FEASIBILITY REPORT
ON
ILOCOS NORTE IRRIGATION PROJECT
IN
THE PHILIPPINES
(PHASE II)
MAIN REPORT

DECEMBER 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

No.=

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PREFACE

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

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

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

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

December, 1980

Keisuke Arita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Keisuke Arita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir;

We have the honor to submit herewith our report on the feasibility study of the Ilocos Norte Irrigation Project (Phase II), Philippines. The field survey was conducted for the period of three months from January 7 to March 27, 1980. This report has been prepared on the basis of various discussions held between the Philippine Governmental agencies concerned and the team.

The team has completed the feasibility study involving the irrigation and hydropower components for the area of about 12,400 hectares, located on the Ilocos region, northern Luzon island, based on the overall development plan of the Ilocos Norte Irrigation Project.

This report consists of two volumes: Volume I - Main Report, summarizes the results of the study including the conclusions and recommendations; Volume II - Appendix, provides the detailed technical information.

We hope that this irrigation development project would serve as a good example and greatly contribute to the social and economic development in the Philippines.

Finally, we take this opportunity to express our deep graitude to National Economic and Development Authority, National Irrigation Administration, Ministry of Agriculture, Ministry of Public Highways, National Power Corporation, Bureau of Plant Industry, Fertilizer and Pesticide Authority, Ministry of Foreign Affairs (Japan), Embassy of Japan in the Philippines, Ministry of Agriculture, Forestry and Fisheries (Japan), Japan International Cooperation Agency and Advisory Group of the Project for their valuable assistance and cooperation extended to us throughout the survey period leading to the compilation of this report.

