq. m to 2,000 sq. m depending on the topographical conditions. The size is small in higher area with steep slope and large in lower area with gentle slope.

The shapes of almost all plots are rectangle, and the length runs along the contour lines and width crosses the contour lines.

CHAPTER IV. THE PROJECT

4.1. Objectives

This project is aiming at levelling-up of terminal water management technique which is a bottleneck to increase the effect up to the target in many irrigation projects which have been implemented.

In these irrigation project areas, the farmers have been enforced to undertake the terminal water management in conformity with the proposed cropping pattern which has never been experienced. However, it has been apt to cause the less increase of cropped area and unbalance of water distribution to the farm plots due to the low terminal irrigation efficiency, because the terminal water management technique has not been levelled up as projected. Thereby, the levelling-up of the terminal water management technique is very important factor to achieve the target in agricultural development projects.

This Terminal Irrigation Facilities Project will take place to level-up the terminal water management technique and will lead the Palsiguan River Multi-Purpose Project which will be promoted by the Government of the Philippines.

4.2. Project Components

4.2.1. Position in the Overall Project

This Project will be implemented before the Phase I development of the Palsiguan River Multi-Purpose Project. And the Phase I development will be followed by the Phase II development; thus, by the time of completion of Phase II project, the Palsiguan River Multi-Purpose will be completed.

The Project Area is located in the Labugaon Area at the north edge of the Phase I Area.

The relationships between this Project and the Palsiguan River Multi-Purpose Project are as follows:

TABLE-8 THE POSITION OF THE TERMINAL IRRIGATION FACILITIES PROJECT IN WHOLE DEVELOPMENTS

Project Components	Unit	Phase I Area		Full Development (Phase I + Phase II) Phase II Development
		Terminal Irrigation Facilities Project (This Project)	Phase I Development	
1. Service Area	ha	1,029	10,200	21,150
2. Irrigable Area (Probable Year)		(1/2 year)	(1/5 year)	(1/5 year)
Wet Season	ha	1,000	8,080	21,150
Dry Season	ha	960	2,960	21,150
3. Hydro-Power	MW	-	-	41.5
4. Construction Period	Years	1	4.5	8
5. Major Structures				
Dam *-1		-	-	1 (Plsiguan Dam)
After bay *-1		-	-	1
Diversion Dam *-1		1 (Temporary)	5	2
Link Canal *-1	km	-	-	95 km (for Phase I)
Main Canal *-1	km	(0.9 + 9.2)	116.5	97
Lateral Canal *-1	km	4.9	92.0	209
Drainage Canal *-1	km	13.7	147.1	128
On-farm Development *-2	ha	1,000	10,200	21,150

Note) *-1: Construction volume in each development
*-2: Developed area including already-developed areas

4.2.2. Components of the Project

This Project will provide the irrigation and drainage systems and the terminal facilities as main component. Whereas, the Table-9 shows the project components and the demarcation between the Governments of Philippines and Japan.

The Project will be implemented prior to development of the Labugaon Area in which the project area is involved, because the Labugaon Area is scheduled to be implemented in the development of the Phse I Area. Therefore, almost all of the major facilities such as diversion dam and main canal for full development of the Labugaon Area will be provided inevitably in this Project. However, if the diversion dam were constructed as permanent structure, it takes a long period and a great deal of fund for its construction. Thereby, it is strongly recommended to construct the diversion dam as temporary structure for quick effect and demonstration of the terminal irrigation facilities which is the main component of this Project. The permanent diversion dam will then be constructed at the time of Phase I development.

TABLE-4. PROJECT COMPONENTS

Project Component	Details: Facilities	Details: Capacity & Construction Volume	Demarcation: Japanese Government	Demarcation: Philippine Government	Remarks
Intake Facilities	°Temporary Diversion Dam °Intake Canal	Q = 3.634 cu.m/sec L = 900 m	o	-	O & M road of 4 meters width will be provided along canals
Main Canal	°Main Canal	Q = 4.238 - 1.172 cu.m/sec L = 9,170 m	o	-	
Lateral Canal	°3 Lateral Canals	Q = 0.412 - 0.268 cu.m/sec L = 4,885 m	o	-	
Drainage Canal	°8 Drainage Canals	L = 13,650 m	o	-	
Terminal Facilities (On-farm Development)	°Farm Road °Main Farm Ditch (MFD) °Sub-Lateral Drain (SLD)	L = 30,000 m	o	-	The total area will be 1,000 ha for On-farm development
	°Supplementary Farm Ditch(SFD) °Farm Drain	L = 83,000 m	-	o	
Project Office	Project Office site: 6,000 sq.m Project Office - 400 sq.m Garage --------- 252 sq.m } 802 sq.m Warehouse ------ 150 sq.m		°Buildings °Power Supply Network °Water Supply & Drainage	°Site Development (upto land levelling) °Power Supply to site °Fencing °Land scaping	
Construction Equipment	4 Backhoes 1 Dumptruck 5 Tampers		o	-	To be utilized for construction of SFD and farm Drain

