2. Farming Status

a) Farm Size

The present number of farm households and farm population in the Project Area are about 5,430 households and about 29,200 persons, respectively. These farmers belong to five municipalities and 44 barangays. The average farm size is 1.4 ha and about 43 percent of total farm households possesses the land less than 1.0 ha to give the total occupancy at about 20 percent of total land in the area. But as a whole, the farm households which hold the land from 1.0 ha to 2.0 ha occupy the biggest share and 53 percent of total farmland belongs to these farmers. (See Appendix 3D-1).

b) Transient Farmers

In the lower reaches of the Project Area, farmers who come mostly from Laoag, San Nicolus, Sarrat occupy 20 percent of total farm households. During transplanting and harvesting seasons, these farmers are transmigrating to the area to cultivate the land. Their cultivation method remains extensive and have lower yield as compared to that of the settled farmers.

The existence of such transient farmers are caused by the following reasons:

i) The area along the Bonga river is unstable for cultivation because the flowstream of the Solsona and Madongan rivers have changed their courses when flooding occurs. Thus the number of settled farmers is relatively small and their farm size is comparatively larger. Under these conditions, the land owners hire considerable number of tenant farmers to cultivate the lands.

ii) The farmers in the downstream area of the Bonga river, Laoag, San Nicolus, Sarrat etc. and on the left bank areas of the Bonga river have limited cultivated lands and want to hold additional lands.

iii) Land owners dwelling in the other area can affored to purchase the lands in the Project Area at a low price. The tenant farmers outside the Project Area are also hired to cultivate these lands.

3. Present Cropping Pattern and Crop Production

The cropping pattern in the Project Area is classified into the following five types:

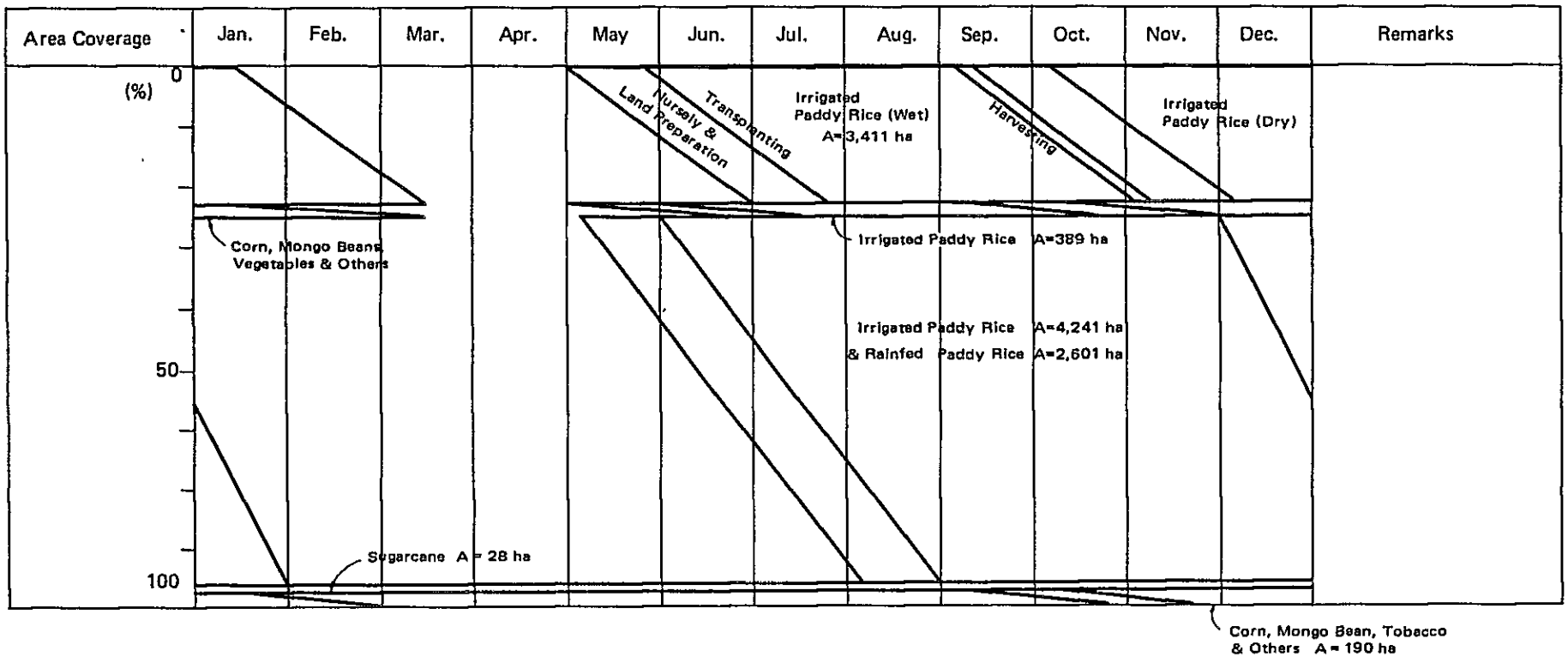
Cropping Pattern (Wet Season)	(Dry Season)	Cultivation Area (ha)
i) Paddy Rice	+ Paddy Rice	3,411 (Irrigated paddy field)
ii) Paddy Rice	+ –	6,842 (Irrigated paddy field, 4,141 ha Rainfed paddy field, 2,601 ha)
iii) Paddy Rice	+ Upland Crops	389 (Irrigated paddy field)
iv) –	+ Upland Crops	190 (Upland crop field)
v) Sugarcane	+ –	28 (Rainfed paddy field)
Total Cultivated Area		10,860
Total Cropping Area		14,660 (See Figure 3-1)
Cropping Intensity		135%

As mentioned above 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 croping of rice with high yielding varieties has been made in 1977. 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 planted once a year, thus paddy rice of high yield varieties is planted in the remaining area. 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 though 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.

FIGURE 3-1 PRESENT CROPPING PATTERN



Total of Cultivated Area: 10,860 ha

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

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 follows: 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 crop is about 1.4 ton/ha. The yield of wet season crop in the rainfed areas is about only 1.3 ton/ha. Consequently, the total production of paddy per year is estimated at about 21,530 ton.

Present Crop Production

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

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.

In Madongan sub-project area, each type of paddy rice has less yield than that in other sub-project areas (See Table 3D-8, Appendix 3D-2). A big excessive discharge from the mountainous areas to the Project Area, especially the Madongan sub-project area has been left uncontrolled conditions even in the communal irrigation areas. The excess discharge to rivers, creeks and even communal irrigation canals washes away surface soils together with applied fertilizers because plot-to-plot irrigation prevails in the Project Area with low density of canals. Under such conditions, all roads except a few main roads get impassable throughout the wet seasons. It naturally makes the farm management extensive, especially in the Madongan sub-project area.

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 (See Table 3D-4, Appendix 3D-1). However, according to the farm management survey conducted by NIA, LRED, 1978, 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 only the dry season, where irrigation will be prerequisite.

4. Input Materials Supply

The amounts of major input materials in the Project Area are estimated as follows (See Table 3D-10, Appendix 3D-2).

Paddy seeds:	808 tons (about 64 percent, HYVs)
Fertilizers:	833 tons (urea, ammosul and some kinds of compound fertilizers)
Pesticides:	2,602 quart (liquid)
	3 ton (water soluble powder)
Herbicides:	3.4 quart (liquid)

About 64 percent of total paddy seeds is of high yield varieties. But the field survey revealed the latest type of high yield varieties with resistance to major farmful insects and diseases have been used in only a small area. Most of the farmers use self-supplied seeds and it induces the mixture of different varieties, resulting in low yields by non-uniform growth height of plants.

Although relatively large amount of fertilizers, about 32 kg of nitrogen per hectare has been applied for the irrigated dry season paddy rice, the smaller amount has been applied for the irrigated wet season paddy rice (14 kg/ha) and for the rainfed wet season paddy rice (7 kg/ha). The applied amounts of phosphate and potassium are relatively very small as compared with these amounts of applied nitrogen. On the other hand, fertilizer application covers 66 percent of the irrigated dry season crop and about 40 percent of the both of the irrigated wet season crop and the rainfed wet season crop. Although the amount of fertilizers for the irrigated dry season crop reaches 49 kg in nitrogen, it is concluded that the applied amount of fertilizers for paddy rice remains

at low level, because of vast areas of no fertilizer application and their low application rate (See Table 3D-11, Appendix 3D-2)

The insecticides application covers about 30 percent to 40 percent of the cropped area and the amount applied is very small (See Table 3D-11, Appendix 3D-2).

5. Farm Labor Balance and Farm Mechanization

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.

The estimated annual labor requirements in the Project Area are about 1,095 thousand man-days, which are equivalent to the only 36 percent of available labor sources in the area. Furthermore, even at the peak of labor requirement, the excess labor is estimated at about 19 percent of labor source (See Table 3D-13, Appendix 3D-3). Under these circumstances, about 50 percent of required labor is accustomed to be hired for the operations of paddy rice transplanting and harvesting; thus the excess labor will be increased. In future, proper utilization of such excess labor should be made to raise agricultural production and farmers income level.

6. Animal Husbandry

The major animals and poultries which are raised in the five municipalities concerned are carabaos, cattle, hogs and chickens as shown in Table 3D-14, Appendix 3D-4. About one carabao and two cattle are raised per farm, out of them about 0.7 carabao and 0.5 cattle are estimated to be the working ones, based on the agricultural census. (In case of carabo, see Table 3D-15, Appendix 3D-4). As for hogs and chickens, only two hogs and five chickens are raised per farm. Relatively, there is no farm raising of above-mentioned animals in large-scale and most of poultries are considered to be raised for home consumption.

7. Farm Economy

Farm management survey was executed by NIA, LRED staff from January to February 1977. The 348 farmers were selected in the municipalities concerned by the random sampling method.

Distribution of farms by tenure is shown in the following table.

Distribution of Farm Household by Land Tenure

(Unit: %)

Area	Owner	Tenant	Lease	Partial Owner Share Tenant	Partial Owner Lease	Total
Project Area	9.3	63.6	–	25.9	1.2	100.0
Batac-Badoc Area 1/	14.3	17.3	–	68.4	–	100.0

1/ Phase II area

As seen in the above table, share tenant farmers occupy a large portion in the Project Area, and this fact leads to the disadvantageous of farm economy in the Area. Furthermore, lower cropping intensity of 116 percent than 146 percent in the Batac-Badoc area would result in a shortage of cash income.

Average yields of palay planted in both areas are almost the same as 32.6 cavans in the Project Area and 30.6 cavans in the Batac-Badoc area. Disposition of palay production indicates a little quantity of market-oriented palay as follows.

Disposition of Palay Production

Area	No. of Farms	Area Planted (ha)	Total Production (cavan)	Rent to Landlord Share (%)	Rent to Landlord Lease (%)	Harvester/ Thresher (%)	Market-Oriented (%)	Home Use (%)	Seed Feeds (%)	Credit - or (%)
Project Area	218	228.09	7,099	34.4	–	13.6	2.3	44.7	4.3	0.7
Batac-Badoc Area	140	149.34	4,571	24.6	0.2	4.8	1.3	64.0	5.1	0.0

The larger share for the rent to landload and labor custom in harvesting in the Project Area would bring the smaller share for market-oriented quantities and for home consumption. In the other way, home consumption quantity in Batac-Badoc Area has some spare to be sold because the total populaton of farm households is almost the same in both areas.

Inventory and capital investment per farm household in the Project Area is 286 pesos which is extremely less than that in Batac-Badoc area, 1,017 pesos. Livestock and poultry inventory, however, is 3,100 pesos, nearly the same in both areas.

The number of farmers and the fertilizer-applied area in the Project Area indicate a remarkable difference from those in Batac-Badoc area, as shown below:

Area	No. of sample	Farm reported	Area planted (ha)	Area applied for fertilizer (ha)
Project Area	218 (100%)	127 (58%)	228 (100%)	117 (51%)
Batac-Badoc Area	140 (100%)	136 (97%)	149 (100%)	145 (97%)

Active populaton engaged in farming is 2.5 persons out of total populaton of 5.76 persons per household, and the hired labor days per hectare for paddy cultivation is 37 percent of the total labor days of 76 in the wet season and 33 percent of 82 labor days in the dry season, respectively.

The following table indicates a farm economy in the Project Area. The farmer having an average size of land with 1.05 ha obtains an agricultural income of 2,434 pesos from crops and livestock trading. About 60 percent of sample farms is engaged in other works to get non-farming income, a great part of which are salaries, wages, by being hired in other farms. Such farmers obtain 633 pesos per year on an average. But, the averaged income by total sample farmers is estimated at 371 pesos. Then, average farmers earn 2,805 pesos of gross income. Production cost is evaluated at 559 pesos of which labor hiring cost occupies 50 percent.

The average farmers can get farm income of 2,246 pesos. However, due to high rental charge of land, the net farm income would not be sufficient to cope with the cost of living.

Present Status of Farm Economy in the Project Area

Average Farming Status	
Size of Farm	1.05 ha
Area Cropped (Palay)	1.22 ha
Gross Income	
Palay Production	1,931 tons
Crop Income	2,124 Pesos
Livestock Income	310 Pesos
Agricultural Income	2,434 Pesos
Other Source Income	371 Pesos
Gross Income	2,805 Pesos
Production Cost	
Seeds	66 Pesos
Fertilizer	107 Pesos
Pesticides	8 Pesos
Hired Labor	303 Pesos
Hired Animal	48 Pesos
Repayment	15 Pesos
Feed	12 Pesos
Production Cost	559 Pesos

Other Expenditures		
Rent to Landlord	730 Pesos	(1,931tons x 0.344)
Creditor	12 Pesos	
Farm Income		
Net Farm Income	1,504 Pesos	
Living Allowance	2,160 Pesos	
Surplus Income	- 656 Pesos	

The detail description of the present farm economy is given in Appendix 3D-5.

8. Processing and Marketing of Farm Products

Rice is one of the major farm products in the Project Area and it occupies a great part of the farm products, amounting to about 21,530 tons per year by both wet and dry season crops.

NGA possesses a warehouse with a capacity of 100,000 cavans (2,000 tons) at Laoag, equipped with a rice mill (milling capacity: 160 cavans/12 hr) and at present has a plan to install 50,000 cavans (1,000 tons) of warehouse equipped with a rice mill (milling capacity: 100 cavans/12 hr) at Dingras.

Besides those public warehouses, a private warehouse was installed in Dingras with 500 cavans capacity. Other small warehouses and rice mills exist at 200 places in the Project Area with the total capacity of about 7,970 cavans.

9. Agricultural Credit

The agricultural credit system was initiated in 1908 under the American Administration and has taken a long and hard time to be firmly stablished as it is now. The banks and organization that are currently handling the agricultural credit are the Agricultural Credit Administration (ACA), the Philippine National Bank (PNB) and the Rural Bank (RB).

One of the major agricultural credits is provided in accordance with promotion of Masagana 99 program, which finances for the purchases of input materials and for other required expenditures. BPI and BAEx are responsible for guidance and offering good offices on this finance which is mainly made by Rural Bank under control and support by Central Bank of the Philippines. For farmers' side, credit has been supplied through Samahang Nayong, Farmers' Association and others. But in some cases, credits are financed through private channel.

In general, the credits are financed as unsecured loan on the following conditions: six month repayment with the 12 percent of annual interest and the limitted amount of ₱ 1,600 per hectare. Sometimes, Samahang Nayon has two percent of handling charge, hence making the net interest amounts to 14 percent. This amount of interest is very low as compared with that of city banks.

Middle and long term loans have been provided for the purpose of construction of irrigation facilities and warehouses, purchase of farm machines and domestic animals and so on under more severe loan conditions for the guarantee, repayment and spending purpose.

The current repayment for the financed loans under Masagana 99 program amounts to 12.2 million pesos and the outstanding balance is 5.4 million pesos. Hence, the gross amount of the loans to date in the Project Area is 17.5 million pesos.

10. Research and Extension Services

a) Research

There are following research institutes serving the Project Area mainly for paddy rice, tobacco and garlic: BPI Dingras Experiment Station for paddy rice, diversified crops inclusive of tobacco and garlic, Ilocos Agricultural Research Center for Tobacco, which is located at Batac, PVTA Nangalisan Experiment Station for Virginia Tobacco located at Laoag, and BAI Animal Breeding Station located at Dingras. Among them, the BPI Dingras Experiment Station, which has 5 ha of foundation seed farm, will be the center for researching services in the Project Area. The Don Mariano Marcos Memorial College of Sciences and Technology, which is located at Batac is also one of the cooperating research stations and will play a role to educate the technicians and leaders of farmers concerned with the Project.

b) Extension Services

BPI and BAEx have promoted jointly agricultural extension services especially under Masagana 99 program. In the municipalities concerned, 16 persons of production technicians under BPI and 57 persons of extension workers under BAEx are engaged in the activities for leveling up the farming techniques and raising up the agricultural production in managing two or three model farms or demonstration farms. The allocation of corresponded production technicians and extention workers are as follows:

- BPI: One Production Technician per each 140 ha or 160 farmers
- BAEx: One Farm Management Technologist per each 150 farmers and one Assistant Farm Technologist per 10 farmers each.

Besides the production technicians and extension workers, each municipality engages some associated technologists for extension services.

Concerning execution of extension services, BPI is engaged in promotion of Masagana 99 program, supplying seeds, fertilizers, agri-chemicals, loan for farm management, etc. BAEx makes an effort for selection of recommended varieties, technical guidance to application of fertilizers and agri-chemicals, and improvement of farming practices. And BAEx has organized 131 groups of Farmers' Associations, 28 groups of Home Improvement Clubs and 30 4H Clubs etc. in the Project Area, in order to provide with extension services and guidance through the groups.

11, Farmers' Organization

There are presently such farmers' organizations in the Project Area as Associations of Communal Irrigation Systems, Samahang Nayon, Farmers' Associations, etc. The respective structures and their activities are as follows:

a) Association of Communal Irrigation System

The Project Area has 138 Communal Irrigation Systems (8,097 ha of concerned area), which were organized almost spontaneously more than 100 years ago and reorganized or improved. Management of the systems is made independently by key members such as President, Vice President, Secretary, Treasurer and Auditor selected among farmers under guidance of the provincial office of NIA.

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.

b) Samahang Nayon (Barangay Association) and Kilusang Bayan (Cooperative)

32 Samahang Nayons have been registered in the Project Area under DLGCD. Samahang Nayon is expected to be established throughout the Project Area and to provide various functions such as development of rural community, promotion of campaign for Masagana 99 and Masagana Maisan, provision of systems to receive credits, and frame works for establishment of agricultural cooperatives.