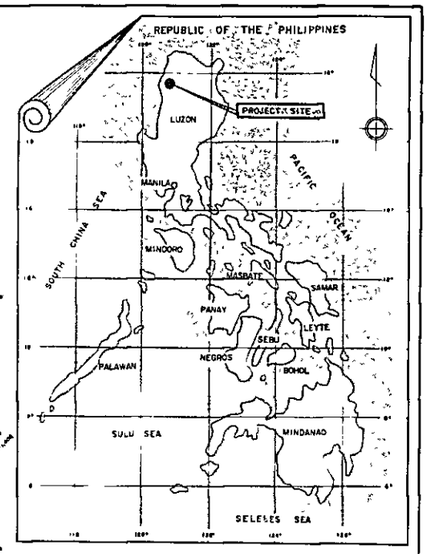
Respectfully yours,

December 1980

S. Takamine

Susumu Takamine
Team Leader for the
Ilocos Norte Irrigation Project

DEVELOPMENT PLAN FOR ILOCOS NORTE IRRIGATION PROJECT



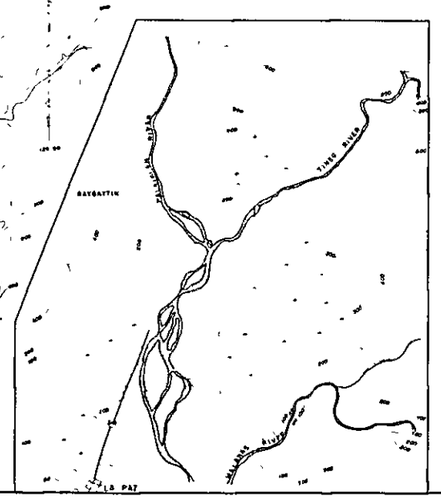
SCALE

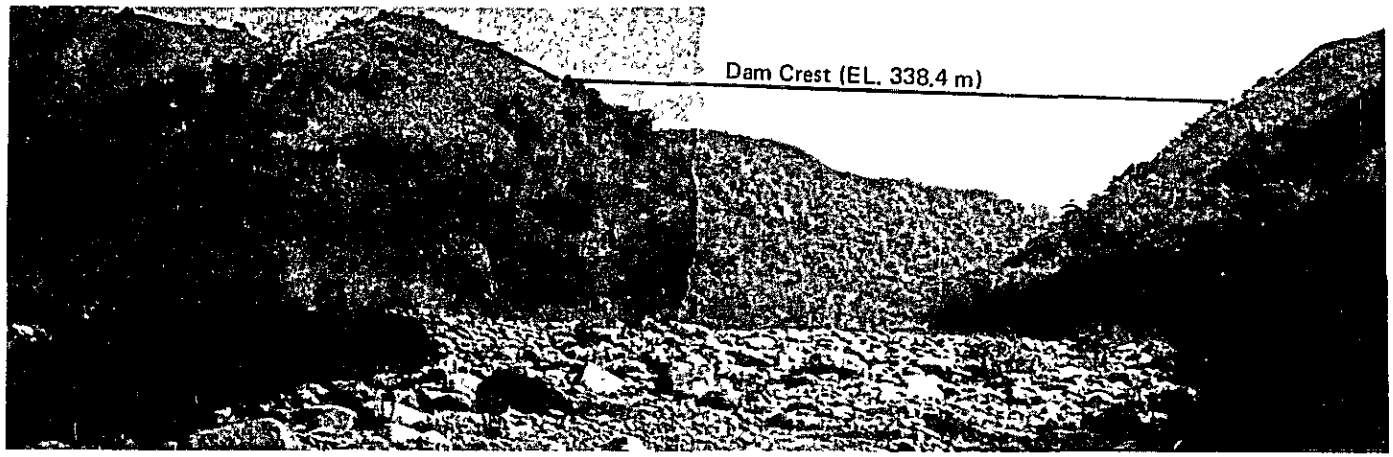
0 2 4 6 8(KM)

VINTAR
TO PAGUDPUD
LAOAG
LAOAG RIVER
SAN NICOLAS
SARRAT
PIDDIG
CURA AREA (PHASE II)
A=1,410HA
DINGRAS
LABUGAON DIVERSION DAM
SOLSONA
SOLSONA DIVERSION DAM
BATAC-PAOAY AREA (PHASE II)
A=6590 HA
PAOAY LAKE
PAOAY
BATAC
SOUTH CHINA SEA
LINK CANAL-1
MADONGAN DIVERSION DAM
RIGHT BANK OF BONGA RIVER (PHASE I)
A=10,200HA
ESPIRITU
PAPA DIVERSION DAM
LINK CANAL-3
BADOC-SINAIT AREA (PHASE II)
A=357.0HA
PINILI
BADOC
NUEVA ERA (L.B) AREA (PHASE II)
A=67.0 HA
PIDING DIVERSION DAM
LINK CANAL-2
NUEVA ERA
MAIN LINK CANAL
NUEVA ERA DAM
OUTLET
MADUPAYAS DIVERSION DAM
LINK CANAL-4
MADUPAYAS DIVERSION DAM
NUEVA ERA POWER STATION
BONGA POWER STATION
MADUPAYAS AREA (PHASE II)
A=160 HA
INTAKE STRUCTURE
PALSIGUAN DAM
ILOCOS NORTE PROVINCE
ILOCOS SUR PROVINCE
TO TAGUDIN