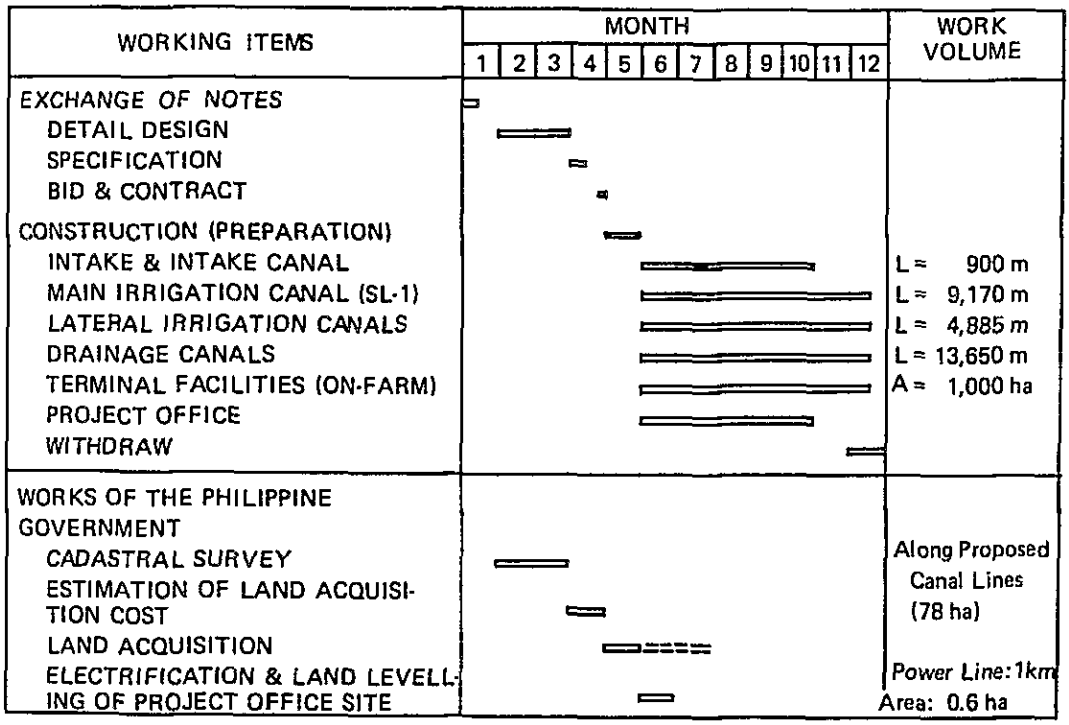
Note: 1) o shows the responsibility in demarcation.
2) The Government of Philippines will have responsibility of right-of-way for all the facilities.

4.2.3. Project Cost and Construction Schedule

This project will be implemented with the grant-aid amounting to 916,000,000 yen (equivalent to 28,625,000 pesos) and some expenditure from the Government of Philippines, and this project will be completed within one year construction period. The expenditure for right-of-way, site development of project office and construction of some part of terminal facilities will be prepared by the Philippine Government, according to the demarcation shown in Table-9.

The construction schedule is shown in Figure-6 below.

FIGURE - 6. CONSTRUCTION SCHEDULE



4.3. Agricultural Plan

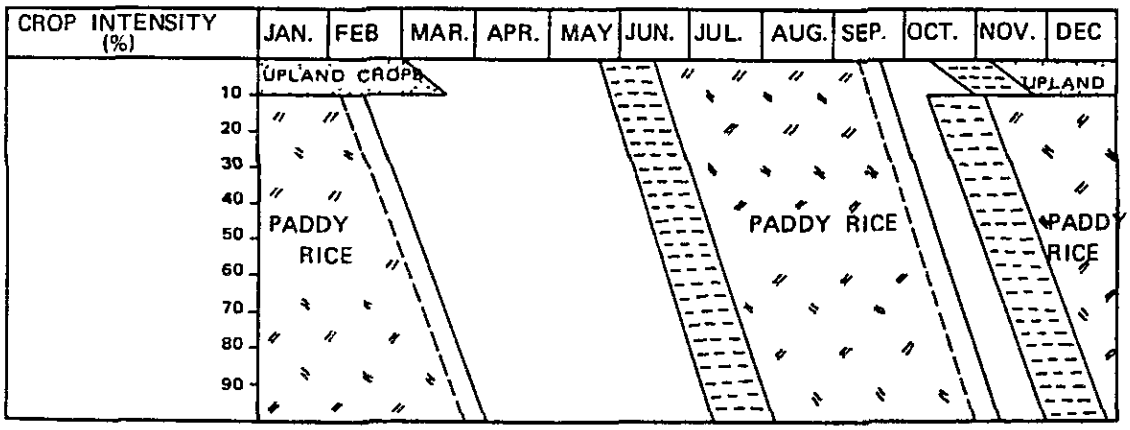
4.3.1. Proposed Cropping Pattern and Land Use