There exists no cooperative such as Kilusang Bayan. However, with the progress of this Project, Kilusang Bayan will be established, considering further progress in regard to Barangay Saving Fund and Barangay Guarantee Fund.

c) Farmers' Association

To promote the Masagana 99 program and to provide guidances on agricultural improvement and improvement of living conditions, BPI and BAEx have cooperatively established 131 Farmers' Associations, 28 Home Improvement Clubs and 30 4H Clubs in five municipalities concerned.

CHAPTER IV. THE PROJECT

CHAPTER IV. THE PROJECT

A. Objectives and Components of the Project

1. Objectives and Scope

The Project Area is one of the regions that are left behind in economic development. An average per capita income of about ₱955 [1/] is much lower than that of the national average of ₱ 1,601 [1/]

There might be many reasons to be counted in this regard, but the major reason might be the absence of water resources available for irrigation under the existing conditions. Under the status, on the right bank area of the Bonga river, there exist many diversion dams so-called brush dam to divert irrigation water to the communal irrigation systems. However, cropping area in the dry season is quite limited due to the low river discharges. So, the rainfed paddy cultivation has prevailed even in the wet season, and in the dry season only 39 percent of the existing paddy fields is planted for cultivation. Upland crops such as tobacco, corn and mongo bean have been grown in the area of two percent of the Project Area throughout the year.

In addition to the shortage of irrigation water, the area has neither rationalized irrigation and drainage canals nor farm roads. Specially, transportation to and in the Project Area is suffering from flooding.

Under the conditions, the agricultural productivity in these areas is remained at low level, which results in poor farm income, mostly due to the shortage of agricultural facilities required for rationalized agricultural production inclusive of water source facilities, irrigation and drainage canals and farm road networks.

Since the Project Area is blessed with natural conditions including soil, climate and topography for paddy and diversified crops cultivations, the potentiality of the Project Area for agriculture development could be surely exploited by means of adequate facilities.

The project aims to increase agricultural production, create the employment opportunities throughout the year, and improve the living environment from a view point of the rural development through assured irrigation water supply with improved agricultural

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1/ Devided from Long-term Development Plan, 1977, NEDA

supporting services, and farm roads. In order to achieve the above-mentioned objectives and to get quick benefit in the whole Project Area, the following should be envisaged in accordance with the proposed works schedule.

i) Establishment of irrigation and drainage systems for double cropping of high yield varieties of rice and for cultivation of tobacco, garlic and other profitable crops;

ii) On-farm development for irrigated agriculture as well as for modernized agricultural practices;

iii) Institutional arrangement and strengthening of agricultural supporting services for full development of the Project Area; and,

iv) Rural Community development after the implementation of on-farm development.

2. Component

The components of the project for 10,200 ha irrigation development consist of irrigation and drainage canals, on-farm development, road, agricultural supporting service and institutional arrangement.

B. Project Formulation

1. Alternative on Optimum Scale of Development

a) Alternative Plan

To formulate the Project, the following four alternative plans have been proposed from an aspect of water resources development as illustrated in Figure 4B-1, Appendix 4B-1.

Case I: Diversion Plan

Natural river flow will be utilized through seven diversion dams proposed in Phase I and Phase II areas. Available water for irrigation will fluctuate year by year depending upon river run-off, thus, irrigation acreage will be limited. On the other hand, project costs will become lower than those of other plans.

Case II : Single Reservoir Plan

In combination with the said seven diversion dams, Palsiguan dam is planned to relieve irrigation area from water shortage mainly in the dry season and in addition to irrigation purpose, hydropower energy will be produced by using difference in elevation between delivery of water through trans-basin. Before completion of Palsiguan Dam,

development of Phase I area becomes same as that of Case I alternative plan.

Case III-1: Multi-Reservoir Plan with Trans-Basin

Putting stress on phasing development, Madongan dam with Labugaon, Solsona, Papa and Nueva Era diversion dams is planned in Phase I area in order to bring more incremental benefits of agriculture for the area and as a by-product of irrigation, hydropower energy will be produced.

In Phase I development, Madongan dam combining with four diversion dams will not be sufficient to supply irrigation water for the proposed area of 10,200 ha; hence, Palsiguan dam will cover this shortage water in addition to development of the Phase II area.

Case III-2: Multi-Reservoir Plan without Trans-Basin

This plan aims at development of major water resources available within the Ilocos Norte region. In Phase I Project, Madongan and Nueva Era dams are provided so as to develop water resources as much as possible. In Phase II Project, Tibangran dam with Madupayas diversion dam will be planned.

b) Evaluation of Alternatives

Estimation on irrigable area by relevant water sources to each alternatives has been made on the basis of water balance studies for the period of ten years, 1960 to 1969, and the associated benefits and costs including hydropower generation are given in Table 4B-1, Appendix 4B-1.

As concluded in Overall Project, Case II, Single Reservoir Plan, is an optimum plan among alternatives in the aspects of IRR and project cost per hectare. In Phase I Project, irrigable area by five diversion dams, i.e., Labugaon, Solsona, Madongan, Papa and Nueva Era becomes 8,080 ha which covers about 80 percent of the proposed area. Irrigation project cost per hectare amounts to US$2,850 and IRR becomes 13.2 percent.

2. Proposed Scheme of Development

The project development in the Phase I stage has been made to expect the full use of river waters to irrigate the areas as vast as possible in the dry season, by means of construction of diversion dams. In the project, necessary facilities, such as diversion dams, canals and on-farm facilities, will be provided to realize irrigated agricultural development.

The main features of the plan are as follows:

Service Area

Labugaon Area	2,290 ha
Solsona Area	2,610 ha
Madongan Area	3,210 ha
Papa Area	2,090 ha
Total	10,200 ha

Diversion Dam

Name	Intake Discharge (cu.m/sec)	Height (m)	Length (m)
Labugaon	3.63	2.3	84
Solsona	3.29	2.3	67
Madongan	7.44	2.5	181
Papa	6.01	2.3	162
Nueva Era	1.75	13.0	195

Canal and On-farm

Irrigation Canal	208,530 m
Drainage Canal	147,090 m
On-farm	10,200 ha

3. Irrigation Plan

a) Irrigation Water Requirement

(1) Potential Evapotranspiration

Potential evapotranspiration (ETp), generally recognized as fairly reliable index in calculating consumptive use, can be determined by number of methods, such as the evaporation measurement from evaporation pan and the application of empirical formula based on the climatological data. In the Project, the evapotranspiration of the proposed crops is estimated by applying the Penman Method[1/], based on the climatrological data observed in Vigan, Ilocos Sur.

(2) Consumptive Use

Paddy

The consumptive use of paddy (actual evapotranspiration, ETp), which is assumed to be equal to evapolation, can be estimated by multiplying the estimated ETp values by crop coefficient which express the relationship between potential and actual evapotranspiration during distinct vegetative stages of the crops.

No data on such coefficient, however, are available in the vicinity of the Project

1/ Penman Method: This is the most complete theoretical method for the rather humid area not far from ocean and essentially covered with growing vegetation.

Area, so that the ETp values estimated by the Penman Method is adjusted by the ratio of an actual evaporation observed at Vingan and Laoag.

Upland Crops

Crop diversification, in which upland crops are tobacco, garlic and onion, is planned during the dry season in the Project. In deriving the consumptive use for these upland crops, the following crop coefficients are applied to the estimated ETp.

Crop Coefficient

Month	Tobacco	Garlic	Onion
November	0.70	0.35	0.70
December	0.80	0.50	0.75
January	0.70	0.25	0.65
February	0.60		
Average	0.70	0.37	0.70

The following table gives the consumptive use of crops estimated by the above procedure on the daily basis.

Estimated Consumptive Use

Month	Paddy	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	5.4	3.4	5.0
January	6.4	4.5	1.6	4.2
February	6.0	3.6		
March	6.6			
April	6.7			
Average	6.3	4.5	2.4	4.5

(3) Crop Water Requirement

Crop water requirement on the 10-day basis is estimated based on the proposed cropping pattern. In this estimate, the following assumptions are made:

- Percolation rates in the paddy field are two millimeters per day throughout the growing period of paddy. Percolation rates were measured at several sites in the existing paddy fields and it was found that the percolation rates, ranging from

one to seven millimeters in the Phase I area, are relatively large than those observed in the Phase II area, in which the paddy fields have impervious nature with low percolation rate around one millimeter. (See Table 4B-1, Appendix 4B-1).

- Additional water supply for land soaking and preparation of the paddy field is decided at 250 mm for the wet season paddy and 230 mm for the dry season paddy as shown below:

Water Requirement for Land Preparation

Item	Wet Season Paddy (mm)	Dry Season Paddy (mm)
1st irrigation for land soaking	175	150
2nd and 3rd irrigation	75	80

Note: detail description is given in Table 4B-3, Appendix 4B-2.

On the other hand, additional water supply for land preparation of the upland fields is 200 mm for tobacco and 100 mm for garlic and onion respectively.

The estimated crop water requirement of each crop is shown in Figure 4B-3, in Appendix 4B-2.

(4) Diversion Water Requirement

Diversion water requirement should be calculated by taking into account the effective rainfalls and water losses in adding to the average crop water requirement weighed by the planted area. The criteria of the effective rainfalls and irrigation efficiency used for the Project are as follows:

Effective Rainfall

The effective rainfall during land soaking period of the paddy fields is estimated at 250 mm considering the land soaking capacity. The maximum effective rainfall during the growing stage of the paddy is estimated at 60 mm. Therefore, the maximum allowable flooding depth is 80 mm.

The effective rainfall for upland crops is decided to be zero throughout growing stage.

Irrigation Efficiency

In the estimation of diversion water requirement for paddy cultivation, the followings are adopted: i) farm efficiency of 65 percent and 75 percent for the wet and dry

seasons respectively, ii) conveyance efficiency in the canal of 80 percent for both seasons and iii) operation efficiency of 90 percent for both seasons. On the basis of above criteria, the overall irrigation efficiency for paddy cultivation is estimated to be 46.8 percent in the wet season, and 54.0 percent in the dry season. (See Appendix 4B-2, Page 6)

The irrigation efficiency for upland crops is assumed to be 60 percent, after making reference to the NISIS I.

The diversion water requirement of each crop which is estimated in the year of 1965 corresponding to about 10-year probability, is given as follows:

Diversion Water Requirement

(Unit: mm)

Season	Paddy	Upland Crops 1/	Average 2/
Wet Season	611.7	–	611.7
Dry Season	1,923.0	764.2	1,807.1
Total	2,534.7	764.2	2,418.8

Detail estimation is given in Table 4B-4 Appendix 4B-2

1/: Tobacco 300 ha
Garlic 350 ha
Onion 350 ha

2/: Weighted diversion water requirement in the dry season on the basis of following diverification ratio:
Paddy: 90%
Upland crops: 10%

b) Design Discharge of Canals

(1) Land Soaking and Land Preparation for Paddy Cultivation

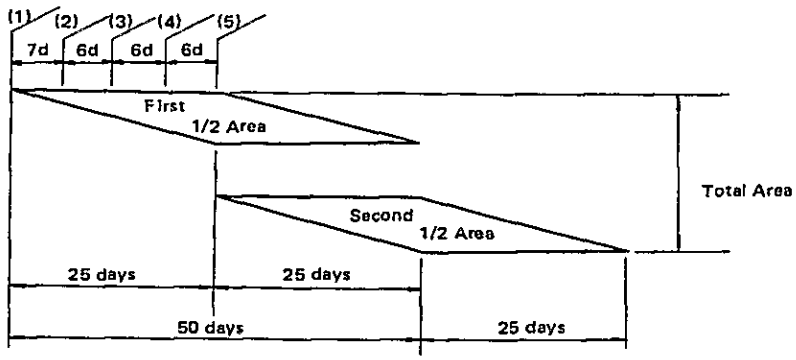
According to the natural environments and cultivational habit of farmers, the process of land soaking and land preparation is designed to comprise one plowing followed by three times of harrowing with an interval of six days for each time for land plot.

The first irrigation is proposed for seven days before plowing for land soaking, then second irrigation will be given for 13 days later to prevent the field from drying. The last irrigation will be applied just before the last harrowing which may be followed by transplanting immediately.

Generally, the period to complete the land preparation for the whole Project Area is decided at 50 days. However, the area in one irrigation rotational area covering the

preparation schedule so arranged can be illustrated in the following figure.

Illustration of Working Schedule for Land Soaking and Preparation



(1) First Irrigation for land soaking
(2) Land plowing
(3) First harrowing and second irrigation
(4) Second harrowing
(5) Third harrowing and third irrigation

(2) Design Discharge of Terminal Canals

The design discharge of terminal canals such as main and supplementary farm ditches will be decided by the following procedures: Supply of water from the main ditch to the supplementary farm ditch is planned to be simultaneous, while distribution of water from the supplementary farm ditch to the farm lots is rotational. Consequently, each supplementary farm ditch covering about six hectares, one rotational unit, will have same canal capacity in one rotational area, however, the canal capacity of main farm ditch will be decreased in proportion to the number of rotational units. Then, the design discharge of canals is determined based on the following figures:

- One rotational area: 30 ha (6 rotational units)
- Land preparaton period for one rotation area: 25 days
- Water requirement for land soaking and preparation
  - Wet season paddy: 250 mm
  - Dry season paddy: 230 mm
- Application losses
  - Wet season paddy: 35 %
  - Dry season paddy: 25 %

Consequently, the design discharge of the supplementary farm ditch is calculated at 10.68[1/] lit/sec, which is equivalent to 1.78 lit/sec/ha inclusive of 35 percent of application losses (waste water), while that of main farm ditch will vary ranging from 53.40 lit/sec to 10.68 lit/sec.

(3) Design Discharge of Main and Lateral Canals

According to the proposed cultivation schedule, paddy cultivation will be planned in the whole Project Area during the wet season and in the cultivation, separate application of land soaking and preparation waters will be carried out within 50 days.

Then, the maximum weighted water requirement appears in mid-July with the amount of 2.33 lit/sec/ha.

c) Water Balance

(1) Irrigable Area

As studied in the development plan of the overall project, irrigation water in the Phase I Project will be supplied only through the Labugaon, Solsona, Madongan, Papa and Nueva Era diversion dams. The supplied water will fluctuate year by year by depending upon run-off volume of each river to be developed; hence, irrigable area will vary in accordance with this water.

To grasp the irrigable area and shortage water, i.e., water supplied from Palsiguan dam in Phase II Project, water balance for the proposed irrigation area has been studied for the period 1960 to 1969 for which available run-off data were obtained.

From an annual water balance point of view, Phase I area has an abundant run-off volume with 1,078 MCM equivalent to four times of irrigation water requirements with 261 MCM (see Table 4B-5, Appendix 4B-2). However, seasonal distribution of run-off will not meet that of water requirements, therefore, water shortage will occur even in the wet season.

Based on 10-day unit computation, water balance and irrigable area for the period 1960 to 1969 are summarized as follows:

1/ 250mm x 10^{-3} x 6.0ha x 10^{4} x 10^{3}/25days x 86,400 x 0.65 = 10.68 lit/sec

Water Balance in Each Sub-Area

Sub-Area	Irrigation Area (ha)	Average Run-off (MCM)	Average I.W.R. (MCM)	Average Irrigable Area 1st Crop (ha)	Average Irrigable Area 2nd Crop (ha)
Labugaon	1,560	266.7	40.1	1,480	960
Solsona	2,140	209.7	54.7	1,990	890
Madongan	3,190	314.4	81.7	2,880	1,310
Papa	2,560	136.4	65.7	1,860	710
Nueva Era	750	151.2	19.2	720	550
Total	10,200	1,078.4	261.4	8,930 (87.5%)	4,420 (43.3%)

Note: Detailed calculation is given in Appendix 4B-2.

Average available water for irrigation through five diversion dams amounts to 203.4 MCM which occupies 19 percent of the total run-off volume and surplus water becomes 874.9 MCM, 81 percent of the run-off colume. Maximum shortage water appears in 1968, which amounts to 89.9 MCM.

Irrigable area is determined by possible supply water during the irrigation period, i.e., in water balance study, by run-off volume of the rivers at the time of maximum water shortage occurred. Furthermore, even if once water shortage occurred, irrigation area will be restricted by supply water at that time. As seen in Table 4B-7, Appendix 4B-2, appearance of minimum irrigable area for the first cropping period in 1963 results in this assumption in spite of sufficient run-off volume obtained during that period.

For selection of design year in Phase I Project, the year 1969 was adopted due to the following reason; In case of irrigation done by diversion dams, a drought year in 5-year frequency is selected as a design year. As for the irrigation area either in first and second cropping within 10 years, the year 1969 is placed next to the smallest. In overall plan, irrigation for the whole area will be attained by Palsiguan Dam, and the year 1968 in which maximum shortage volume appeared was selected as a design year. This year is considered to be a drought year occurred at 10-year frequency. As shown in Table 4B-8 and Figure 4B-6 to 4B-7, Appendix 4B-2, probability analysis on rainfall and water requirement indicate that 1968 falls on the same frequency.

In design year 1969, water shortage appears not only in the first crop season but also in the second crop season, thus, irrigable area becomes 8,080 ha, 2,960 ha, respectively.

(2) Influence on Lower Reaches of the Bonga River after Completion of the Phase I Project

At present, Dingras RIS area under NISIS located on the left bank of the Bonga river is diverting irrigation water through intake structures installed at Marcos.

According to data obtained from NISIS Sub-Region Office, the diverted amounts during 1977 are shown in Table 4B-9 in Appendix 4B-2. After completion of the Phase I Project, run-off volume of the Bonga river at Dingras RIS Intake will be influenced by provision of Papa and Nueva Era diversion dams.

As shown in Table 4B-10, run-off volume at the intake consists of the following three flows:

- o Run-off from river basins excluding Papa and Nueva Era basins.
- o Surplus water through Papa and Nueva Era diversion dams.
- o Return flow from irrigated area by the above two dams.

Water balance in Table 4B-10 indicates that water shortage will not occur through the year, thus, Phase I Project will not affect on Dingras RIS Intake.

4. Drainage Plan

a) Drainage Modulus for Designing Drainage Canals in the Paddy Field

Drainage in Irrigated Area

In general, excess water in paddy fields shows the following phenomena:

- The excess water during and after heavy rains overflows from the paddy field to the neighboring lower paddy field.

- In sloping area, the overflow mentioned above is hydraulically the same phenomenon as seen at a broad-crested weir of free overflow type. In this case, a quantity of overflow discharge is decided by the difference of the water levels in the upper and lower paddy fields. On the other hand, in an area having not much difference of the water levels in two adjoining paddy fields, the quantity of overflow discharge is decided mainly by the water level in the lower paddy field as seen at a submerged broad crested weir.