LEGEND

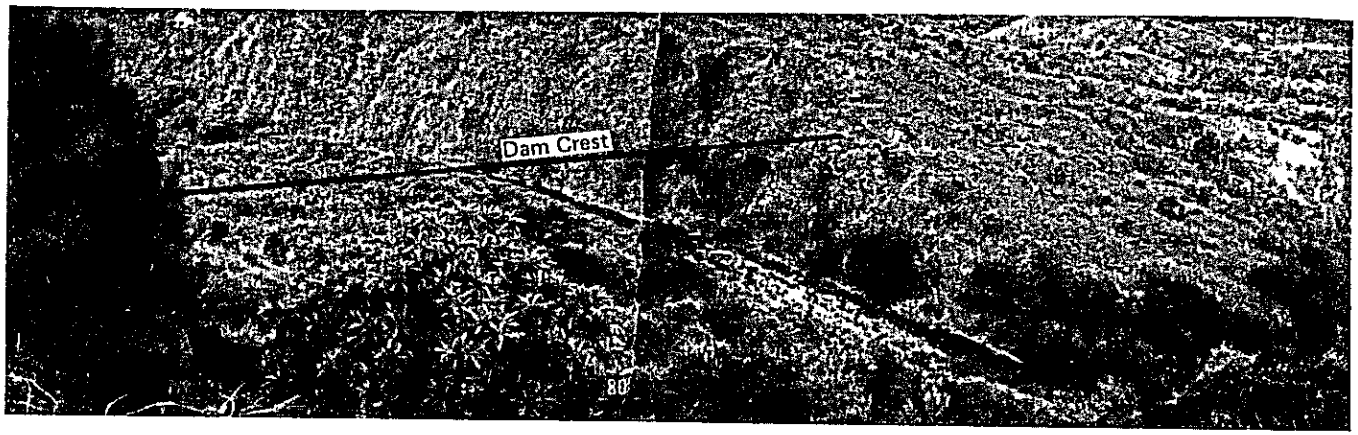
- BOUNDARY OF PROVINCE
- NATIONAL AND PROVINCIAL ROADS
- RIVER AND RIVER WASHED AREA
- TOWN
- EXISTNG PADDY FIELDS
- TROPICAL GRASS LAND
- CONTOUR LINE
- BOUNDARY OF BENEFICIAL AREA
- PROPOSED DAM
- PROPOSED DIVERSION DAM
- PROPOSED TUNNEL
- PROPOSED POWER STATION
- PROPOSED LINK CANAL AND ROAD
- PROPOSED MAIN AND LATERAL IRRIGATION CANAL AND ROAD
- PROPOSED MAIN DRAINAGE CANAL (NEWLY CONSTRUCTED)
- PROPOSED MAIN DRAINAGE CANAL (EXISTNG RIVER OR CREEK)
- PHASE-I PROJECT AREA AND FACILITIES
- PHASE-II PROJECT AREA AND FACILITIES