The proposed land use of the Project Area is classified into two types; namely, "double cropping of paddy rice in the wet and dry seasons", and "paddy rice in the wet season and diversified crops in the dry season." The former pattern will be introduced in ninety (90%) percent area and the latter in ten (10%) percent area. The selected crops for the diversified crops are cash crops such as garlic, tobacco and onions.

Paddy rice	+	Paddy rice	900 ha (90%)
Paddy rice	+	Diversified Crops	100 ha (10%)
Total			1,000 ha

The proposed cropping pattern is shown in Figure 7 below.

FIGURE - 7. PROPOSED CROPPING PATTERN



4.3.2. Crop Production

The following target yields can be expected by means of provision of irrigation and drainage systems:

Crops	Target Yield
Paddy Rice:	
Wet Season Paddy	3.9 tons/ha
Dry Season Paddy	4.2 tons/ha
Diversified Crops:	
Tobacco	1.3 ton/ha
Garlic	2.7 tons/ha
Onion & Other Vegetables	14.0 tons/ha

The increase of crop yield will be 2.4 times on wet season paddy rice and 2.9 times on dry season paddy rice of the present crop yield.

4.3.3. Farm Mechanization

Farm mechanization with small-sized machineries has been proposed as the short-term mechanization by the feasibility study. The required minimum machineries per 60 ha are shown in Table 10 below.

TABLE - 10. PROPOSED FARM MACHINERIES

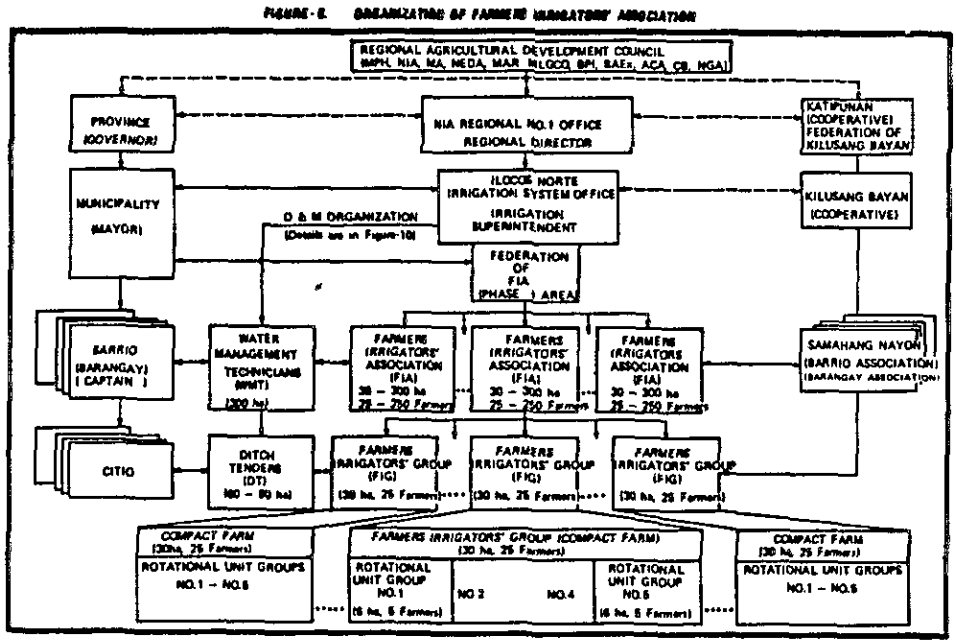
(Per 60 ha)

Farm Practice		Machineries	Required Units
Works	Mechanization		
Land Preparation	40%	Hand Tractor 7 - 8 Ps	3
Threshing	50%	Powered thresher 7 - 8 Ps	1
	50%	Pedal thresher	5
Dring	50%	Drier (flat-bed type, 2.0 tons)	1

4.3.4. Proposed Farmers' Organization

According to the conclusion of feasibility study, Farmers Irrigators' Association (FIA) instead of the present Association of CIS will be newly organized in each barrio depending on the proposed irrigation network in the Phase I Area including this Project Area.