- Both in sloping and slight sloping areas, the paddy field from which excess water is naturally discharged to the lower paddy fields has no drainage problem, and even if a paddy field is submerged by excess water, paddy does not suffer from it in case the water depth and duration are within the allowable extent.

- However, the paddy field located at the lowest part has not place to discharge excess water, if no measures are taken. It is generally said that the natural

drainage by gravity is effective in the areas having a slope of more than 15 cm/km. In the other areas especially flat or very slightly sloping area, the drainage problem is caused, and some facilities including pump are required.

Method for Estimation of Drainage Modulus

Studies have been made to clarify the relationship between the possible deduction of paddy rice yield and excess water discharge. In general, water more than 10 cm depth causes a damage in yield of paddy rice according to the inundation period and an average depth in this duration. Therefore, an actual maximum depth in the lower paddy fields does not play an important role in this study. The study has been made based on the following simplified principles and assumptions.

- The excess water in higher paddy fields is discharged immediately to lower paddy fields.
- All rainfall in the block in the Project Area flows into depressed areas such as lower paddy fields, which occupied (1/A) of the total area of block.
- The irrigation water supply is stopped during the heavy rainfall period.
- The depth of standing water after n days from the starting date of raining is as follows:

$$D = A[R(n, max)_T - n(DC + CU)]$$

Where: D: depth of standing water after n days in mm
$R(n, max)_T$: maximum rainfall during n days in mm, which is equal or exceeds the rainfall of once every T years
CD: drainage capacity in mm/day
CU: consumptive use of paddy rice in mm/day: CU = 8.0 mm/day

- It is assumed from topographic map that the depression area occupies about 25 percent of the total area of block. This means that the value of A is 4.0.
- If a smaller percentage than 25 percent is chosen, the damage itself becomes severe because the concentration of a certain water quantity in a smaller area causes a deeper standing water during a longer time. On the contrary, if a larger percentage is chosen, the damage will not be so severe in comparison with the above case because both the depth and duration of standing water become small. In the former, the damage is severe but damaged area is limited, while in the latter the damage is not so severe but larger area suffers from standing water. Under the situations, a total yield reduction will not be much affected by the difference of A value.
- The other factor to estimate the depth of standing water in lower paddy fields is the design return period of (T). If a small return period such as two or five

years is adopted from the economic point of view only, the Project Area will frequently suffer from the standing water. On the contrary, if a larger return period is chosen for drainage, it will result in increase of costs. The decision of the return period should be made only after having compared the benefits with costs in a number of alternatives. For the moment, the value of T is decided at five years in this study from the aspect of agricultural development.

- It is considered that the combination of A = 4.0 and damage amounting to 25 percent of the yearly yield of paddy will lead to a reasonable relation between the value of increased yield of paddy rice and the cost for drainage facilities.
- In general, even if a paddy field is submerged by excess water of more than 10 cm depth, paddy grown in the field does not suffer from it in case that its duration is less than three days and an average standing water depth in the duration is less than 25 cm.

In applying the above-mentioned calculation method, it appears that one or two days rainfall has to be drained so that the depth of excess water in paddy fields is less than 250 mm.

$$D_1 = A[R(1, max)_T - DC - CU]$$

$$D_2 = A[R(2, max)_T - 2DC - 2CU]$$

$$\frac{D_1 + D_2}{2} = 1/2\ A[R(1, max)_T + R(2, max)_T - 3CD - 3CU] < 250$$

and the following formula is derived from the above equations,

$$DC > 1/3\ R(1, max)_T + 1/3\ R(2, max)_T - 500/3A - CU$$

Estimation of Drainage Modulus

On the basis of the above-mentioned assumptions and principles, the drainage modulus of 8.72 lit/sec/ha is computed, which is equivalent to the drainage capacity of 75.3 mm/24 hr. In this estimate, the following average probable rainfalls observed at the Laoag statoin are used.

Maximum Probable Rainfall

(Unit: mm)

Return Period	R (1, max)	R (2, max)
5-year	335	440
10-year	420	520

But these rainfalls are revised taking into account storage effect of 200 mm in the paddy field, which will be caused by high water level in adjacent farm drain.

The modulus of 8.72 lit/sec/ha could be applied to the area smaller than 400 ha but a smaller modulus should be applied to a larger area than the above-mentioned because the rainfall intensity becomes low in a larger area than 400 ha. Figure 4B-8, Appendix 4B-3 shows an approximate linear double logarithmic relation between a reduction factor and an area.

When such reduction factor (F) is applied to the areas larger than 400 ha, the discharge criteria are obtained. The discharge criteria for drainage are tabulated below:

Discharge Criteria for Drainage

Area (ha)	Drainage Modulus (lit/sec/ha)
0 - 400	8.72
400 - 1,000	8.37
1,000 - 3,000	7.63
3,000 - 5,000	7.15
5,000 - 10,000	6.71

b) Drainage Discharge from Hilly Land

Since the Project Area is formed by alluvial fan, many small rivers and creeks of which catchment area is less than 100 sq.km are flow into the Project Area at their upper portions. This paragraph will discuss about the storm run-off from the areas except big river basins of Labugaon, Solsona, Madongan, Papa and Nueva Era.

Several procedures, in general, have been applied to estimate the storm run-off from hilly land, but the procedures through Mcmath or Rational methods have been usually used for the purpose in the NIA's Projects. Out of these methods, Mcmath method is applicable for the river vasin having the time of concentration of more than one hour with catchment area more than 100 sq.km, so that storm discharge from the hilly land related to the Project will be analized by applying the Rational method.

Rational formula is expressed as follows:

$$Q = 0.2778 f \cdot \gamma_t \cdot A$$

Where; Q: peak discharge of storm run-off (cu.m/sec)
f: run-off coefficient
γ_t: areal hourly rainfall intensity (mm/hr)
A: catchment area (sq.km)

In the above estimation, run-off coefficient (f) and areal hourly rainfall intensity (γ_t) are decided at f = 0.269 and γ_t = 36.8 mm/hr (5-year return period) respectively, which are referred to the report on hydrological study[1/] of NISIS, Package I, prepared

1/ Brief discription of the study is given in Appendix 4B-3, page 2.

by NIA in 1976. As a result, specific discharge of storm run-off from hilly land is estimated to be 2.75 cu.m/sec/sq.km.

5. Road Plan

The proposed roads in the Project are classified as follows:

Service Roads

The service roads are to be provided along the main and lateral canals in order to carry out the operation and maintenance of irrigation and drainage facilities as well as to transport the input and output materials. The proposed roads have two types of width, six meters along main canals and four meters along lateral canals, and these will be paved by coarse materials.

The proposed cross-section of above two types of roads has a surfacing of 15 cm thick of base coarse and selected borrow of 20 cm thick.

On-farm Roads

On-farm roads, which are the terminal roads in the cultivated area for farming, are planned along the main farm ditch, and no pavement is planned. The width of the roads is two meters.

6. Farm Land Development (On-farm Level)

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.

a) Premise in Farm Land Development

Farm Managements

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' groups will be organized by farm households in a cultivation area of about 60 ha involving the two rotational areas of about 30 ha.

Crops

Paddy of high yield varieties as the major crop will be grown in both the wet and dry season after the implementation of the Project. This project will increase the cropping intensity up to 200 percent.

Farm Practices

For the farm practices to grow paddy, an integrated farm mechanization system will be established using tractor, thresher and dryer which will be introduced for land preparation, threshing and drying works respectively, and the other works will mostly be made by a combination of manpower and carabao for the time-being.

b) Land Parcelling

(1) 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 bones of land parcelling on the basis of 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.

(2) Design of Rotational Area

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.

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 hectare, in consideration of the existing communal irrigation systems, their topographic conditions and also the NISIS. (See Appendix 4B-4)

c) Terminal Water Management System

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 rotation 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 hectare, 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 lit/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 lit/sec/ha. The sections of ditch becomes small towards the down-stream 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 lit/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 crossing:	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.

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 lit/sec/ha.

Detailed descriptions of on-farm facilities are given in Appendix 4B-4.

C. Proposed Agricultural Development

1. Proposed Land Use

The Project Area has a total gross area of about 15,890 ha, and out of the area, the total arable land is determined to be 10,200 ha, mainly based upon water balance,

land classification survey, agro-economic analysis and proposed crop cultivation, and these arable land is planned to be irrigated as paddy fields in the project. The other area of about 5,690 ha consists of such non-cultivated areas as right-of-way, residential area, and others. (See Table 4-1)

The whole arable land will be fully irrigated in both the wet and dry seasons by gravity systems.

The proposed land use pattern for the irrigated paddy field is divided into two types; namely, "double cropping of paddy rice in the wet and dry seasons" and "paddy rice in the wet seasons and diversified crops in the dry seasons". The selected crops for the diversified crop are such cash crops as garlic, tobacco and onions. These diversified crops are to be planted in 10 percent of the total irrigation area during the dry season. Then, the double cropping of paddy rice will be introduced in 90 percent of the total irrigation area.

The proposed cropping area of the diversified crops has been determined, based on the present cropping status of the diversified crops in the Project Area and its vicinity. Regarding the soil conditions, more than 80 percent of the total arable land is the suitable land for dual crops; namely, paddy rice and diversified crops, and the remaining 20 percent is suitable for paddy rice. Furthermore, the climatic conditions in the Project Area is suitable for both paddy rice and the diversified crops, having good marketability. On the other hand, the cash crops will bring more income for the farmer than what is expected in case of mono-cropping of paddy rice.

2. Proposed Cropping Pattern

Two types of cropping pattern have been proposed in the project from the result of land use, that is, "double cropping of paddy rice in the both wet and dry seasons" and paddy rice in the wet season and diversified crops in the dry season". The cropping areas of each pattern are as follows:

Proposed Cropping Pattern		
Cropping Area		1/
Wet Season	Dry Season	Area (ha)
(1) Paddy Rice +	Paddy Rice (Type 1)	9,200 (90%)
(2) Paddy Rice +	Diversified Crop	1,000 (10%)
a) Paddy Rice +	Tobacco (Type 2-1)	300
b) Paddy Rice +	Garlic (Type 2-2)	350
c) Paddy Rice +	Onion & Others (Type 2-3)	350
	Total Area	10,200
	Total Cropping Area	20,400
	(Cropping Intensity)	(200%)

Note: See Figure 4-1
1/ Irrigable area based on overall development

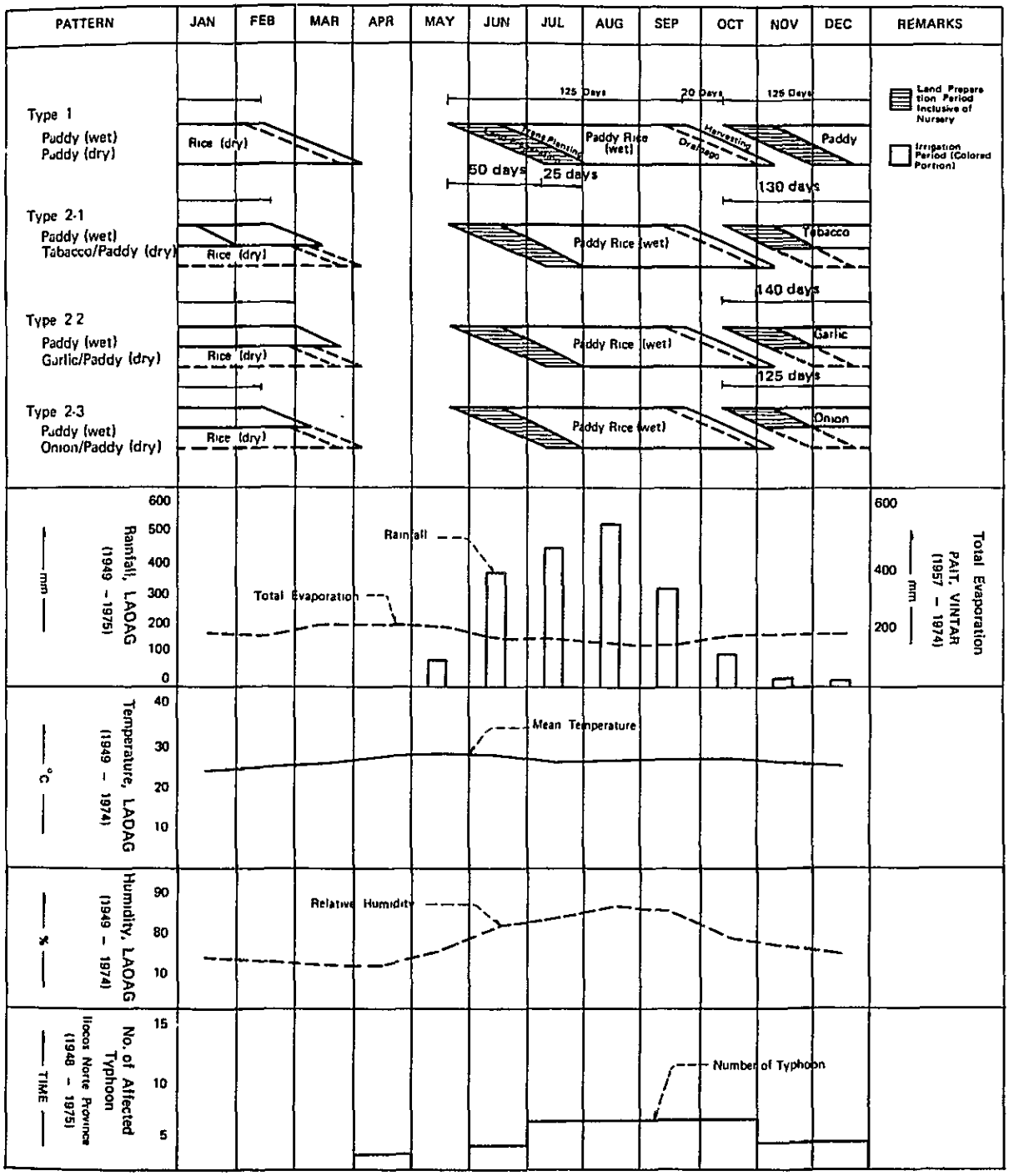
Table 4-1 Proposed Land Use

(Unit: Area)

Sub-Project Area	Arable Lands	Rights-of-Way 1/	Residential Area	Others	Total
Labugaon	2,290	183	105	316	2,894
Solsona	2,610	209	75	1,185	4,079
Madongan	3,210	258	120	2,240	5,828
Papa	2,090	166	145	685	3,086
Total	10,200	816	445	4,426	15,887

1/: Consists of rights-of-way for the proposed facilities of the Project.

FIGURE 4-1 PROPOSED CROPPING PATTERN



To determine proper timing of paddy rice cultivaton, many factors are examined from the hydrometeorological aspects for maximum utilization of effective rainfall and also from agronomical aspects for proper timing to weather conditions. Paddy rice cultivation would start in late May for the wet season crop and in mid-October for the dry season crop. The harvest time will start in late September and in mid-February for the wet and dry season crop respectively. This cropping schedule will bring proper period for the cultivation of diversified crop, especially for garlic whose yield is affected by photoperiodism if not planted in the months of October and November.

The lag period of 50 days are planned for the wet and dry season paddy rices among the above-mentioned four types of cropping patterns in case that the periods of 25 days of lag period are taken for the diversified crops.

According to the cropping schedule for paddy rice and diversified crops, irrigation water will be supplied from late May to mid-March. This would give about 60 days of off-irrigation period from April to early May to allow maintenance of the systems. On the idle period. farmers may optionally plant other cash crops if they can utilize residual water from the second crops: for instance, by applying inter-cropping within the second cropping land.

3. Market Prospect

a) Rice Market

The Philippine government published the long-term and five year (1978-82) development plans (1978-82), although it is draft. According to the plan it is found out that the increases of food production in the next five years will generally keep pace with the growth in demand, and self-sufficiency of basic food commodities will be attained and maintained. In fact, the Philippines already exported the rice of about 89,000 metric ton over the fourth times from the end of 1977 to April, 1978 to Indonesia and Malaysia. This means that the Philippines has just become a marginal exporter.

The grain industry development plan under NGA estimated the volume of surplus or deficit of palay during 1976 to 2000. It was reported in the plan that about 60 percent of production increments of palay would be due to irrigation under NIA's twenty five year program. Therefore, the incremental palay after completion of the Project would contribute to the international trade of the Philippines.

The balance of supply and demand of rice at present in Ilocos Norte Province attains the surplus by 100 kg of rice consumption by capita and the deficit or just balance by 130kg (see Table 4C-1, Appendix 4C-1). It is considered that the balance of rice consumption of Ilocos Norte is under the instability.

The balance of rice consumption without and with the Project was studied. The balance without the Project in future would be flexible depending on progress of annual growth rate of population and palay yield. If the rate of palay yield goes down by less than 1.5 percent, the balance without the Project will be in deficit. However, after completion of the Project, Ilocos Norte would be able to obtain the surplus rice of 67 to 77 thousand tons because the rice volume to be supplied will increase to double of that at present.

Balance of Supply and Demand of Rice in Future (1990)

– Ilocos Norte Province –

(Unit: 1,000 tons)

	Supply Products			Demand Capita rice Consumption		Surplus or Deficit Capita rice Consumption	
	Palay	Rice	Population	100 kg	120 kg	100 kg	120 kg
Without Project (Annual growth 1.5%)	100	63	497	49.7	59.6	13.3	3.4
With Project	202	127	497	49.7	59.6	77.3	67.4

The market moving volume of palay produced in 1977 is estimated at about 40,000 tons, 48 percent of total volume of 83,600 tons. The capacity of warehouse installed by NGA, Laoag, is of 100,000 bag of palay. This capacity corresponds to about 12 percent of the 40,000 tons of the moving volume of palay.

30.7 percent of palay produced in 1977 was disposed to landowner, 10.4 percent to harvester or thresher, 52.1 percent for home use and only 1.8 percent was sold or to be sold, according to the result of farm management survey conducted by LRED, NIA. Therefore, it can be said that about 70 percent of the market moving volume belongs to landowner. NGA, Laoag, is active and has a new project of warehouse at Dingras. Farmers bring directly their palay to NGA's warehouse in Laoag because of higher purchasing price than that of rice dealers.

b) Virginia Tobacco Market

Virginia tobacco was cropped in about 32,000 ha in 1972 and 36,000 ha in 1976 in the nationwide. Production has fluctuated over 1972 to 1976 between about 18,600 tons and 26,500 tons.

About a half of virginia tobacco is exported. Total exports in 1977 were about 8,940 tons, equivalent to the worth of US$12.6 million. West Germany is No.1 importing country followed by Japan with imports totalling US$6.1 million and US$2.6 million respectively. Finland and Australia are new tobacco trading countries. Development of new markets like the communist countries is now being undergoing.

According to the marketing study by the World Bank, Philippines virginia tobacco commands a premium in European markets over virginia tobacco from India, and it is reported that market prospects for tobacco exports from the Philippines appear sound from the view points of the consumption growth of tobacco in the world and the increasing competitiveness of Philippine tobacco.

Virginia tobacco of Philippines are mainly produced in Region I. Tobacco farmers of Ilocos sell their products to the private sector, trading centers which contract with tobacco companies such as Fortune, Continental, Oriental Leaf, etc. 13 trading centers are in Batac, four in Currimao, four in Dingras, two in Espiritu, one in Laoag and one in Pidding. Region I has 156 buyers of the trading centers. The price paid by the trading centers is set in various grades which are determined by the Philippine Virginia Tobacco Association (PVTA). PVTA dispatches their staff of a field inspector, grader and clerk to each trading center. Virginia fluecured tobacco operated by PVTA in the 1977 trading operation was about 44,000 tons, of which 21,600 tons (49%) are from Ilocos Sur, 14,200 tons (32%) from La Union, 7,200 tons (16%) from Ilocos Norte and 1,000 (3%) from Abra. Ilocos Norte Province has a tobacco drying plant at Currimao which belongs to Ilocandia Tobacco Processors Incorporated. Tobacco leaves bought by each trading center are sold to tobacco companies. Big companies like Fortune and Columbia use the above-mentioned drying plant, and after drying export from Manila and San Fernand Port.

In general, cigarette manufacturers had compete with exporters in purchase of Virginia tobacco. Before the trading centers were set up, tobacco leaves were under monopoly of local cigarette manufacturers. Now, it is different. The only problem now encountered is how to cope with the increasing demands, both in local and foreign markets. PVTA people say that the problem is supply and not demand.

c) Garlic Market

Garlic is an important cash crop for farmers in the Ilocos Region, especially in Ilocos Norte and the northern part of the Ilocos Sur. The total garlic planted area in 1977 was 4,910 ha with a total production about 16,000 tons in the nation. Ilocos Norte occupies 3,280 ha. (67 percent) and 10,490 tons (65 percent) of the national total.

Some garlic has been exported in recent years, but in 1978, sizeable exports was reportedly to Singapore, and Hongkong. If a progressive marketing policy is timely given, it should be a more important export item.

According to the report of "Garlic Production and Market" prepared by DA, 52 percent of garlic produced in 1977-78 in Ilocos Norte was sold, 18 percent was held in

storage for later sale (in anticipation of higher prices in near future), 15 percent was set aside for seed and 12 percent went to the landlord. And 90 percent of garlic sold was on picked-up basis and only 10 percent was delivered to buyers. The types of middlemen involved in the marketing were agents, contract buyers, assembler-wholesalers, contract buyer-assembler-wholesalers, exporters, wholesalers, whole-saler-retailers and retailers.

Therefore, the market channels from producers to consumers are very complicated. 26 percent of market moving quantity was treated by agents, 28 percent by assembler, 60 percent by wholesaler, 72 percent by wholesaler-retailer and 90 percent by retailers. This complicated and undeveloped marketing systems grow high margins to the above-mentioned middlemen. The farm gate price of garlic per kilogram is 3.3 pesos and retailer price is 6.3 pesos and consumer price is 8.9 pesos. This marketing system controlled by middlemen also results in a fluctuation of seasonal market price. Farmers without store of enough capacity are forced, by necessity (to get money) or fear of lower prices, to sell garlic shortly after harvesting when prices are relatively low.

For garlic farmers to obtain better returns, this Project supply enough irrigation water, and establish a proper farmers' organization.

d) Onion Market

The nationwide onion planted area in 1976 was 11,930 ha with total production of 54,280 tons, of which 4,500 ha or 20,000 tons are in Ilocos region.

Onion of 1,500 tons was exported in 1974, and 6,800 tons in 1977. Japan is the biggest importing country, about 1,400 tons in 1974 and 4,950 tons in 1977.

FOB export price was almost the same price as farm gate price in 1977. The seasonal fluctuation of market price of onion is not so severe in comparison with that of garlic. It is considered that marketing system of onion is not so complicated. This would not raise strong competition between exporters and domestic buyers.

Introduction of onion in the Project area would contribute to the international trade of the Philippines.

e) Fertilizer Market

58 percent of farmers who cropped palay in the Project Area applied fertilizers in 1976 - 1977 cropping season, (while a great part of farmers, 97 percent of palay farmers, 93 percent of tobacco farmers and 77 percent of garlic farmers in the Phase II area applied fertilizers), according to the results of farm management survey, NIA.

Farmers in the Project Area dare to go to Laoag City to purchase fertilizers crossing the Bonga river by raft. Dingras and Marcos have one dealer of fertilizers. However, the field survey found that the retail prices of urea per one sack differ from market to market, 85 pesos at Marcos, 82 pesos at Dingras and 80 pesos at Laoag.

The transportation cost component to Laoag is about one peso for bus fare in the Project Area, 0.5 peso for raft, and 1.5 peso for bus fare from Dingras to Laoag. There is an enough difference between the price of fertilizer available in the Project Area and that of Laoag to cover the transportation cost to and from Laoag. Furthermore, the farmer would be able to pick up their daily goods and may deliver their palay to NGA located in Laoag. It may also be noted here that NGA pays about 1.5 to 3.0 pesos as transportation cost of the palay.

In 1977, the Philippines imported 60 percent of the total quantity of fertilizers used, and the remaining 40 percent was domestically produced. The imported fertilizers were Urea. Ammosul, Can/Anchlor and MOP. But PNP and NPK were not imported. In 1978, there will be no change in the situation for sometime infuture.

The Fertilizers and Pesticide Authority (FPA) has the supply and demand program up to 1985. A great part of Urea would be imported from ASEAN Ammonia/Urea Plant. However, it is expected that Phosphate and Potassium would be domestically supplied.

4. Agricultural Production

The rate of increase in the yields of paddy rice and corn has been assumed only about one percent per annum, based on statistical data on their crop production in the Project for the past seven years (see Table 3D-6, Appendix 3D-2). Thus the rate of increase in the future yield is assumed at the same rate as above-mentioned in case that the present irrigation condition will not be improved.

On the other hand, in case of with-project, the target yield and total production by crop are estimated as follows:

Crop Production in With-Project

Crop	Cropping Area (ha)	Target Yield (ton/ha)	Production (ton)
Paddy Rice			
– Wet Season Crop	10,200	3.9 (3.7)	39,140
– Dry Season Crop	9,200	4.2	38,640
Sub-total	19,400		77,780
Tobacco	300	1.3	390
Carlic	350	2.7	945
Onion & Other Vegetables	350	14.0	4,900
Total	20,400		84,015

Note: 1) The figures in parenthesis show the yield for the wet season paddy rice in Madongan sub-project area.

2) All these target yields are weighted average at each area of different land classes (see Appendix 3B-5).

The target yields for paddy rice in the Project are estimated at 3.9 tons/ha and 4.2 tons/ha for the wet and the dry season crops respectively. But Madongan sub-project area will have less target yield of 3.7 tons/ha for the wet season paddy rice because of the poor production conditions caused by flooding during the wet season. The target yields for the diversified crops are estimated at 1.3 ton/ha for tobacco, 2.7 ton/ha for garlic and 14.0 ton/ha for onion and other vegetables respectively. (see Appendix 4C-2)

The projected yields of all proposed crops would be attained within five years after the completion of construction work of the Project, taking into account that most farmers have experience of the irrigated paddy rice cultivation throughout the Project Area.

Sufficient extension and other supporting services, particularly for agricultural credits and marketing of agricultural products, etc. should be provided and also proper irrigation water management to the on-farm level with necessary on-farm facilities, should be performed to meet the high production.

The estimated total crop production per annum will reach about 77,800 tons of paddy or about 3.6 times of the present production of 21,500 tons, and 390 tons of tobacco, 945 tons of garlic and 4,900 tons of onion and vegetables.

There is no major obstacle found to attain the projected high yield of these production in terms of soil and weather conditions except for the big typhoons which have affected the Project Area and its vicinity once every 10 years during the wet season, because the excess discharge from mountain areas near the Project Area would be controlled

to some extent by newly provided drainage canal network and modernized intake facilities of the Project. Furthermore, the flood control in the Project Area will possibly make progress by some series of flood control projects under DPW.

The improved farm practices for the proposed crops as shown in Appendix 4C-3, with proper varieties and necessary amount of input materials shall be applied to secure the proposed production throughout the Project Area.

5. Forecasting of Population and Labor

The population of Ilocos Norte province, during 1970 to 1975, grew annually at the smaller rate of 1.6 percent in comparison with 2.7 percent of the national average. This population would be forecasted to grow with almost the same rate in future. According to the data on the Population Dimension of Planning, 1975, NEDA, a population projection by provinces would be estimated as follows:

Population Projection by Provinces of Region I

(Unit: '000 persons)

Province	1975	1980	1985	1990	1995	2000
Region I	3,254	3,631(2.9)	4,039(2.9)	4,445(2.8)	4,712(2.6)	5,387(2.5)
1. Abra	149	182(2.2)	205(2.4)	228(2.1)	252(2.0)	277(1.9)
2. Benguet	300	348(2.7)	399(2.8)	454(2.5)	510(2.4)	571(2.3)
3. Ilocos Norte	371	414(1.8)	456(1.9)	497(1.7)	544(1.7)	591(1.7)
4. Ilocos Sur	417	429(1.0)	462(1.5)	492(1.3)	532(1.6)	572(1.5)
5. La Union	413	464(2.1)	520(2.3)	577(2.1)	639(2.1)	702(1.9)
6. Mt. Province	94	117(2.3)	132(2.4)	149(2.5)	167(2.3)	187(2.3)
7. Pangasina	1,509	1,678(1.8)	1,865(2.1)	2,049(1.9)	2,267(2.0)	2,487(1.9)

Note: The figures in parenthesis show the population growth rate at percent.

Population by phasing projects will be forecasted using the annual growth rate by municipality which was estimated by NEDA. The following table indicates the projection by phasing projects. The annual growth rate in the Project Area, 1.6 percent, is less than 2.2 percent for the Batac-Badoc area, during May 1970 to May 1975.

Total Population Projection by Phasing Project

Phase	1970	1975	1980	1985	1990	1995	2000
Project	31,395	33,962	37,097	40,237	43,131	46,571	49,905
Batac-Badoc Area	59,791	66,588	74,354	82,562	90,514	99,903	109,218

According to the data of "Population Dimension of Planning" prepared by NEDA, the trend of annual growth rate would rise by 1980 and afterwards decrease gradually as 1.78 percent from 1975 to 1980 and 1.39 percent from 1995 to 2000 in the Project Area and 2.23 percent from 1975 to 1980 and 1.8 percent from 1995 to 2000 in the Batac-Badoc Area. (See Table 4C-7, Appendix 4C-4)

Farm household population will be projected to be about 29,200 persons in 1975 and about 41,380 persons in 2000 in the Project Area, while about 51,800 and about 82,730 in 1975 and 2000 respectively in the Batac-Badoc area. (See Table 4C-8, Appendix 4C-4).

Number of farm households who cultivate the land in the Project Area amounts to 6,777 which consist of 5,432 of permanent farmer and 1,342 of temporary farmer in 1975. These farmers will be forecasted as about 7,110 in 1990 moderately (See Table 4C-9, Appendix 4C-4).

Over the past five years, Ilocos Norte has remained basically in agricultural region and nearly two-thirds or 65 percent of total grainful workers are engaged in the agriculture. Compared with the 1970 statistics, the number of agriculture workers increased by 2.0 percent. On the other hand, that of manufacturing workers decreased by 3.7 percent. After completion of the Palsiguan dam, supply of enough electric power would boost the capacity for manufacturing labor. (See Table 4C-10, 4C-11, Appendix 4C-4).

According to the information of the Bureau of Statistics, Laoag, the unemployment rate for the third quarter in Ilocos Norte has been improved from 4.4 percent in 1977 to 2.0 percent in 1978. On the other hand, the National Census and Statistics Office (NCSO) reported that the unemployment rate for the first quarter in 1978 stood at 5.1 percent in the nation in comparison with the 6.3 percent of previous quarter. The unemployment rate of Ilocos Norte is Lower than that of the nation. However, that is not always low in the Region I. (Ilocos Sur 6.3, Dinguet 4.8, La Union 3.4, Pangasinan 1.8, Abra 0.7 percent respectively as of the third quarter 1977).

Population Census in 1970indicated the ratio of unemployment of economic active population of 10 years old and over by municipality. Unemployment ratio of Solsona, Dingras, Marcos, Espiritu and Nueva Era is computed as 11.4, 8.9, 13.4, 11.0 and 2.2 percent respectively. The unemployed population of these municipalities amounts to about 1,960 persons. Laoag City, San Nicolas and Piddig in Batac-Badoc area are of 6.6, 13.0 and 9.3 percent respectively and their populations are about 2,300 persons. These unemployed population would be supplied to agricultural labor market in future.

6. Farm Mechanization and Farm Labor Balance

Farm mechanization will be needed to some extent to perform the improved farming with scheduled water management for the maximization of water utilization and for rasing cropping intensity.

It is assumed that farm mechanization area will cover about 40 percent of farm lands for land preparation of both wet and dry season croppings, 100 percent for threshing of paddy rice by powered thresher (50 percent) and pedal thresher (50 percent), and 50 percent for drying of paddy. The required farm machineries such as hand tractors, threshers and driers are locally available in the Philippines and they are already used prevalently in other modernized irrigation system areas (See Appendix 4C-5).

On the assumption that the minimum units of these farm machineries will be collectively utilized within each compact farm, an average size of 60 ha, following units of machinereies per one compact farm will be introduced (see Appendix 4C-5).

Hand tractor (7 - 8 pH):	three units
Powered thresher (7 - 8 HP, throw-in type):	one unit
Pedal thresher:	five units
Drier (flat-bed type: 2.0 ton bin):	one unit

Based on the above-mentioned fact, the proposed farm operation system as shown in Figure 4C-1, Appendix 4C-5 will be applied to the Project.

Labor requirements for the improved farm operation systems are estimated at 105 man-days per hectare for the paddy rice cultivation and at 278 man-days, 172 man-days and 212 man-days per hectare for tobacco, garlic and onion cultivation respectively. (See Table 4C-13 to 4C-16, Appendix 4C-5). Labor balance between the requirement and available labor force in the Project Area shows some surplus of available labor force even at the peak of the requirement, which will happen during in November due to overlapping of paddy rice transplanting season with planting season of diversified crops (see Table 4C-18, Appendix 4C-7). Farmers can afford to utilize the surplus labor force for other farm activities, for instance, for introducing inter-cropping in the second crop lands and expanding the management scale of animal husbandry.

7. Requirement of Input Materials

Total requirement of input materials such as seeds, fertilizers and other agrochemicals are estimated per year as shown in Appendix 4C-8. As compared to present amounts of these input materials used in the Project Area per annum, the amount in With-

Project will increase to about two times of paddy rice HYV seeds (970 tons), about three times of fertilizers (5,700 tons) and relatively high amount of such agri-chemicals as pesticides and herbicides.

Based on BPI's recommendation to renew paddy rice HYV's seeds in every two cropping, the necessary amount of seeds for the renewal is estimated at 485 tons per year. The seed production by seed growers' association under BPI can easily cope with this amount of seeds.

Some necessary marketing arrangement as well as the arrangement of agricultural credit institutions should be done to meet these amount of input materials to be used in the Project Area.

8. Farmers' Organization

Aiming at an effective farming practices after the completion of project, a functional farmers' organization shall be established in the Project Area.

As previously mentioned in the Chapter III, the Project Area, there are some existing organizations in the area such as Communal Irrigation System (CIS) for irrigation, Samahang Nayon for Cooperatives activities and Farmers' Association to coorperate with the extension services. However, these existing ones are not complete to function as a promoting body for the project and it will be necessary to rearrange them and to improve their functions.

The proposed farmers' organization shall be fully provided with the following functions:

1) O & M for irrigation/drainage facilities and a rational water distribution at on-farm level together with control of farm machineries and collection of O & M cost for irrigation services shall be made independently by farmers themselves.

2) Cooperatives such as supply of seeds, fertilizers, insecticides, pesticides, farm machinereies and daily commodities, colletive selling of products and credit services shall be actively practised.

3) New farming techniques as promoted by BPI and BAEx can be extensively introduced.

Considering the above, an establishment of farmers' organization as shown in Figure 4-2 is proposed.

Organization for O & M of irrigation facilities

In September, 1978, NIA prepared "Report on the Workshop in Water Management" and it is expected that irrigation operation after the date shall be practised in accordance with the Report. The proposed organization for O & M of irrigation facilities is formed on the basis of the said Report in which the rotation area of about 30 ha no average and rotational unit of six hectares will be established under the project.

- o As mentioned in the Chapter III, about 80 percent (8,097 ha, 138 systems) of the service area in the Project Area is commanded by the existing CIS, and it will be necessary to secure a full coordination with the existing CIS in constructing farm ditches at farm level.

- o Aiming at more effective water utilization, the rotational irrigation method is to be practised both in the wet and dry seasons under the project. With this method, there will be some restrictions in land preparation, transplanting, selection of varieties and plowing method, and it shall be necessary to realize a collective cultivation of same varieties.

- o As the proposed organization would function effectively only upon receiving full supports from the administrative and cooperatives organizations concerned, necessary measures to maintain a close relation with these organizations shall be provided in the organization.

- o In the Project Area, transient farmers occupy about 20 percent in the total farm households. They shall be connected to settled farmers so as to fully bring about the benefit of irrigated agriculture.