The proposed Farmers' Organization is shown below.



The proposed Farmers Irrigators' Association (FIA) shall fully provide the following functions:

1) Following the NIA's plan for O & M of irrigation systems, related Irrigators' Group shall be rearranged and properly controlled so as to realize a fair water distribution and further to practise improved irrigated agriculture;

2) Under the guidances/supervision by BPI and BAEx, introduction of new farming techniques and farm machineries shall be realized and collective use of the machineries and collective works shall be actively promoted;

3) O & M and repair of terminal ditches and farm roads downstream of turnout structures shall be made by farmers;

4) In case there are any changes in NIA's water distribution program depending on the weather conditions and so on, FIA has to secure a full coordination at the FIA level and the most reasonable water distribution shall be carried out through a full cooperation with the NIA's Water Master, Water Management Technician and Ditch Tender;

5) Under the guidance and cooperation by Samahang Nayon and Kilusang Bayan, collective selling of farm products and procurement of various farm inputs shall be realized;

6) Cooperating with Samahang Nayon, promotion of savings and progression of rural development shall be made actively;

7) Not only cooperating with NIA in the collection of irrigation fee, but also the FIA has to handle O & M fee collection for FIA itself;

8) FIA shall actively participate in the training programs as organized by NIA and other governmental agencies and provide farmers' training programs for O & M of irrigation facilities;

9) Obtaining full cooperation by the administrative organizations at Barrio level, irrigated agriculture shall be actively promoted.

4.4. Irrigation Plan

4.4.1. Irrigation Method

In the paddy fields, "continuous 24 hours irrigation" will be introduced during the crop maintenance stage, and "25 days rotational irrigation" will be adapted in each rotation block (30 ha) at the stage of land soaking.

On the other hand, the upland fields will be irrigated with "furrow irrigation" in an intermittent irrigation manner so as to meet these field capacities.

4.4.2. Irrigation Efficiency

Irrigation efficiencies (Table 11 below refers) are applied taking into account irrigation methods and conveyance losses by earth canal.

Table 11. IRRIGATION EFFICIENCY

EFFICIENCY	PADDY RICE		UPLAND CROPS
	Wet Season	Dry Season	
Field Application	65%	75%	
Conveyance	80%	80%	
Operation	90%	90%	
Gross	46.8%	54%	60% /1

NOTE: /1 --- Estimation by NIA, NISIS I.

4.4.3. Water Requirement

Water requirement is thus determined that consumptive use, land preparation water, percolation, effective rainfall and irrigation efficiency (refer to Table 11) are taken into account.

Consumptive Use

TABLE 12. CONSUMPTIVE USE

(Unit: mm/day)

	Paddy Rice	Tobacco	Garlic	Onion
May	6.5			
June	6.5			
July	5.4			
August	5.9			
September	5.7			
October	6.9			
November	6.1	4.3	2.1	4.3
December	6.7	6.4	3.4	5.0
January	6.4	4.5	1.6	4.2
February	6.0	3.6		
March	6.6			
April	6.7			
Mean	6.3	4.5	2.4	4.5

Land Preparation Water

Water requirement during land preparation period is estimated as shown in the following table.