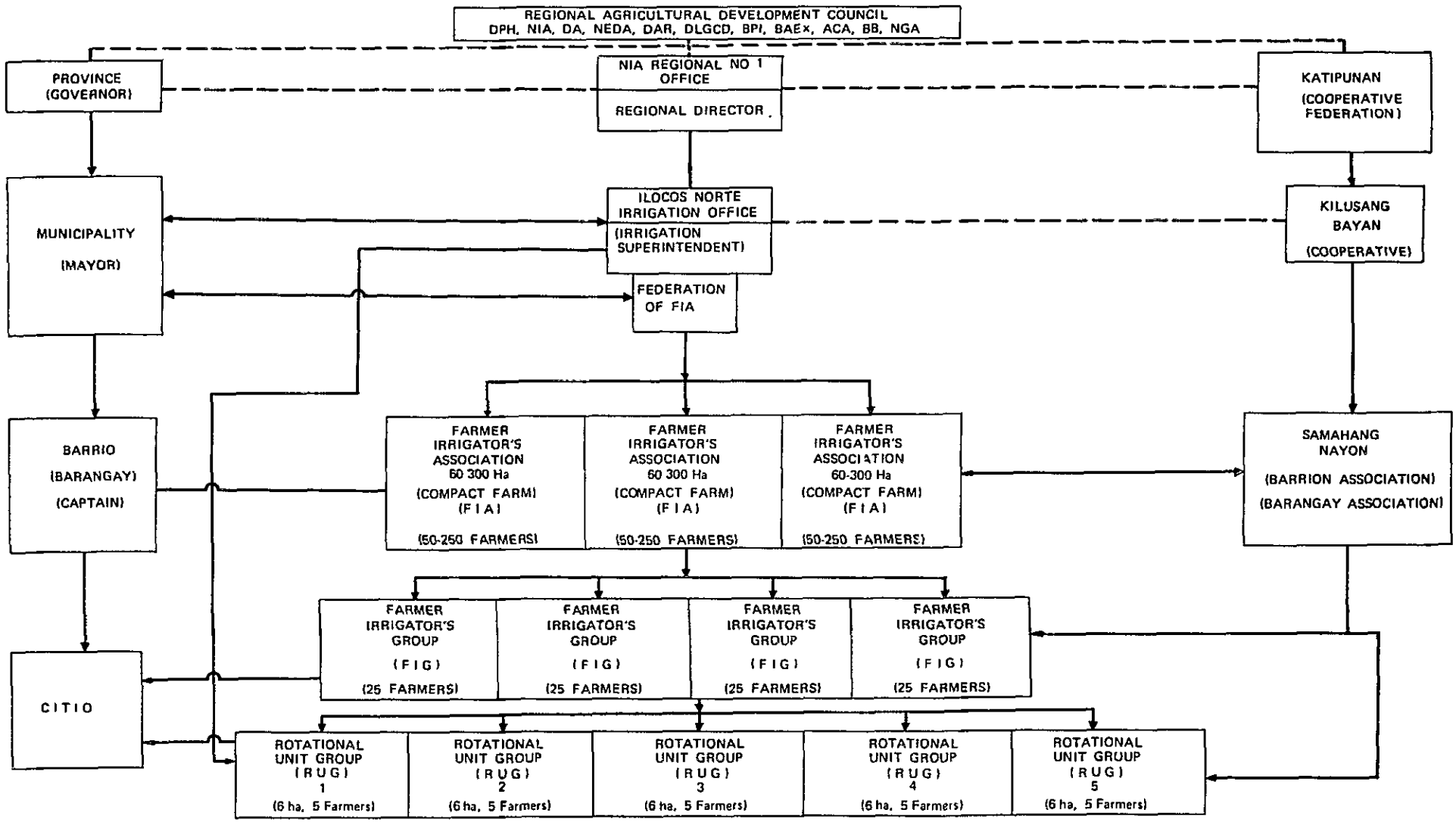
As an organization which can satisfy all the above functional requirements, Farmers Irrigators' Association (FIA) shall be established.

Functions of Farmers Irrigators' Association

- o 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.

- o Under the guidances/supervision by BPI and BAEx, introducing of new farming techniques and farm machineries shall be realized and collective use of the machineries and collective works shall be actively promoted.

FIGURE 4-2 ORGANIZATION OF FARMER IRRIGATORS' ASSOCIATION



- o O & M and repair of terminal ditches and farm roads downstream of turnout structures shall be made by farmers.

- o In case there happens to be 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.

- o 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.

- o Cooperating with Samahang Nayon, promotion of savings and progression of rural development shall be made actively.

- o Not only cooperating with NIA in the collection of irrigation fee, but also the FIA has to handle repayment of project cost and O & M fee collection for FIA itself.

- o 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.

- o Obtaining a full cooperation by the administrative organizations at Barrio level, irrigated agriculture shall be actively promoted.

9. Supporting Services

The program for extension of irrigated agriculture techniques under the Project aims at systematic and smooth introduction of new farming techniques by farmers to attain the maximum benefit from irrigation and promotion of cooperative activities in the area.

a) Introduction of new farming techniques

i) In the service areas, double cropping of rice shall be practiced with the application of rotational irrigation method.

ii) Partly, however, upland crop will be cultivated in the dry seasons. As for rice cropping, HYV with low sensitivity to photo-periodism will be planted. Accordingly, selection of varieties and application of fertilizers and agri-chemicals require higher standard of techniques.

iii) For the intensive farming to be realized in the area, farm machineries shall be introduced.

Considering the above, it will be necessary that new techniques mainly for the promotion of irrigated agriculture will be introduced only through FIA organization to improve the present condition.

For this, it is necessary to allocate such experts being fully knowledgeable about irrigated agriculture, collective farming practices, mechanized farming, application of agri-chemicals and nursery preparation etc. Also necessary facilities for training of extension workers and farmers shall be more intensified.

b) Strengthening of cooperatives activities

The final target of new irrigated agriculture is strengthening and further development of farm management so as to increase farm income and promoting the regional economic development, and thus contributing to the national economy.

For aiming at the above, Samahang Nayon and Kilusang Bayan have been established and managed. In the Area, Samahang Nayon has been established as of date in most Barrios. While, Kilusang Bayan is under preparation for its establishment at each municipality level.

Service items by the said cooperatives are as follows:

(1) Supply of farm inputs

Seeds

With practicing of double cropping of rice for the entire service area, 512 ton and 462 ton of new variety seeds will be necessary for the wet and dry season croppings, respectively. Though, at present, seeds are supplied by the Seed Center located at Dingras, enough quantity as required for the Project can not be supplied. For this, seed farms shall be provided for each FIA so as to meet the seed requirements of member farmers.

Fertilizers

Application of fertilizers will be increased in parallel with the progress in double cropping of rice. When the project implementation is completed, about 2,550 tons and 3,250 tons of fertilizers for the wet season cropping and the dry season cropping, respectively shall be required to be distributed for farmers' use. Necessary funds for purchasing of fertilizers shall be secured by the cooperatives.

Agri-chemicals

To attain higher paddy yields under irrigated agriculture, an intensive countermeasure by applying more agri-chemicals is necessary. On the other hand, there will happen some accidental damages by insects and pests, for which enough storage of agri-chemicals at national level will be required. Required agri-chemicals are estimated at about 120 tons for the wet season and 91 tons for the dry season cropping.

Farm machineries

Necessary farm machineries shall be purchased by cooperatives. and through each FIA, machineries will be utilized by Rotational Unit Group (RUG) or farmers either on a rental basis or on installment basis. Under the Project, 408 units of farm tractors, 204 units of threshers and 204 units of driers are planned to be introduced.

(2) Collective selling of farm products

Collective purchasing of required farm inputs and collective selling of products shall be handled by the cooperatives. Rice milling and storage for the increasingly produced shall also be managed by the cooperatives. It is estimated that 93,700 tons of rice will be handled by the cooperatives out of the total increased production of about 78,420 tons (full season) after deducting rice consumption within the Area and the amount can be handled by the existing mills in and around the Project Area.

(3) Encouragement of savings

It will be necessary and advantageous for the cooperatives to establish a cash handling system in which income by collective selling of products can be deposited and cost for labors and purchasing of farm inputs can be paid by issuing slips. With this system, the balance to be carried over after necessary payments is the deposit for the cooperatives and it may encourage farmers to do savings.

(4) Credit supply

For the payment to purchase seeds, agri-chemicals, machineries and for labor cost, farmers are in need of funds. The required funds for the whole Project Area is estimated at about 61.0 million pesos annually after the completion of project implementation.

10. Community Development

Residential areas

Presently, residential areas are located rather disorderly or along the existing roads. Residential lot for family is about 0.07 ha on an average and every 5 - 60 households forms a group. Therefore, no difficulties are found in future plans for electrification and potable water supply. Under the Project, however, rearrangement of residential areas is not included.

Roads

Under the Project, O & M roads along main and lateral canals and some farm ditches together with access roads for construction purposes are to be provided. While, DPH is undertaking the barangay roads project in the Area. Such O & M roads to be constructed under the Project shall be properly connected with the barangay road networks.

Potable water

The Project Area is rich in groundwater resources and most of farm families use the groundwater as potable water. Under the situation, no public clean water supply facilities are existed in the Area, though there are plans formulated for constructing clean water supply system in Solsona and Nueva Era Pablacions.

Electrification

In the Project Area, electrification is on-going for a certain area year by year as scheduled in accordance with the NPC's electrification program. Presently, 28 barrios (64 percent) has been already electrified, and it is expected that the remaining 16 barrios (36 percent) will be electrified in the near future.

D. Proposed Facilities

1. Diversion Dams

a) Labugaon Diversion Dam

(1) Dam Site

The dam site for constructing Labugaon Diversion Dam was selected at a little upper-stream (about 1.3 km) of the starting point of the alluvial fan where the Labugaon river begins to widen its river bed (about 3 km northeast of barrio Mananteng). In selecting the site, various conditions such as proposed irrigation canal network, designed intake water level, intake method/systems, river and foundation conditions were fully taken into consideration.

The service area extends over the left bank of the Labugaon river with the elevation at about 100 m above mean sea level. In terms of required elevation for the dam site, the vicinity of the proposed dam site is high enough and the link canal to the service area would be much shorter than the selected site. However, the dam crest length would be about 300 m in case of diversion dam at the river of the fan, which requires a big amount of construction cost. Furthermore, river conditions of this dam site is inferior to that of the upperstream one.

The selected dam site (hereinafter referred to as the dam site) has advantages in its river conditions as follows.

i) The water route is stabilized near the left bank where the service area extents and the river bed can stand with the expected floods.

ii) A necessary dam crest length of about 167 m is reasonable for saving the construction cost of the dam body.

iii) The foundation condition is favorable, and

iv) Adverse effects which might be brought about on the river system by damming up of the discharge are deemed rather small.

(2) Type of Head Works Adopted

Natural diversion from the concave portion forming a pool might be possible at the dam site. However, once the river bed lowers in the future, the diversion will be impossible if the natural diversion is adopted. Taking into consideration the irrigation plan to utilize all the river discharges during the dry season, head works equipped with a diversion dam (with the scouring sluice/fixed weir/cut-off wall), intake and appurtenant facilities have been planned for safe and stabilized diversion of water (see Table 4-2 regarding the main features of the head works).

(3) Design of Dam

Scouring Sluice

A big volume in sediment transportation is anticipated at the dam site during flood seasons. The scouring sluice has been planned to keep always the water-route as it is expected and to flush away sand and gravel being accumulated during diversion periods. This scouring sluice will also play a role of the sedimentation basin. For a high velocity scouring sluice way, a jet-flow has been planned to strengthen the capacity of flushing away and flowing down the sand and gravel as far as possible. To increase the said capacity, guide walls have been planned for both upstream and downstream reaches. Judging from the small river discharges, accumulation of sand and gravel on the scouring

sluice during the dry season seems relatively small. On the contrary, sediment accumulation during the wet season will be considerably big. Scouring sluice with a gate of seven span is determined based on ordinary discharge of 18 cu.m/sec of the wet season so that the accumulation can be washed away whenever it is required. In addition, it will function to lead the water-route to an appropriate course during and immediately after floods.

Fixed Weir

It is hardly anticipated that the damming-up at the site will give adverse effects to the other portion of the river systems, so fixed weir type has been proposed. In general, the dam height is determined to meet the required water level for irrigation and also, based on the functional capacities of head works.

The dam site elevation is high enough to supply water to the service area, so, the crest elevation is determined at EL. 113.35 (dam height: 2.30 m) based only on the functional capacity aspect of the head works. The dam body of a fixed type has been planned as the dam will be constructed on rock foundation.

Cut-off Wall

Except flooding periods, river water will flow over the fixed weir, but to cope with flood discharges, the high water channel with cut-off walls has been planned.

(4) Intake Facilities

The intake should meet the requirements of smooth diversion of water and also prevention of sediment intrusion. So, i) the elevation of the intake sill is designed one meter higher than the scouring sluice and ii) the intake width is designed to keep the intake velocity as low as 0.6 m/sec. The scouring sluice way located in front of the intake plays a role of sedimentation basin. Therefore, intrusion of sediment to the intake is hardly anticipated during the normal water levels. On the other hand, during flood discharges, sediment of small diameter comes into the intake though big ones can not come into because a spiral flow of water is formed in front of the intake when the scouring sluice gate is open. The small particles do not harm irrigation canals and paddy fields. So, no sedimentation basin has been planned on the downstream of the intake. For easy operation, the gate span is determined at 2.3 meters.

b) Solsona Diversion Dam

(1) Dam Site

The dam site for Solsona Diversion Dam was selected on the river of the alluvial fan developed by the Solsona river (about 1.2 km southeast of Barrio Lamdagon). The service area extends over both banks of the river with the elevation at about 100 m

above mean sea level. While, the elevation of river bed at the selected site is around EL 110 m, being high enough for the planned gravity irrigation system.

Considering the service area which extends over both banks of the river as mentioned above, double intake system is the most advantageous. However, the river having a slope of 1/40 to 1/80 is so called rapid flow river and only single intake system can meet the requirements in preventing the sediment load intrusion. Therefore, no portion of this river can offer a favorable dam site which enables the double intake system to divert water to both banks. (If the river flow is slow and deep, this system can be applied. Generally, the double intake system can hardly be applied to the rapid flow portion of a river.)

Under the circumstances, necessary water for both service areas will be diverted on the left bank where the water route is stabilized and through a siphon to be placed in the dam body, a part of the water will be diverted to the right bank service area.

Judging from the prevailing river conditions, the selected dam and intake sites have the following advantages.

i) The river water route is stabilized near the left bank and the river bed can stand with the floods;

ii) A siphon can be placed in the dam body to divert water for right bank service area.

iii) The length of dam crest is only about 67 m and the construction cost is reasonably low;

iv) The foundation condition is favorable; and

v) Adverse effects which might be brought about on the river system by damming up of the discharge are deemed small.

(2) Type of Head Works adopted

Being favored with the desirable river conditions, natural diversion from the concave portion forming a pool might be possible. In this case, however, the diversion will be impossible when the river bed lowers in the future. Taking into consideration the irrigation plan to utilize all the river discharge during dry season, head works composed of diversion dam (fixed weir), scouring sluice and cut-off wall, intake and appurtenant facilities have been planned for safe and stabilized diversion of water. Dimensions of such facilities are as shown in Table 4-2.

(3) Design of Dam

Basic ideas in designing the Solsona Diversion Dam are similar to those in designing the Labugaon Diversion Dam.

Scouring Sluice: Aiming at flushing of sand and gravel deposited in front of intake, a roller type gate (Span. 8 m x 1) will be provided.

Fixed weir: Crest elevation of the fixed weir shall be EL 134.65 considering the function of head works.

Cut-off wall: Cut-off wall shall be provided for the high water channel on the right bank.

(4) Intake Facilities

For designing intake facilities, ideas as adopted for intake facilities for the Labugaon head works shall be basically applied. With this intake facilities, water be taken on the left bank alone and the water for the right bank area shall be driven through the inverted siphon constructed in the dam body. Accordingly, two span gates will be provided for the right bank area as attached to the scouring sluice and three span gates for the left bank area at the upperstream side. Considering an easier operation and maintenance of this head works, an O & M bridge (2.7 m width) shall be constructed on the dam body.

c) Madongan Diversion Dam

(1) Dam Site

The starting point of the alluvial fan where the Madongan river, after running down the mountainous area, begins to flow in the plain area has been selected as the diversion dam site. The location is about two kilometers south-east of Barrio Podsan.

Service areas extend over both banks of the river with the elevation at about EL 100 m. As the river bed elevation at the dam site is about EL 118 m, requirement for irrigation network plan can be fully satisfied. As to the intake system, the double intake system shall be advantageous as similar to the Solsona Diversion Dam.

(2) Type of Head Works adopted

The site is favored with the desirable river conditions, natural diversion from the concave portion forming a pool can be made. Takeing into consideration, however, the irrigation plan to utilize fully the river discharge in the dry season and the lowering of river bed elevation in future, a diversion dam is necessary. As is the case, head

works composed of diversion dam (with scouring sluice, fixed weir and cut-off wall), intake and other appurtenant structures have been planned.

(3) Design of Dam

Basic ideas in designing the Madongan Diversion Dam are similar to those for designing the Labugaon Diversion Dam.

Scoruing Sluice: Aiming at flushing of sand and gravel deposited in front of intake, a roller type gate (Span, 7.00 m x 2) would be provided.

Fixed Weir: Crest elevation shall be fixed at EL 120.15 m. considering the function of head works, the dam body should be of floating type and be constructed on a permeable foundation rock. Hydraulic calculation for the weir design is as shown in the Appendix 4D-1

Cut-off Wall: Cut-off wall shall be provided for the high water channel on the left bank.

(4) Intake Facilities

Ideas as adopted for designing the Solsona Diversion Dam shall be applied basically for designing the intake facilities. With this, water will be taken on the right bank alone and water for the left bank area shall be driven through the inverted siphon placed in the dam body. Three span gates, therefore, will be provided for the left bank area in adjacent to the scouring sluice and two span gates for the right bank area at the upperstream side. Considering an easier O & M works of this head work, an O & M bridge (2.7 m width) shall be constructed on the dam body.

(d) Papa Diversion Dam

(1) Dam Site

The dam site for Papa Diversion Dam was selected on the rivet of the alluvial fan developed by the Papa river and is located at about two kilometers south of Barrio Padson. The service area extends over both banks of the river with the elevation at about EL 120.0 m. While, the river bed elevation at the selected site is around EL. 133.0 m, being high enough for the planned gravity irrigation network. As to intake. the double intake system is considered for the service area extending over both banks as similar to the Solsona Diversion Dam, though there are some particular features observed in case of the Papa Diversion dam as follows.

Papa Diversion Dam has been planned across the Papa river and also a small tributary flowing into the Papa river just at the diversion dam site. Three intakes have been designed for this diversion dam, two on the right bank of the Papa main stream and one on the left bank of the tributary. Of the two right bank intakes of the main stream, one is for supplying water to the right bank and the other is to supply water to the left bank area through an adverse siphon to be placed in the dam body, in addition to the intake on the tributary, as the discharge of the tributary is estimated always sufficient.

(2) Type of Head Works adopted

Under the similar conditions of the site and river to those of the Solsona Diversion Dam, a diversion dam shall be constructed.

(3) Design of Dam

Basic ideas in designing the Papa Diversion Dam are similar to those in designing the Labugaon Diversion Dam.

Scouring Sluice:	Aiming at flushing of sand and gravel deposited in front of intake, the following roller type gate shall be provided. 7.00 m x 1 (Right site), 3.00 m x 1 (Left side)
Fixed Weir:	Crest elevation of the weir (fixed type) shall be EL 134.65 on rock foundation
Cut-off Wall:	Cut-off wall shall be constructed at the center of the river.

(4) Intake Facilities

Basic ideas as adopted for intake facilities for the Labugaon Diversoin Dam shall be applied. Two span gates will be provided at both intakes for right and left bank areas. For easier O & M works, an O & M bridge (2.7 m width) shall be constructed on the dam body.

e) Nueva Era Diversion Dam

(1) Dam Site

The dam site was selected on the Bong river at about 0.4 km south of Municipality of Nueva Era so as to secure an elevation of 120.0 m at intake, which can affored to serving water to the Papa service area with the paddy field elevation at about EL 115.0 m.

As the service areas to be commanded by this diversion dam extend over both banks (right bank: Papa service area of Phase I and left bank: Nueva Era service area of Phase II), ideas as applied for planning the Solsona Diversion Dam shall be adopted.

There was another dam site planned at the upperstream of the selected site. However, the upperstream site was abandoned due to the difficulty in constructing link canal and a larger total cost, through the dam-up height is less with shorter dam length.

(2) Type of Head Works adopted

The dam body to be constructed on the selected site is comparatively large with the dam-up height of about 13.65 m and the dam length of about 194.5 m. The head works consist of a diversion dam (Scouring sluice, over-flow type fixed weir and non-over-flow type fixed weir), intake facilities and other appurtenant structures as listed in Table 4-2.

(3) Design of Dam

Though basic ideas in designing of dam are similar to those in designing the Labugaon Diversion Dam, the Nueva Era Diversion Dam is planned as a fixed type high dam because of the considerable dam up height.

Scouring Sluice:	Aiming at flushing of sand and gravel deposited in front of intake, a roller type gate (7.00 m x 1) shall be provided.
Fixed Weir: (Over-flow type)	Crest elevation of the weir shall be fixed at EL 120.15 m considering the planned irrigation network. The weir type shall be of fixed type because of the rock foundation.
Fixed Weir: (Non-Over-flow type)	Though the dam body shall be of the same as the above over-flow type, crest elevation shall be fixed at EL 123.65 m from the designed high water level (including one meter allowance).

(4) Intake Facilities

Ideas as adopted for designing the Solsona Diversion Dam shall be applied basically for designing intake facilities of the Nueva Era Diversion Dam. Water will be taken on the right bank alone and an inverted siphon placed in the dam body shall be used for supplying water for the left bank area (Nueva Era service area). As is the case, two span gates close to the scouring sluice shall be for Nueva Era service area and the upstream two span gates for the Papa service area.

Geological conditions of the proposed dam sites are given in Appendix 4D-2.

Typical design of five diversion dams mentioned above are shown in the attached Drawing No.001 to No.010.

2. Irrigation Canal

a) Canal Alignment

With sufficient knowledge of topographical conditions of the service area, layout of the canal network was plotted on 1:10,000 topographic map. In this work, attention

Table 4-2 Major Dimensions of Diversion Dams

Item	Labugaon	Solsona	Madongan	Papa	Nueva Era
1. Catchment Area (sq.km)	100.5	79.0	153.8	51.0	57.0
2. Estimated High-Water Discharge (cu.m/sec)	1,310	1,030	2,000	670	750
3. Necessary Intake Discharge (cu.m/sec)	3.63				
Left bank	3.03	3.29	4.64	3.17	1.72
Right bank	–	1.71	2.80	2.84	1.75
4. Necessary Water Surface (N.W.L.)	W.L. 113.20	109.85	120.00	134.50	120.00
5. Dam Crest Elevation (m)	E.L. 113.35	110.00	120.15	134.65	120.15
6. Dam-up height (m)	2.30	2.30	2.50	2.30	13.65
7. Intake (m)	(B) x (H) x (Set)	(B) x (H) x (Set)	(B) x (H) x (Set)	(B) x (H) x (Set)	(B) x (H) x (Set)
	2.30 x 1.50 x 4	2.00 x 1.50 x 3	2.20 x 1.70 x 3	2.70 x 1.50 x 2	1.60 x 1.50 x 4
		1.60 x 1.50 x 2	2.00 x 1.70 x 2	2.50 x 1.50 x 4	
8. Dam	(B) x (H) x (Set)			7.00 x 2.15 x 1	
Scouring Sluice	8.00 x 2.15 x 1	7.00 x 2.15 x 1	7.00 x 2.35 x 2	3.00 x 2.15 x 1	7.00 x 2.15 x 1
Fixed Weir Length (m)	48.0	42.5	60.0	50.0	85.0
Cut-off Wall Length (m)	27.5	16.0	104.0	107.0	102.5
Dam Length (m)	85.0	67.0	172.5	170.0	194.5
Dam type	Fixed type	Fixed type	Floating type	Fixed type	Fixed type

was paid to making the possible benefit accrue from the canal system to cover the maximum acreage of land available and fully command the lower area therefrom. The estimated length of canals is as follows.

Proposed Length of Irrigation Canals

Area		Canal Length (m)	Service Area (ha)	Canal Intensity (m/ha)
Labugaon	Main	26,290		
	Lateral	17,850	2,290	19.3
	Sub-total	44,140		
Solsona	Main	30,270		
	Lateral	27,530	2,610	22.1
	Sub-total	57,800		
Madongan	Main	32,980		
	Lateral	26,770	3,210	18.6
	Sub-total	59,750		
Papa	Main	26,940		
	Lateral	19,900	2,090	22.4
	Sub-total	46,840		
	Total	208,530	10,200	20.4

b) Canal Section

Embankment materials obtainable in the Project Area are good for constructing earth canals. So, unlined earth canal will be mostly adopted and only small portions where a big leakage is anticipated will be lined with thin concrete. Its section will be trapezoidal. The design is made based on the Manning's Formula in consideration of the topographic conditions and also the construction works by man-power. It will have a base-depth ratio of 2.5, side slope of 1.5:1 and coefficient of roughness "n" of 0.025.

A free board of 0.4 times of the depth of water or a minimum 30 centimeters is provided to give a sufficient height for checking purposes.

The discharge velocity in the canal, determined as a result of computations based on the open channel formulas, is checked so that it is within the critical velocities of silting and scouring. Generally, the velocity varies from 0.25 m/sec to 1.0 m/sec depending on the size and slope of canal.

c) Related Structures

Various structures related to canals will be needed to convey irrigation water from headgates to the end checks. An inverted siphon will be used where a canal goes across river and creek whose maximum flood elevations are close to or above the canal grade line.

When the maximum flood elevation has 0.9 meters allowance or more from the side grade line of canals, an aqueduct may be used. Road crossings will be provided when canals pass across the existing or proposed roads. Bench flumes and chutes/drops may be needed for water to flow safely to a lower part. Thresher crossing will be placed at convenient points where there is no road crossings. It is usually spaced at every 300 to 500 m of canal in residential and non-residential areas.

(1) Regulating Structures

In some points along the canal system, especially at the headgates of lateral canals, regulating structures will be provided to raise the canal water elevation higher than normal one when water is less than the designed discharge. An example of this is a check structure constructed across the main or lateral canals, in order to raise the water surface elevation and allow the desired amount of irritation water to enter into the lateral canal.

(2) Protective Structures

The protective structures are to be provided in canals in order to prevent excess water from flowing into the canal and also to prevent canal waters from flowing out, which causes destruction of canal embankment. Spillway will be provided to release excess water in the canal to a drainage canal. The optimum protective structures should be selected in consideration of the canal water level. Where the water level of waterway is lower than the canal bottom elevation, a culvert will be needed. When the water level of waterway is higher than the canal bottom elevation but more than 30 cm lower than the canal water level, a siphon will be used. When the waterway water level is higher than the canal water level, excess water is released to paddy fields along the canal through a paddy drain.

Detail descriptions of canal design are given in Appendix 4D-3.

Typical design of the canals and related structures mentioned above are as shown in the attached Drawing No.011 to No.024

3. Drainage Canal

A layout of the drainage canal network was plotted on the topographic map of 1:10,000 in scale,prepared by NIA after an investigation of the Project Area. Existing waterway like rivers, creeks, etc., will be utilized as main or lateral drainage canals. Most of these natural channels have to be dredged and widened to cope with the designed discharges.

The estimated length of proposed drainage canals are as follows:

Proposed Drainage Length

Item	Proposed Drainage Length (m)
Main drainage canal	54,980
Lateral drainage canal	92,110
Total	147,090

The intensity of drainage canal in the Project Area will be 14.4 m/ha. This value does not satisfy the NIA criteria. However, it might be sufficient since the existing rivers and creeks are fully utilized for drainage purpose.

a) Canal Section

Based on the topographic map with a scale of 1:10,000, the maximum drainage areas are estimated at about 1,370 ha for the main drainage canal and about 290 ha for the lateral drainage canal. For these canals the maximum acreage of hinterland is estimated at 1,150 ha and peak run-off from the hinterland is estimated at 128 cu.m/sec using the Rotational formula (see Appendix 4D-4). The capacity of drainage canals is, therefore, computed in the range of 2.4 to 130 cu.m/sec based on the drainage areas in the layout map. The drainage canal is a trapezoidal earth canal designed on the NIA criteria. It will have a base-depth ratio of 0.8, side slope of 1:1 and coefficient of roughness for Manning's Formula "n" of 0.025.

The maximum permissible velocity of water in the drainage canals is 1.0 m/sec which is determined as non-scouring velocity.

b) Drainage Drops

Drainage drops will be required to protect the canals from scouring and erosion caused by floods. The grouted riprap will be used to minimize the construction cost.

Detail descriptions of canal design are given in Appendix 4D-4.

Typical design of the canals and related structures are attached in the Drawing No.025 to No.026.

4. Road

The two types of roads would be provided in the Project Area; namely, i) service roads to be constructed along the main canals and ii) those along the lateral canals.

Service roads along the main and lateral canals would be six and three meters in width, respectively. The proposed cross-section of above two types of roads have a surfacing of 15 cm thick of base coarse and selected borrow of 20 cm thick.

The total length of the proposed service road is as follows:

Type A (along main canals)	93.7 km
Type B (along lateral canals)	83.4 km
Total	177.1 km

Note: Details are indicated in Appendix 4D-5.

Road intensity in the Project is estimated at 17.4 m/ha, which will satisfy the NIA standard.

Typical design of the proposed road section is shown in the attached Drawing No.027.

5. On-Farm

The proposed on-farm facilities are main and supplementary farm ditches, farm drains, farm roads, and small structures such as turn-outs, diversion boxes and end checks, etc. The main and supplementary farm ditches will be constructed of earth as the farm drains and farm roads. The farm ditches should be designed according to the criteria of on-farm water management which was proposed by NIA on September, 1978;

The construction and operation and maintenance of on-farm facilities, excluding farm ditches and farm drains of which construction will be made by farmers, will be undertaken by NIA.

a) Model Design for Sample Area

In order to give the shape to the concept of the proposed terminal facilities, the model design of roads and irrigation & drainage canals as well as land parcelling were actually carried out at the two sample areas. Furthermore, the required costs for on-farm development were estimated and their results were applied to the design of on-farm development works in the whole Project Area.

Site Selection for Sample Area

Two sites for sample area of about 100 ha each were selected after reconnaissance of the service area. One site was selected for the representative of areas with gently sloping topography, and the other site was more or less of the rugged or rolling type.

Sample area No.1 on the northern part of the Project Area is located just on the outskirt (westside) of the town of Solsona. The area is presently cultivated with paddy rice

served by several communal irrigation systems, and very easily accessible from the present national road network.

Sample area No.2, in the southern part of the Project Area is located at Barrio Barikir and Nueva Era. The area will be also planted with paddy rice, served by a communal irrigation system, and the site is accessible from the Barrio road network linking with Nueva Era Town. The area is more rugged than the No.1 area.

Land Parcelling and Typical Design

The land parcelling in the sample areas was made based on the topographic map with scale of 1:2,000 prepared by NIA. As a result, one rotation area is decided at about 30 ha on an average, depending on topographic condition especially existing canal and road networks.

Typical layout of on-farm facilities and design of related facilities are shown in the attached Drawing No.028 to No.031. The result of layout and design is shown below:

Results of Typical Design in Sample Area

	Sample Area No.1		Sample Area No.2	
	Quantities	Average (m/ha)	Quantities	Average (m/ha)
1. Area (ha)				
Gross area	123		107	
Net area	122		100	
2. Major On-farm Facilities				
Main farm ditch (m)	(1,150)		(1,360)	
	3,140	25	3,115	32
Supplementary farm ditch (m)	(3,130)		(3,860)	
	8,460	70	7,480	74
Farm drain (m)	(2,330)		(110)	
	6,700	55	5,440	54
Farm road (m)	1,850	15	1,460	15
Turn-out (Place)	3		4	
Thresher crossing (place)	5		5	
Check structure (place)	27		30	

Note: Figures in parenthesis show the length of existing canal which is utilized even after completion of the Project.

b) On-farm Facility in the Whole Project Area

As mentioned previously, the results of sample estimation at the selected two areas are applied to the estimation of the whole Project Area for the required on-farm facilities and costs. The whole Project Area of 10,200 ha is classified into the following two categories, based on the topographic map of 1:10,000 in scale; i) gentle sloping areas of 2,970 ha, to which

the results of the sample area No.1 will be applied and ii) rugged and rolling areas of 7,230 ha to which those of the sample area No.2 will be applied.

E. Cost Estimate

The total investment cost, including the cost for price escalation during the construction period, is estimated at about US$42.1 million of which US$19.8 million will be foreign currency component and US$22.3 million will be an equivalent to local currency component.

The following table shows the breakdown of the investment costs by major items, and their detail estimation is given in Appendix 4E-1.

Investment Cost of the Project

(Unit: US$ '000)

Description	Foreign Currency	Local Currency	Total
1. Civil Works	7,476	10,285	17,761
2. Land Acquisition and Compensation	–	1,832	1,832
3. Construction Equipment	4,209	41	4,250
4. Agricultural Development	–	270	270
5. Operation and Maintenance	59	654	713
6. Project Facility	95	513	608
7. Project Administration	946	1,079	2,025
8. Consulting Services	763	137	900
Sub-total	13,548	14,811	28,359
9. Contingency	1,315	1,433	2,748
Sub-total	14,863	16,244	31,107
10. Price Escalation	4,931	6,024	10.955
Total	19,794	22,268	42,062

The project cost per hectare is estimated at US$2,940, based upon the following conditions; i) depreciation costs of construction equipment are involved in the unit cost of civil works instead of cost for construction equipment, and ii) price escalation is not included.

The annual disbursement schedule for the investment cost is shown in the Table 4E-3 in Appendix 4E-2. The cost estimates of the Project were made in the following manners:

(1) Civil Works

The cost of civil works consists of the construction cost on engineering works for the Project, which are estimated on the basis of unit cost including construction materials, fuel and oil, and repair of equipment and labor cost. The depreciation costs of the imported construction equipment and workshop equipment are not included in the item of civil works.

The major items of engineering works are as follows:

Diversion Dam: to include concrete, gates and intake facilities of Labugaon, Solsona, Madongan, Papa and Nueva Era dams.

Irrigation Canal: to include earth works of main and lateral canals and related structures.

Drainage Canal: to include earth works of existing rivers, creeks, main and lateral canals and drop structures.

On-farm: to include on-farm facilities such as farm ditch, farm drain and farm road.

Road: to include the construction of O & M and access roads

Pre-Engineering: to include survey works for major facilities such as each diversion dam, and irrigation and drainage facilities, hydrological observation and geological investigation. Descriptions on the required items are given in Appendix 4E-3.

(2) Land Acquisition and Compensation

Land acquisition and compensation costs for project facilities are estimated.

(3) Construction Equipment

The construction equipment and spare parts are purchased by government in the lump except small equipment which is available in the Philippines. The cost of construction equipment and spare parts are estimated on the basis of CIF San Fernando in La Union Province, and exclusive of the custom duties and the other local taxes to be imposed in the Philippines.

Unloading cost at San Fernando port and transportation cost from port to construction site are added to above purchase cost.

(4) Agricultural Development

The costs required for agricultural supporting services are included.

(5) Operation and Maintenance

The project cost involves operation and maintenance cost for three years from FY 1982 to FY1984, during which the O & M is required for the project facilities constructed already in the construction period.

(6) Project Facility and Administration

Project Facility:	to estimate the required cost for project facilities such as buildings, furnitures and equipment.
Project Administration:	to evaluate the overhead charge for government staff to be engaged in the newly organized project office.

(7) Consulting Services

Engineering fee for consulting services covers the implementation of final design and supervision of the Project. (See Appendix 5D-1)

(8) Contingency

Allocation for contingencies is included in the total base to cover minor differences in actual and estimated quantities, unforeseeable difficulties in construction, possible changes in plan because of site conditions or uncertainties regarding foundation conditions. The adopted percentages of contingencies on civil work for the Project are 15 percent.

(9) Price Escalation

Price escalation of eight percent per annum is allowed for both the foreign and local currency portions.

(10) Unit Cost

The cost of construction materials to be used in the Project are estimated on the basis of the prevailing prices as of January 1978, prepared by NIA. The labor cost is estimated on the basis of the wage rate of laboreres for every type of job used by NIA.

The unit cost for construction on the contract basis includes ten percent for contractors' profit, overhead and miscellaneous as well as three percent for taxes.

(11) Foreign and Local Procurements of Materials

The cost of such materials as cement, fuel and oil, deformed-bars, etc. is devided into two portions of foreign and local procurements as shown below:

Percentage of Foreign and Local Procurement

Item	Foreign Procurement (%)	Local Procurement (%)
Cement (Portland)	75	25
Fuel and Oil	50	50
Deformed-bar	80	20
Explosive (Dynamite)	–	100
Fuse and Cap	100	–
Bit and Rod	100	–

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION

A. Executing Agency and Coordination

Since this project is a part of the Ilocos Norte Irrigation Project, of which major components are irrigation and hydropower generation, NEDA will coordinate the project, and NIA will function as the Executing Agency of the Project. According to ther equest from NEDA, the Project Steering Committee will be organized under Council Coordinator of INIDP, in order to carry out smoothly the Project implementation. The committee will make a good coordination among the related Departments and Authorities concerned such as NIA, DA etc. and will request them to extend their assistances and advices directly or indirectly to INIDP, and also the Committee will give advices to INIDP from administrative point of view.

Under the control of the Project Manager, the diversions such as administration, agriculture, engineering and so on will be organized. These divisions will keep close cooperation each other as shown in Figure 5-1, which indicates the proposed organization for the Pro ect implementation. In the organization, the Engineering Division would be responsible for the preparation of plans, programs, design and estimates of the facilities as well as revisions dictated by field conditions of these works designed in the central office.