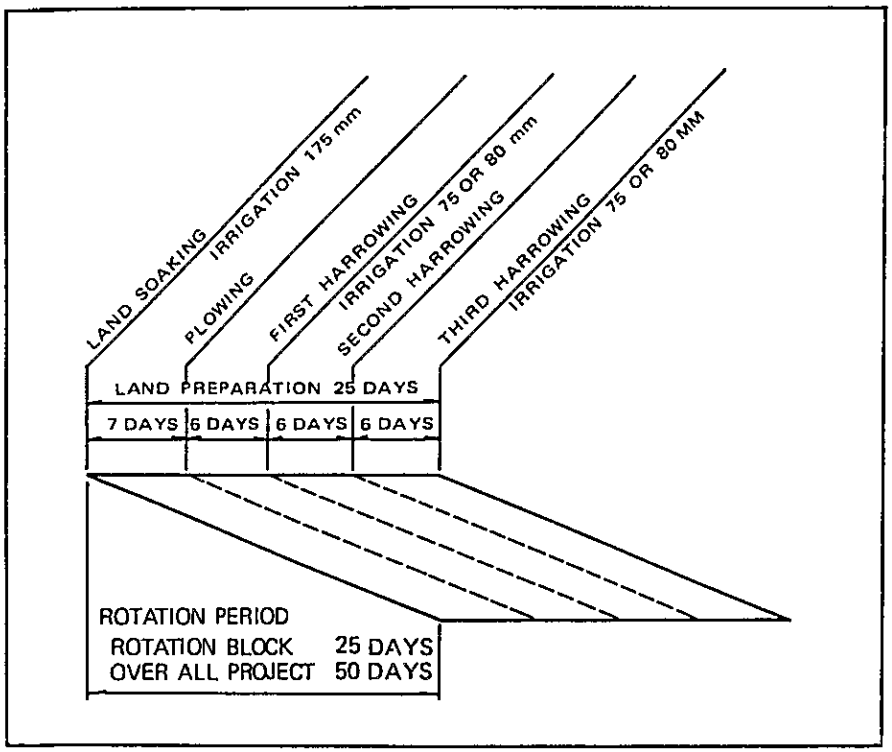
TABLE 13. LAND PREPARATION WATER

(Unit: mm)

Application	Paddy Rice		Tobacco	Onion & Garlic
	Wet	Dry		
1st	175	150		
2nd	75	80		
3rd	75	80		
Total	325	310	200	100

Irrigation for land preparation of paddy field lasts for 25 days in each rotation block, and for 50 days in whole area. The process of irrigation is as indicated in Figure 9 in the succeeding page.

FIGURE- 9. WORK PROCESSES FOR LAND PREPARATION



Effective Rainfall

Effective rainfalls are determined taking depth of standing water on paddy field into account - only a portion of each rainfall which does not exceed the standing depth in the following table is taken as effective rainfall.

For upland crops, no effective rainfall is considered because only 10 percent of the whole areas are planted.

TABLE 14. MAXIMUM EFFECTIVE RAINFALL (STANDING DEPTH OF WATER)

(Unit: mm)

Item	Paddy Rice		Upland Crops
	Land Preparation	Growing Period	
Max. Effec. Rinfall	250/1	60	0
Max. Standing depth	60	60	0

NOTE: /1 --- includes standing water of 60 mm and saturating water.

Percolation

Percolation for paddy field is, according to the surveys of the Feasibility Study, taken as 2 mm/day for the whole paddy field areas.

Water Requirement

Water requirement is determined in two stages each; namely, land soaking and crop maintenance stages. Water requirement at land soaking stage is a peak water requirement to give the design capacity for irrigation facilities; but that at crop maintenance stage is defined as normal water requirement, which is less than the peak requirement. Therefore, normal water requirement gives the designed flexibility of regulating facilities.

TABLE 15. WATER REQUIREMENT

(Unit: l/sec/ha)

Water Requirement	Stage	Design Capacity	
		Main & Secondary Canals	Terminal Canals
Peak	Land Soaking	2.33	1.78
Normal	Crop Maintenance	1.94	1.40
NOTE: Figures above are based on the Feasibility Study Report.			

4.5. Drainage Plan

Drainage rates from beneficial and hilly areas are determined as shown in the table below so as to correspond to a probable rainfall once in 5 years.

TABLE 16. DRAINAGE RATE

(Unit: l/sec/ha)

Beneficial Area	Hilly Area
8.72	27.5

4.6. Design

4.6.1. Hydraulic Criteria

Hydraulic facilities are to be designed based on the elements in the table below.

TABLE 17. HYDRAULIC ELEMENTS

Elements	Unit	Irrigation Facilities		Drainage Facilities
		Main & Lateral Canals	Terminal Canals	
Canal Capacity:				
Peak	l/sec/ha	2.33	1.78	8.72
Normal	l/sec/ha	1.94	1.40	-
Roughness Coefficient		0.025	0.030	0.025
Permisslbe Max. Velocity	m/sec	Kennedy Formula	0.25 - 0.50	Kennedy Formula

NOTE: Permissible maximum velocity is determined taking soil classification (silty clay loam-silty loam) into account. For drainage canal, however, 1.5 times of the value is taken as permissible.

For Irrigation Canal $Va = Cd^k$ m/sec (C=0.60, k=0.50)

For Drainage Canal $Va = 1.5\ C \cdot d^k$ m/sec (C=0.60, k=0.64)

d : depth of water (m)

4.6.2. Canal

Standard sections of canals are those shown in the attached drawings, Plates 6 & 11, which were designed considering the convenience of O & M works. The canals will be partially lined with concrete to prevent much seepage water loss at the place of unfavorable soil such as gravells.

4.6.3. Diversion

Diversion facilities are to be designed according to capacities to be regulated, and will be provided according to the installation criteria as shown in the table below.