The Administrative Division would be responsible for personnel and records management, accounting, property, procurement and other services. The agricultural phase of the Project would be handled by the Agricultural Division.

Furthermore, the Project Manager will try to keep close contact with local offices of the related departments and authorities so that the Project works may be smoothly executed.

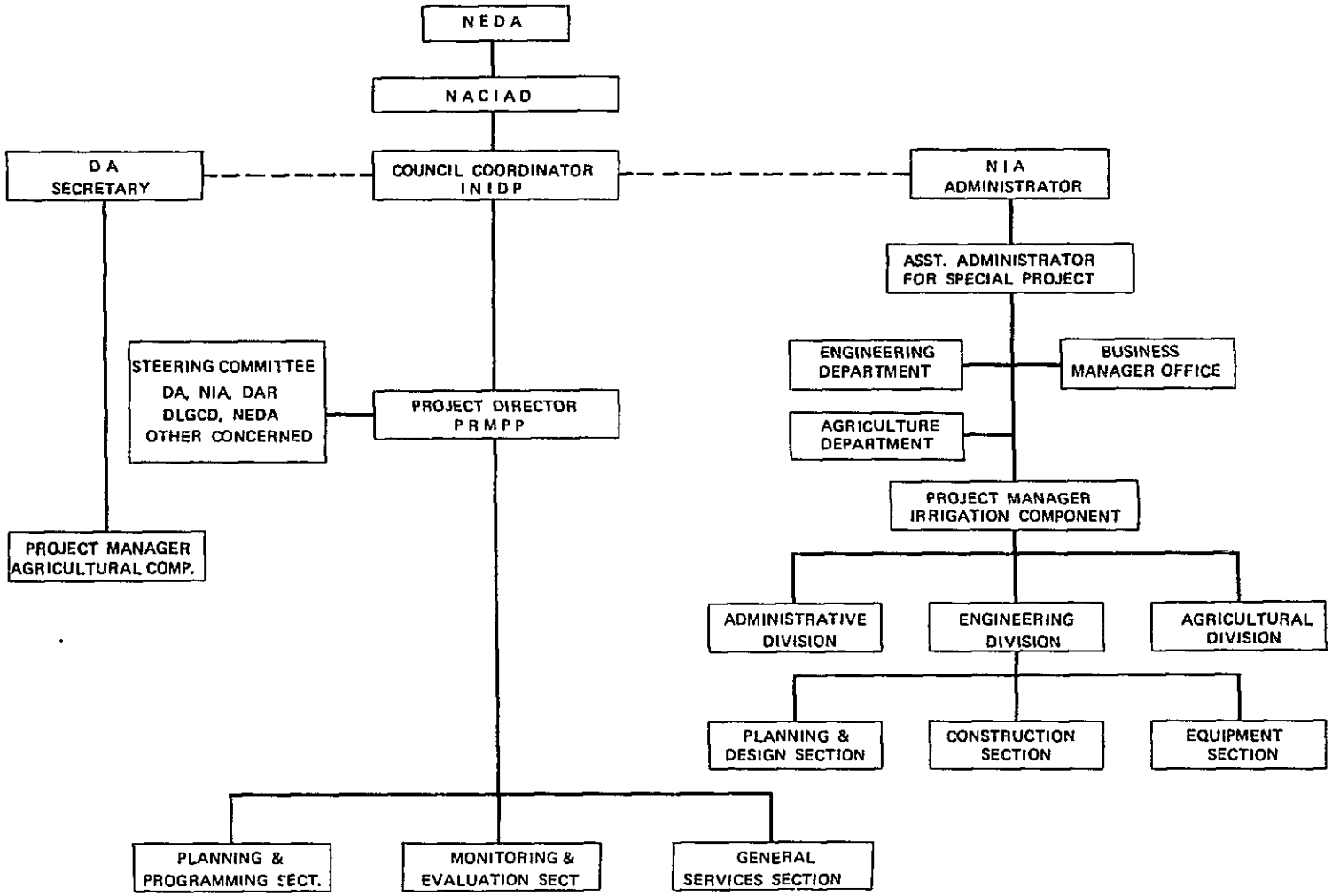
B. Construction Method and Schedule

1. Construction method

The Project includes various kinds of civil works such as construction of diversion dams, irrigation and drainage canals, roads, and on-farm etc.

There are two ways to execute such civil works, execution by force account and contract basis. The contract basis will be adopted in the Project due to the following reasons:

FIGURE 5-1 PROPOSED ORGANIZATION CHART FOR PROJECT IMPLEMENTATION



- Shortage in number of government-owned construction equipment
- Shortage in number of engineers and skillful equipment operators in the related organizations; and
- Intention to level up the technology of the local contractors.

Under the circumstances, the local contractors will execute the construction works in use of the machinery and materials to be imported by the Government.

2. Construction Schedule

Since the civil works involved in the Project are of considerably large scale, the construction period will inevitably depend upon the work volume, climate condition and existing planting conditions of paddy rice. Especially the construction periods of civil works are naturally restricted by climatic and hydrological conditions in the area. Namely, the structures of diversion dam, canals, and on-farm facilities should be constructed in the dry season, November to May, to avoid the damages caused by river flooding.

Considering these facts, the construction period is scheduled to be five years from January 1980 to December 1984, including the final design January 1980 through August 1980, and the construction of the facilities will start in FY 1981 (see Figure 5-2).

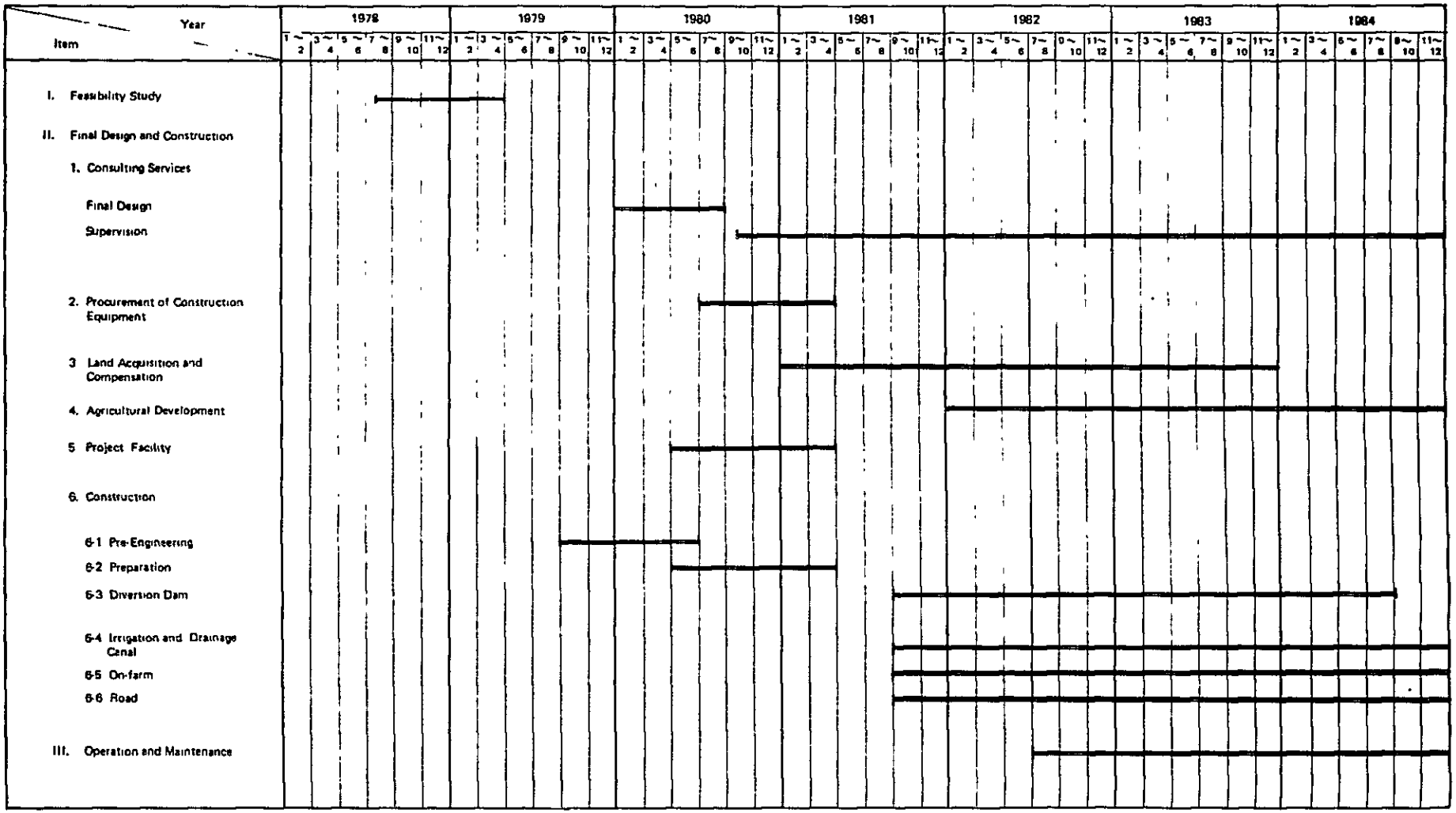
The implemented area of the on-farm development in each year is planned based on the consideration for the expectable irrigation water after implementation of each diversion dam and construction volumes, that is, about 1,020 ha in 1981, 3,060 ha in 1982, 3,060 ha in 1983, 3,060 ha in 1984, respectively.

Construction planning of the major civil works is given in Appendix 5B-1. For the completion of the Project in FY 1984, due consideration shall be paid on the following items.

(1) Final design for the Project will be completed in the September 1980 and, during that time, the tender for procurement of construction machinery and materials shall be completed.

(2) Surveyings and geological investigations for diversion dams, irrigation and draiange canals and other main facilities shall be completed before the commencement of final design.

FIGURE 5-2 IMPLEMENTATION SCHEDULE FOR THE PROJECT



C. Operation and Maintenance

1. Executing Agency and Organization

The entire Project works, upon completion of the Project, will be turned over to the NIA Regional Office No.1 and the responsibility for the operation and maintenance of all irrigation and drainage facilities will be given to the newly organized Ilocos Norte Irrigation Systems (INIS).

The proposed organization chart for the operation and maintenance is shown in Figure 5-3.

The headquarter under the irrigation superintendent would consist of four supporting sections; Operation and Maintenance Section, Engineering Section, Agricultural Section and Administrative Section. The Operation Section would be responsible for day to day operations of the system including water scheduling, and Maintenance Section would handle the equipment for maintenance activities of the Project. The Engineering Section would be responsible for the designs, estimates and execution of minor works and on-farm facilities for the purpose of maintenance of facilities. The Agricultural Section would be responsible for the new water management techniques and farming methods as well as ensuring the necessary agricultural supporting services to be established in the area, and Administration Section would handle the personnel and records management, accounting and other services.

The Project Area will be devided into four areas of Labugaon, Solsona, Madongan and Papa, and each area will be managed under the Supervising Water Management Technologist (SWMT).

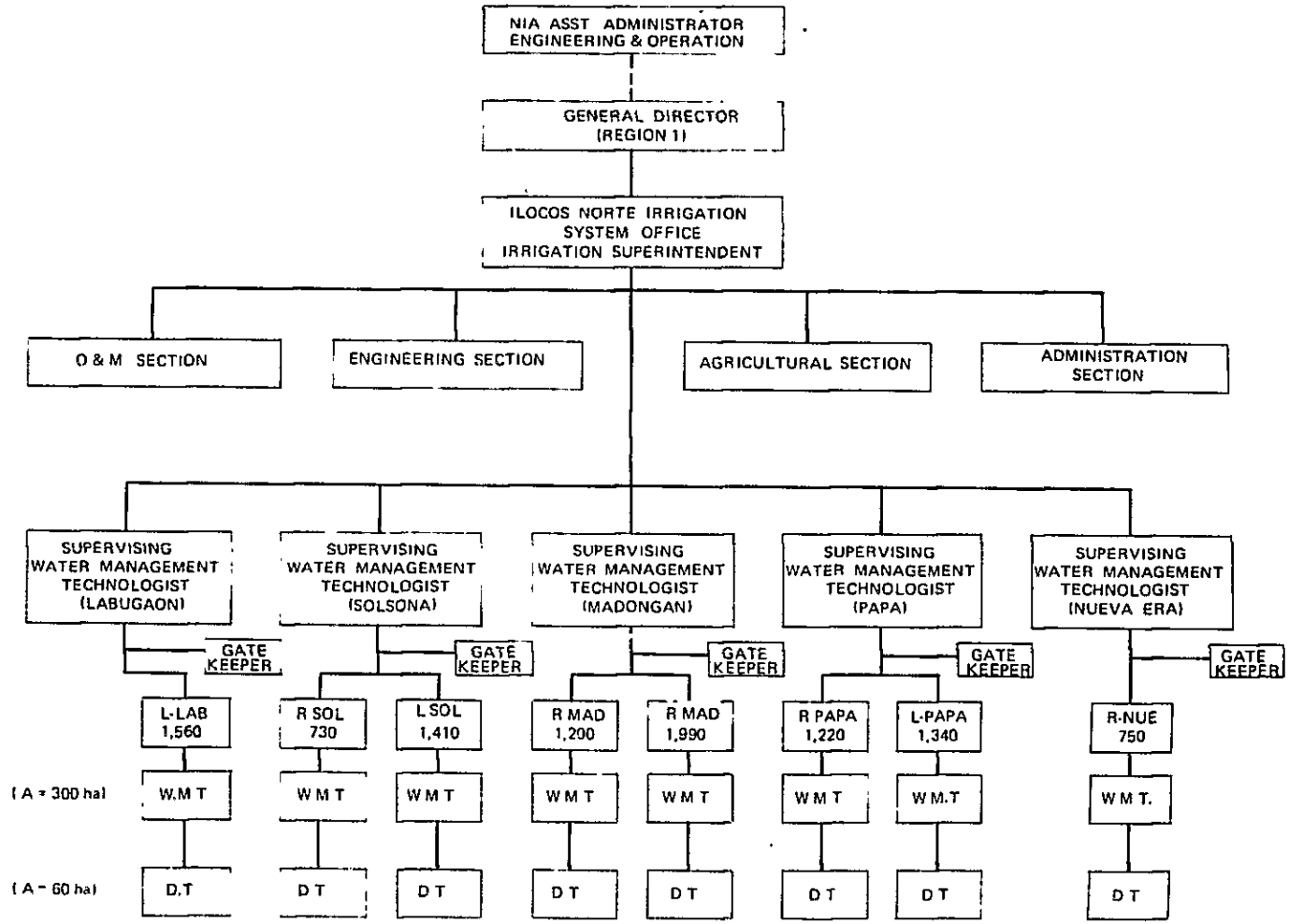
These areas would be subdivided into about 300 ha units and each unit will be managed under a Water Management Technologist (WMT). A ditch tender would be employed for about 60 ha, two rotation blocks. Each WMT, therefore, would be responsible for about five units of the ditch tender. The gates of each diversion dam would be operated by gate keepers.

2. Operation and Maintenance of Facilities

Operation and maintenance of the facilities will be performed by the Irrigators' Association under the jurisdiction of the Ilocos Norte Irrigation System Office (INISO).

The proposed organization chart for operation and maintenance is shown in Figure 5-3.

FIGURE 5-3 PROPOSED ORGANIZATIONAL CHART FOR OPERATION AND MAINTENANCE



NOTE W M T - WATER MANAGEMENT TECHNOLOGIST
D T - DITCH TENDER

3. Operation and Maintenance Cost

The operation and maintenance costs are summarized as follows:

Annual Operation and Maintenance Cost

	Items	O & M Cost (US$ '000)	O & M Cost (US$/ha)
1)	Salary and Wages	234.2	23.0
2)	Equipment Operations	134.1	13.1
3)	Materials and Supplies	141.7	13.9
4)	Administration & General Expenditure	70.2	6.9
	Total	580.2	56.9

Detail estimation is given in Appendix 5C-1.

C. Consulting Services

The Consultant's services include the implementation of final design and supervision of the Project.

The Consultant's services are divided into the following three phases:

i) The final detailed design of the Project as well as the preparation of tender document. It will cover 30 man-month period starting from January 1980. Highly qualified experts will be engaged, including irrigation engineer, engineering geologist, hydrologist, design engineer and economist.

ii) Construction supervision and training of local counterpart personnel in all aspects of the Project activities. The service period would cover 40 man-months from October 1981 to November 1984. The required experts would be project engineers and engineering geologist.

iii) Establishment of agricultural institutional development program and training. It would cover 20 man-months. Highly qualified experts will also be engaged, including agronomist, agri-institutional expert and water and farm management expert.

The Terms of Reference for the Consultant's Services and the proposed schedule for the them are given in Appendix 5D-1.

CHAPTER VI. PROJECT JUSTIFICATION

CHAPTER VI. PROJECT JUSTIFICATION

A. General

This project was schemed to meet the needs of national economy, such as supply of staple food, correction of income inequality and increase of employment opportunity. With the background, the objectives of the project are to increase cash income for small land holding farmers and improve the living status in a view point of farm economy.

To cope with these purposes, the project components as mentioned in the previous chapter have been schemed, namely, the construction of diversion dams and irrigation and drainage networks inclusive of on-farm level in the Project would make possible to stabilize the wet season paddy cultivation and to introduce the irrigated agriculture in the area.

The project justification for such costs invested would be evaluated using direct benefits created by the project.

B. Method of Economic Evaluation

The measurable eocnomic benefits and costs are expressed in monetary terms and the both stream of benefits and costs in annual forms over the evaluation period are converted to the respective present worth values. The internal rate of return (IRR) is used as the main indicator for the economic evaluation of the Project. The project is evaluated based on the difference between the "development with the project" and the "development without the project". Thus, the project evaluation deals with incremental benefits and required costs.

C. Economic Evaluation

1. Evaluation of Commodities and Labor Costs

The traded goods to be evaluated to shadow price are crops and fertilizers.

a) Crop Price

Rice

Traded goods to be evaluated to the shadow price are rice, tobacco, garlic and onion. Foreign exchange rate used for study is US$1.00 = ₱ 7.40 as the official exchange rate but the rate for shadow price is US$1.00 = ₱ 8.22 being used in an appraisal reports of the World Bank.

Farm gate price of rice (constant price in 1978) was evaluated based on the export price of Thai 25 - 30 percent broken rice, f.o.b. Bangkok forecasted by the World Bank, 230 US$/ton in 1978 and 290 US$/ton in 1985. However, as the Philippines has just become a marginal exporter of paddy, the farm gate price on paddy in future should be evaluated based on the export price from the Philippines. According to data, f.o.b. Manila price through 1977 to 1978 was 280 US$/ton to 320 US$/ton. The exported volume of rice from the Philippines, however, does not play a big role to control the world market price of rice, therefore, forecasted f.o.b. Bangkok price was used in this study.