TABLE 18. INSTALLATION CRITERIA OF DIVERSION FACILITIES

Diverted Capacity (cu.m/sec)	Name of Diversion	Facilities Required	Installation Place	Ref. No. of Plate
Q > 0.8	Diversion	Sluice Gate & Pershall Flume	From Main to Main	No.7
Q ≦ 0.8	Head Gate	Double Gated Orifice	From Main to Secondary	No.8
	Turn-out		From Secondary to MFD	
Terminal Facility	Division Box	Flash Board Weir	From Main Farm Ditch (MFD) to Supplementary Farm Ditch (SFD)	No.14

4.6.4. Drop

Land slope of the project area is so steep as 1/100-1/250 that considerable number of drops for irrigation and drainage canals will be necessary. Each drop should be located in a manner that maximum height of a drop is less than two meters.

4.6.5. Road

Service road and farm road will be provided for O/M works of main and secondary canals and for farming, respectively. The width of road is 4 m along main and lateral canals, and 2 m for farm road.

4.6.6. Terminal Facilities

The provision of terminal on-farm facilities such as farm ditch, farm drain and farm road is essential works to execute the irrigated agriculture including farm mechanization, and in this work, farmers' eagerness for agriculture will act as the prime mover. With their support, the rationalized land parcelling and land allocation will be materialized, which are the pre-requisite for upgrading the agriculture. Thus, modernized irrigation and drainage systems as well as new organization for farm management will be established at an early stage.

Premise in Farm Land Development

An average cultivation area per farm household to be allocated in the Project Area is 1.5 ha. For common use of farm road and irrigation and drainage canals, especially for rotational irrigation based on an rationalized irrigation schedule, Irrigators' Associations will be organized by farm households in a cultivation area of about 60 ha involving the two rotational areas of about 30 ha.

- Crops: Double cropping of paddy rice through a year and diversified crops in 10% of the areas during dry season are to be performed aiming at 200% of crop intensity in the future.

- Farm Practices: In the Feasibility Study Report, it proposes both partly mechanized system at initial stage and fully mechanized system of farming in final stage. The breakdowns of mechanized practices are tilling, levelling, threshing and drying works. Thus, partly mechanized system will be followed in the initial stage of this project.

Land Parcelling

- Principle for Land Parcelling

In order to materialize the farm land parcelling satisfying all requirements mentioned above in the Project Area in which there are many existing communal canals, due attentions should be paid

to the following:

i) to plan it in close relation with the farm management plan;
ii) to plan it for materializing rationalized irrigation and drainage water control; and,
iii) to plan it for rationalized farm management for paddy cultivation.

Further details on the above-mentioned facts are as follows:

i) to determine the location of main service and access roads as the basic of land parcelling for the proposed formation of Irrigators' Association, unit farm management group serving the area of about 60 ha to 300 ha, as well as rural community development and public facility construction plan.

ii) to determine the location of irrigation and drainage canals taking into consideration on topographic conditions, separation of irrigation and drainage canals, lengths of terminal canals, and rotational irrigation. In order to systematize and simplify the water supplying systems at terminal on-farm level, each rotational area should have one turn-out.

iii) to plan every plot size to be the same as possible to simplify the extension of new technique for paddy cultivation to farmers. If all the farm plots are in almost the same size, a certain quantity of agricultural chemicals can be sprayed to each farm plot to control the disease and insect damage. The same can be said in fertilizer application. Furthermore, planning and execution of both puddling works by tractors and management of irrigation water supply for puddling will be simple and easy.

- Design of Rotational Area

1) Location of Farm Ditches

Following two alternative schemes for determining the location of farm ditches are considered in the Project:

i) the main farm ditch is aligned across the contour lines, so that the supplementary farm ditch would be located along the contour lines;

ii) the main farm ditch is located along the contour lines.

Taking into consideration the direction and density of existing canals, the latter scheme should be basically adopted. However, the former scheme would still be applicable to some areas depending on their topographic conditions.

2) Rotational Area and Units

Each rotational area has been planned to have an average area of about 30 ha, and each unit of about six hectares, in consideration of the existing communal irrigation systems, their topographic conditions and also the NISIP. (See Plate No. 14.)

Terminal Water Management System

1) Irrigation System

Turn-out will be constructed on the lateral irrigation canals so that the main farm ditches will stretch out from each turn-out. The length of main farm ditches, which will be located along farm roads, will be about 750 m, and these main farm ditches will command an area of about 30 ha (one rotational area). In order to divert irrigation water from the main farm ditch to farm plots, supplementary farm ditches will be provided for the area of about six hectares, one rotational unit.

Water supply from the main farm ditch to the supplementary farm ditch is planned to be simultaneous, while distribution of water from the supplementary farm ditch to each farm lots is planned to be rotational. Hence, the required cross-section of the main farm ditch becomes small towards the downstream and its terminal section corresponds with that of the supplementary farm ditch in size. Irrigation water supply during land soaking and land preparation will be carried out within 25 days. In this case, the design discharge of the terminal canals, main farm ditch and supplementary farm ditch is 1.78 l/sec/ha.

The terminal irrigation facilities are enumerated below.

Turn-out: The facility to divert irrigation water from a lateral irrigation canal to main farm ditch. This is provided with a steel gate to control and regulate the flow of water to the farm ditches.

Main farm ditch: The irrigation canal, which is made of earth, to convey water from the turn-out to the supplementary farm ditches. The design discharge is 1.78 l/sec/ha. The sections of ditch becomes small towards the downstream and terminal section of the canal corresponds with that of supplementary farm ditch in size.

Division box: The facility to check water level in the main farm ditch and divert it to the supplementary farm ditch.

Supplementary farm ditch: The terminal irrigation canal to convey water to the paddy in a rotation unit. The design discharge is 1.78 l/sec/ha.

End check: The facility to prevent discharge of irrigation water in the supplementary farm ditch from flowing out to the farm drain.

Farm ditch crossing: The facility to provide access of farm machinery from farm road to the farm lots. In the Project, one rotation area has one farm ditch.

Road corssing: The facility to convey water under farm roads. Water in the farm ditch or farm drain can flow through road crossing without being intercepted by the farm roads.

2) Drainage System

Excess water in each farm plot is drained through a notch with a width of about 30 cm to a farm drain which is aligned along the supplementary farm ditch. Farm drain is the terminal drainage canal made of earth and constructed in each rotation unit. The design capacity is 8.72 l/sec/ha.

4.6.7. Project Office

The Project Office will be located near Solsona which is the center of the Project Area. The office will be utilized as a construction office during construction period and as an office, which will be in charge of O/M works and training tasks for water management of terminal facilities.

For the purposes as shown above, the following facilities will be installed in minimum required scale:

Project Office Site	:	6,000 sq.m.	
Buildings	:	Project Office	400 sq. m
		Garage	252 sq. m
		Warehouse	150 sq. m

The arrangement and details of the faciltiies are shown in the attached drawings, Plate Nos. 15-18.

4.7. Operation and Maintenance

After completion of construction of this Project, Operation and Maintenance will take place. The organization, which is recommended for operation and maintenance of the Project in this stage, is shown in Figure 10.

The feasibility study recommended the overall organization of operation and maintenance for the Phase I Area as shown in Figure 10. Therefore, the operation and maintenance organization for this Project is involved in the overall organization upon completion of Phase I. However, the operation and maintenance organization for this Project should be organized independently before the overall organization, since the Project will be completed before the Phase I construction ends. The organization for Labugaon AREa is adopted in this Project.

The entire project works will be turned over to Ilocos Norte Irrigation System Office (INISO) which is newly organized under NIA Regional Office No. 1, upon completion of Phase I. Since this Project precedes the Phase I, the project office which will be constructed near Solsona, will be utilized instead of INISO. This project office will be turned over to INISO, after completion of Phase I or levelling-up of terminal water management techniques among farmers.

The functions of project office are the same as that of the functions of INISO proposed in the feasibility study. However, the levelling up of terminal water management techniques among the farmers should be given priority.

The headquarter under the Irrigation Superintendent would consist of four supporting sections; namely, Operation and Maintenance Section, Engineering Section, Agricultural Section and Administration Section. Each section will perform the following works:

- Operation and Maintenance Section: This will be divided into two sub-sections, as follows:

  Operation Sub-section - responsible for day-to-day operations of the systems including water scheduling, and to give instruction to farmers on terminal water management in cooperation with Agricultural Section.

  Maintenance Sub-section - responsible for periodical maintenance of the project facilities.

- Engineering Section: Responsible for the designs, estimates, and execution of repairing and rehabilitation of the Project facilities.

- Agricultural Section: Responsible for the new water management techniques and farming methods as well as ensuring the necessary agricultural supporting services to be established in the Project area.

- Administration Section: Responsible for the personnel and records management, accounting and other services.