Rice Price Structure, 1978 and 1985

– Constant mid 1978 price –

	Item	1978 (₱/ton)	1985 (₱/ton)
1)	Export price of Thai 25 - 30% broken, F.O.B. Bangkok	1,890 (US$230)	2,385 (US$290)
2)	Import price, C.I.F. Philippines port	2,030	2,525
3)	Price of rice ex-mill Laoag	2,015	2,510
4)	Paddy equivalent price	1,270	1,580
5)	Farm gate price of paddy	1,230	1,540
	Financial farm gate price	(1,100)	(1,385)
6)	Farm gate price per cavan	60	73
	Financial farm gate price	(55)	(70)

Main selling center of the increased rice would be Laoag City. The transportation of rice will be made through international port of San Fernando La Union.

Virginia Tabacco

The farm gate price of Virginia tobacco (constant price in June, 1978) was evaluated based on the world market price of export value of fluecured leaf, f.o.b. India, 1,870 US$/ton in 1978 and 1,860 US$/ton in 1985.

According to the appraisal report of the World Bank, Philippines Virginia tobacco commands a premium of about 15 percent over the Indian Virginia tobacco. This margin was accounted to evaluate the farm gate price of Virginia tobacco.

Virginia Tobacco Structure, 1978 and 1985

– Constant June 1978 price –

	Item	1978 (₱/ton)	1985 (₱/ton)
1)	Export unit value of fluecured leaf F.O.B. India	15,370 (US$1,870)	15,290 (US$1,860)
2)	Import price, C.I.F. Europe	16,720	16,640
3)	15% mark-up for higher quality Philippine leaf	2,510	2,495
4)	Import price, C.I.F. Europe for Philippine tobacco	19,230	19,135
5)	Export price, F.O.B. Manila	17,230	17,135
6)	Farm gate price	16,130	16,035
	Financial farm gate price	(7,400)	(14,435)

Garlic

Garlic is also one of the trade goods. However, the quantity exported has not been yet so much according to the BAEcon data, and the export is unsteady, as four tons in 1974, eight tons in 1975, nothing in 1976 and only 60 kg in 1977.

The F.O.B. price is not acceptable to economic evaluation. In this study, the average price which was actually received by farmers in Ilocos Region will be used. According to BAEcon statistics report, such price was 2.92 pesos in 1973, 4.9 pesos in 1974, 8.85 pesos in 1975, 6.01 pesos in 1977 and 5.65 pesos in 1978 (average of those from January to June). Considering the price trend, 5.5 pesos per kilogram were used. This price corresponds to the farm gate price which was obtained by the farm management survey, NIA.

Onion

About 13 percent of total products of onion has been exported. The f.o.b. price per kilogram has been kept around US$0.24 (₱ 1.8) since 1975 according to the data of BAEcon. Farm gate price of onion, therefore, was evaluated at ₱ 1,800 per ton,using above f.o.b. price.

The detail description of economic evaluatin of commodities is given in Appendix 6C-1.

b) Labor

A distinction is commonly made between farm family labor and wage labor. Wage labor is counted as an input, then the cost of wage labor valued at the shadow price must be deducted from the gross value of output. For farm family labor, no such deduction is made, because the return to farm family labor is taken as the net farm return.

After the completion of the Project, cropping intensity would be raised because of the introduction of second crop paddy and diversified crops in the dry season. Then, labor demand would be more severe in spite of the introduction of farm machinery to some extent.

At present, farmers in the Project Area hire the laborers required for cropping operation, and according to the farm management survey conducted by NIA, the ratio of hired labor to the total labor demand amounts to about 30 to 40 percent for paddy cultivation and about 20 percent for that of garlic. These labor customs prevailing at present, however, would be changed in future due to the establishment of farmers' organization on the basis of one compact farm and the introduction of farm machinery.

Supply and demand balance of labor during the construction periods and after the completion of construction was analyzed in the farm labor study. When the farm family labor force works for 26 days per month during labor peak season in future, the cropping operation would be executed without the hired labor force. Construction labor of the Project would be supplied by the unemployment labor and farm labor inside and outside of the Project Area.

Pricing of farm labor is the assessment of the opportunity cost. It is postulated that the marginal opportunity cost of labor supplied for farm work in the Project Area can be represented by "S-shaped" curve.

The present farming wage rate is graded into ten pesos for the highest, five pesos for the lowest and average eight pesos each without meal. Four pesos of difference between ten pesos without meal and six pesos with meal include two pesos of milling cost. Two pesos approximately correspond to the average daily family living allowance per person which was calculated from the result of farm management survey, NIA.

The shadow wage rate of unskilled labor is economically evaluated using this S-shaped curve. Average wage rate was computed as 5.5 pesos to 6.0 pesos during construction periods and 5.5 pesos during the farm labor peak.

Detail description of Economic cost of farm labor is given in Appendix 6C-2.

c) Fertilizer

Fertilizer is also the traded goods as mentioned above. The Philippine port used in this analysis is San Fernando, La Union. Distribution center is Laoag City. International price of Urea, TSP and Potash are evaluated based on the World Bank's forecasting prices at constant 1978 prices.

2. Evaluation of Agricultural Benefit

a) Agricultural Benefit

The formations of annual benefited area were decided to match with the annual construction schedule of diversion dams. The following table shows the irrigable area by year.

Irrigable Area with Project

(Unit: ha)

Sub-Area	Project Area	Irrigable Area Wet	Irrigable Area Dry	1983 Dry	1983 Wet	1984 Dry	1984 Wet	1985 Dry	1985 Wet
Labugaon	1,560	1,560	780	–	–	–	1,560	780	1,560
Solsona	2,140	2,140	610	–	2,140	610	2,140	610	2,140
Madongan	3,190	2,290	720	–	–	–	–	720	2,290
Papa	2,560	1,340	400	–	–	–	–	400	1,340
Nueva Era	750	750	450	–	–	–	–	450	750
Total	10,200	8,080	2,960		2,140	610	3,700	2,960	8,080

In evaluating the benefit in case of without-project, it was assumed that the present cropping pattern would be proceeded further in future. In case of with-project, on the other hand, a proposed cropping pattern could be introduced into the whole Project Area. However, some areas in the Project can not get the target yield due to shortage of irrigation water, then the benefits to be created from such areas are not taken into account in evaluation from conservative view point. Consequently, the evaluations of benefit in the project are made on the basis of two land categories, i.e., i) benefited areas of 8,080 ha to be irrigated and ii) remaining areas of 2,120 ha with shortage of irrigation water.

Cropping Area with the Project

(Unit: ha)

	1978 to 1982	1983	1984	1985
A. Benefited Field				
Wet season palay	–	2,140	3,700	8,080
Dry season palay	–	–	550	2,670
Garlic	–	–	20	100
Tobacco	–	–	20	90
Onion	–	–	20	100
Sub-total		2,140	4,310	11,040
B. Remining Field				
Irrigated palay				
Wet season	8,041	6,181	4,772	1,465
Dry season	3,411	3,308	2,635	515
Reinfed palay	2,601	1,996	1,544	471
Corn	489	474	459	275
Others	118	114	46	–
Sub-total	14,660	12,073	9,456	2,726
Grand total	14,660	14,213	13,766	13,766

Annual benefited area multiplied by the target yield gives gross product with the Project. This target yield would be attained in the term of five years after provision of project facilities. Then, a full benefit for the whole Project Area would be attained in the tenth year.

The following table indicates the annual production.

Annual Production

(Unit: '000 tons)

	Developing Period						
	4	5	6	7	8	9	10
With Project							
Palay	24.4	33.4	34.9	39.4	43.3	45.7	46.5
Diversified Crops and Others	1.8	1.8	0.4	0.5	0.5	0.5	0.5
Total	26.2	35.2	35.3	39.9	43.8	46.2	47.0
Without Project							
Palay	23.1	23.4	23.6	23.8	24.1	24.3	24.5
Diversified Crops and Others	1.9	1.9	1.9	1.9	1.9	2.0	2.0
Total	25.0	25.3	25.5	25.7	26.0	26.3	26.5

Production cost consists of the costs for seeds, fertilizers, pesticides, herbicides and the operation of cultivation and threshing. Production cost without the Project includes the hired labor and animal cost based on the results of farm management survey, NIA.

The supply and demand balance of cropping labor with the Project gives no needs of the hired labor by the introduction of farm machinery and intensive family labor.

The following table shows an annual incremental net production value (NPV).

Incremental Net Production Value

(Unit: ₱ x 10^6)

Benefit		1983	1984	1985	1986	1987	1988	1989
With Project	G P V	38.71	42.54	56.86	64.28	70.41	74.36	75.66
	G P C	7.05	7.90	9.88	11.05	12.01	12.74	12.75
	N P V	31.66	34.64	46.98	53.23	58.40	61.62	62.91
Without Project	G P V	36.78	37.16	37.55	37.89	38.28	38.63	39.03
	G P C	7.82	7.90	7.98	8.06	8.14	8.22	8.30
	N P V	28.96	29.26	29.57	29.83	30.14	30.41	30.73
Incremental N P V		2.70	5.38	17.41	23.40	28.26	31.21	32.18

G P V: Gross Production Value
G P C: Gross Production Cost
N P V: Net Production Value

b) Project Economic Life

Project economic life will be calculated at 50 years. The present value of the future benefit and cost beyond 50 (or even 30) years would be too small to make any real difference in the final result.

c) Escalation Factor

Escalation factor of eight percent would be used in reference to the World Bank's International Inflation Index and Philippines Economic Indicator and other project's rates.

3. Evaluation of Construction Cost

Direct cost to be used in the estimation of internal rate of return consists of engineering design, property and construction costs of the project but it does not include interest during the period of construction.

Both interest and tax are considered as transfer payments; so, they are not included in the economic cost. This project cost include a depreciation cost of construction equipment.

Unskilled labor cost and oil cost were re-estimated using opportunity cost or shadow price. Land acquisition cost was excluded because decrease of incremental benefit obtained from such land was already computed in the benefit stream.

Financial project cost of 230 million pesos (US$31.5 million) excluding the escalation factor is scheduled as shown in Table 6-1. The economic cost to be used for evaluation of internal rate of return was estimated as 180 million pesos (US$24.35 million).

The detailed description of agricultural benefits is given in Appendix 6C-3.

D. Internal Rate of Return

Present worth value of the economic cost and benefit was estimated as follows:

Present Worth Value of Cost and Benefit

(Unit: ₱ x 10^6)

Item	5%	10%	15%
Benefit	410	170	86
Cost	187	133	103

Table 6-1 Evaluation of Economic Cost

(Unit: ₱ x 10^3)

	1979	1980	1981	1982	1983	1984	Total	Note
1. Project Cost excluded Escalation	1,273	7,804	55,177	55,854	63,274	46,818	230,200	
2. Construction Equipment	–	–	33,963	–	–	–	33,963	
3. Depreciation Cost of Equipment	–	–	6,468	6,468	6,468	6,468	25,872	
4. Project Cost	1,273	7,804	27,682	62,322	69,742	53,286	222,109	(1) - (2) + (3)
5. Tax	1	44	371	1,162	1,330	1,034	3,942	
6. Project Cost excluded Tax	1,272	7,760	27,311	61,160	68,412	52,252	218,167	(4) - (5)
7. Cost Items to be re-estimated	(Unskilled labor, Fuel and Oil, Land Acquisition and Compensation)							
Financial Cost	–	–	9,233	18,394	20,346	12,036	60,009	
Economic Cost	–	–	2,110	6,586	7,595	5,730	22,021	
8. Economic Cost	1,272	7,760	20,188	49,352	55,661	45,946	180,179	

The internal rate of return (IRR) amounts to 13.2 percent as shown in Figure 6-1, which is drawn using the above figures. This project would be considered to attain the justifiable line. (see Appendix 6D-1)

E. Sensitivity Analysis

Sensitivity analysis is the effective measures of testing for the riskness of the Project. Analysis were studied in the following cases;

IRR in Sensitivity Analysis

Items	IRR (%)
1. 10% increase in world market price of rice	14.2
2. 10% decrease in world market price of rice	12.0
3. 10% increase in project rice yields	15.5
4. 10% decrease in project rice yields	11.6
5. 10% decrease in project benefit	11.8
6. Two year delay in reaching full project benefits	12.6
7. 10% increase in construction cost	12.2
8. 20% increase in construction cost	11.2
9. One year delay in start of construction	12.7
10. Two year delay in start of construction	11.8
11. Costing farm supply labor	13.1
12. Costing construction equipment	12.2

F. Farm Budget Analysis

Farm budgets for the average size of farm at present is represented by the farmer having 1.4 ha of farm field. According to the result of farm management survey, 42 percent of the total farm households has a farm field less than 1.0 ha, 46 percent for those of 1.0 to 1.99 ha and 12 percent over 2.0 ha.

The following table explains about farm budgets at present and in future. Amortization owner and leaseholder at present take 1,323 pesos and 1,078 pesos of net crop income, respectively. On the other hand, the farm management survey conducted by NIA reported the family living allowances was about 2,500 pesos for five persons per household and non-farm income was 500 pesos to 900 pesos. Then, the negative balance in farm economy at present would be changed to a higher profitable balance in future.

FIGURE 6-1 INTERNAL RATE OF RETURN

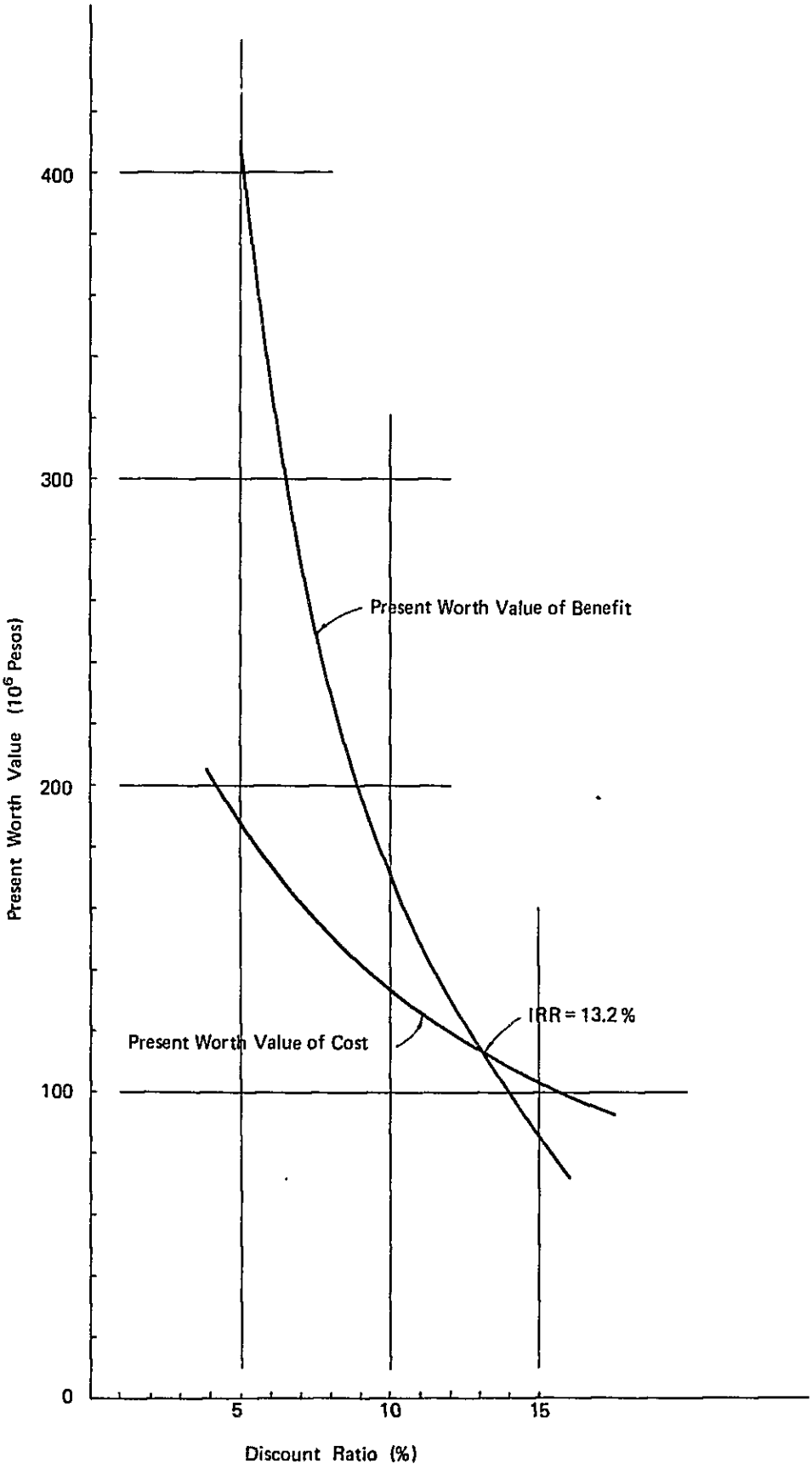


Table 6-2 Farm Budgets Analysis

Item	Present	Future (w/Project)
Size of farm (ha)[1/]	1.40	1.40
Cropping area (ha) [2/]		
Irrigated 1st crop	1.10	1.40
2nd crop	0.22	0.37
Rainfed	0.28	–
Upland: Tobacco	–	0.01
Garlic	–	0.01
Onion	–	0.01
Total	1.60	1.80
Cropping Intensity (%)	114	128
Total Paddy Production (ton)	2.66	7.00
Gross Value of Product (₱)	2,930	10,270
Production Costs (₱)	852	1,815
Water Charges[3/]	–	450
Net Value of Production (₱)	2,078	8,005
(a) Amortization Owner		
Annual payment for land (₱)[4/]	755	755
Net crop income (₱)	1,323	7,250
(b) Leaseholder		
Annual payment for land (₱)[5/]	1,000	3,390
Net crop income (₱)	1,078	4,615

Note: 1/ Based on the results of farm management survey conducted by LRED, NIA, February, 1978.

2/ Based on the farm management survey and cropping pattern of the project.

3/ Based on future charges of ₱ 240/ha (3.5 cavans/ha) in the wet season and ₱ 305/ha (4.4 cavans/ha) in the dry season (derived from the Appraisal Report NISIP, Package I, April, 1977, World Bank)

4/ Based on amortizing owner with annual payment over 15 years at six percent on unpaid balance; based on price of land of 2.5 times present gross value of production (obtained from Appraisal Report of World Bank).

5/ Rent to landlord from share tenant amounts to 34 percent of total production in the Phase I area according to a disposition study of palay production in farm management survey, NIA.