Water management works in the Project will be controlled by a Supervising Water Management Technologist (SWMT) under the Irrigation Superintendent. Whereas, the operation of water management will be performed by three Water Management Technicians (WMT), 15 Gate Keepers (GT), and 15 Ditch Tenders (DT). Following are the duties and responsibilities of the said personnel:

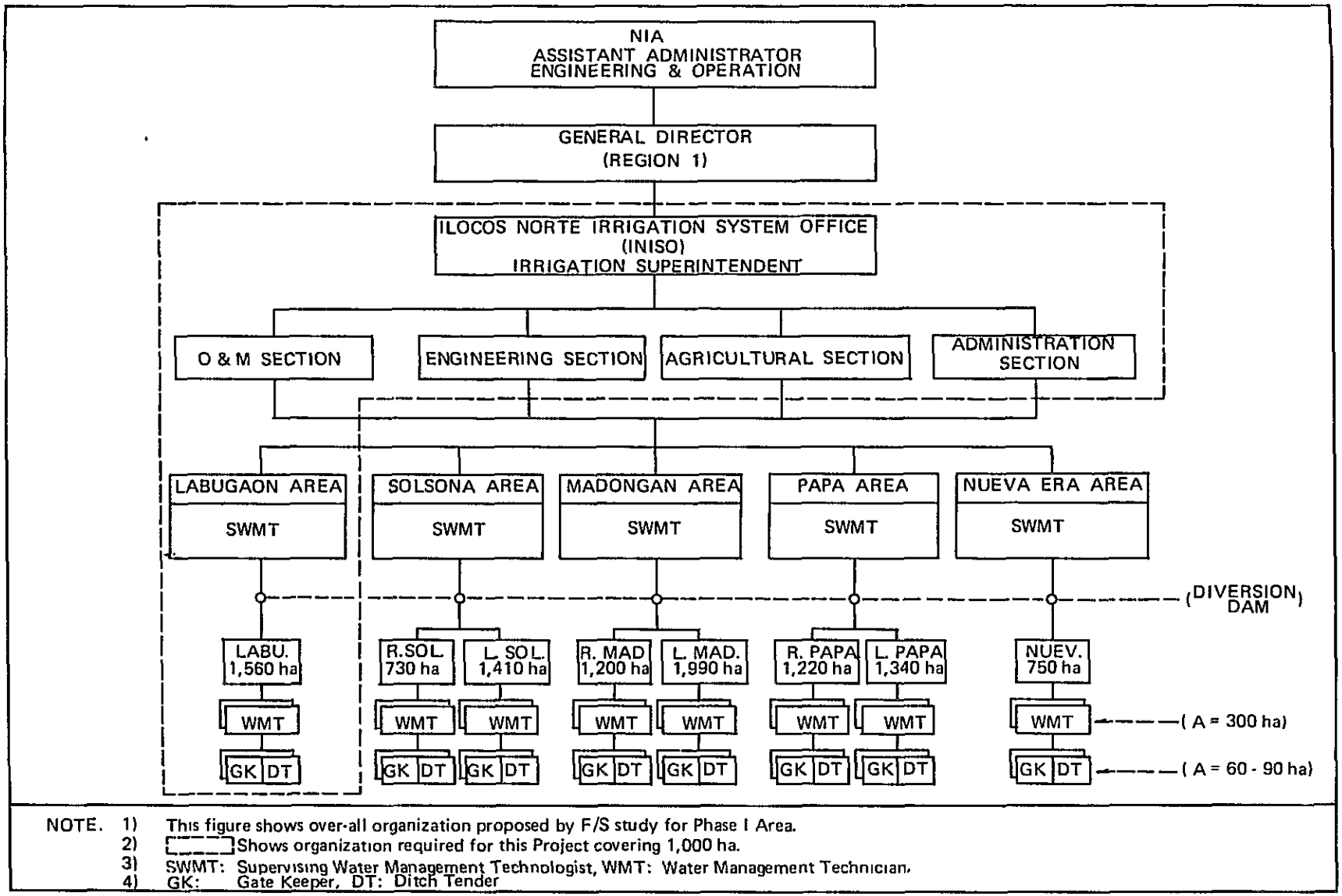
- SWMT: responsible for the control of water management in the Project. He will be assigned at the Project Office under the supervision of Irrigation Superintendent.

- WMT: one WMT for each 300 ha will be assigned under SWMT, and responsible for the control of the works of five Gate Keepers and five Ditch tenders.

- Gate Keeper (GK): under the guidance of MWT, responsible for the operation of main and lateral canals and two turnouts (60 ha) which supply the irrigation water to terminal facilities. He will instruct the farmers to manage the terminal facilities.

- Ditch Tender (DT): under the guidance of MWT, responsible for the maintenance of main and lateral canals and canal structures, such as prevention against sedimentation and plant growth. He will be responsible to the service area of 60 ha.

FIGURE - 10. ORGANIZATION CHART FOR OPERATION AND MAINTENANCE



NOTE. 1) This figure shows over-all organization proposed by F/S study for Phase I Area.
2) [ ] Shows organization required for this Project covering 1,000 ha.
3) SWMT: Supervising Water Management Technologist, WMT: Water Management Technician.
4) GK: Gate Keeper, DT: Ditch Tender