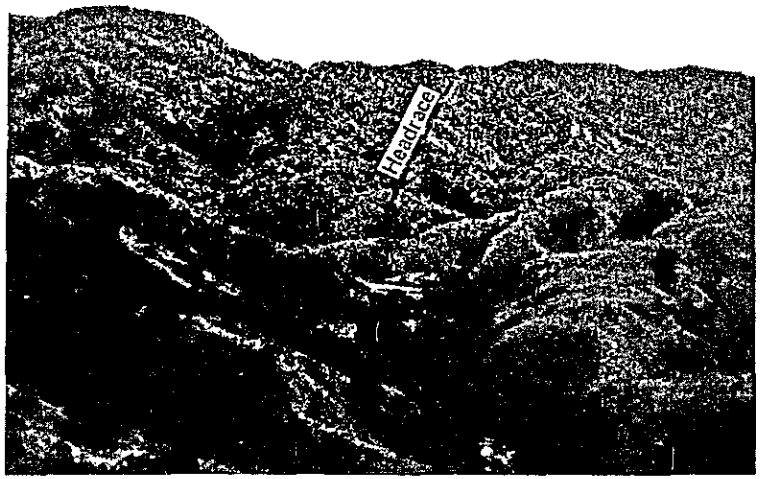


Proposed Palsiguan Dam Site

A View of the Palsiguan Dam



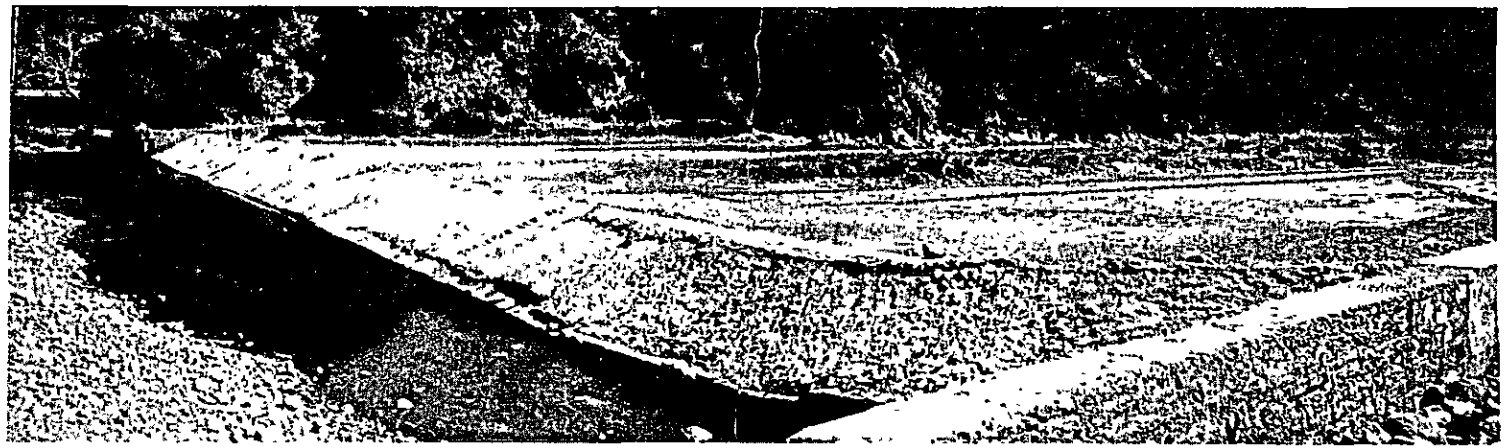
Proposed Nueva Era Dam Site



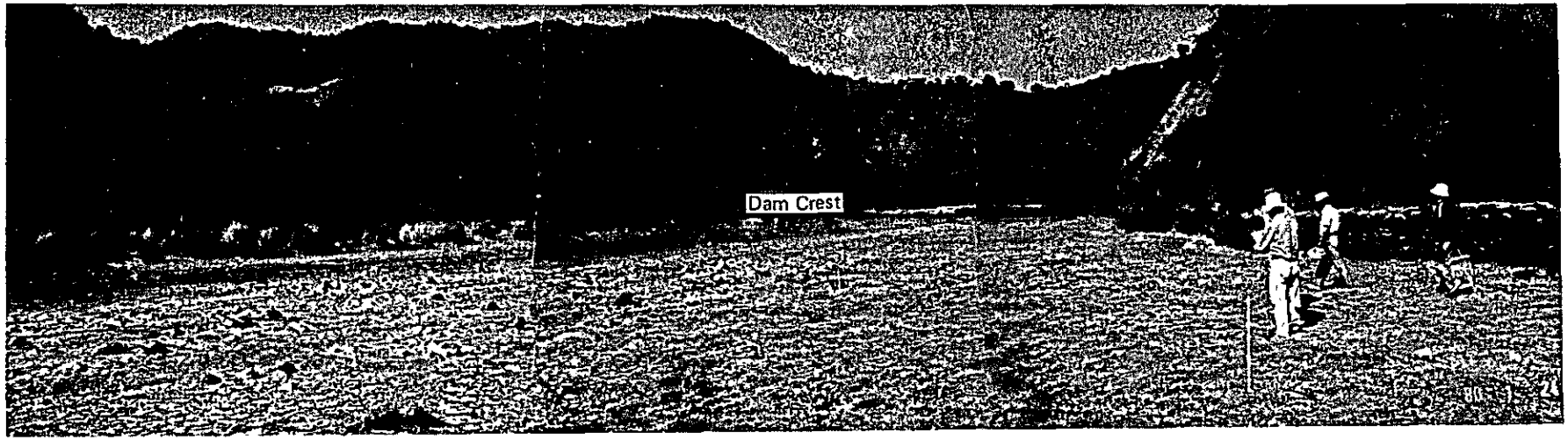
A Distance View of

Proposed Bonga Power Station

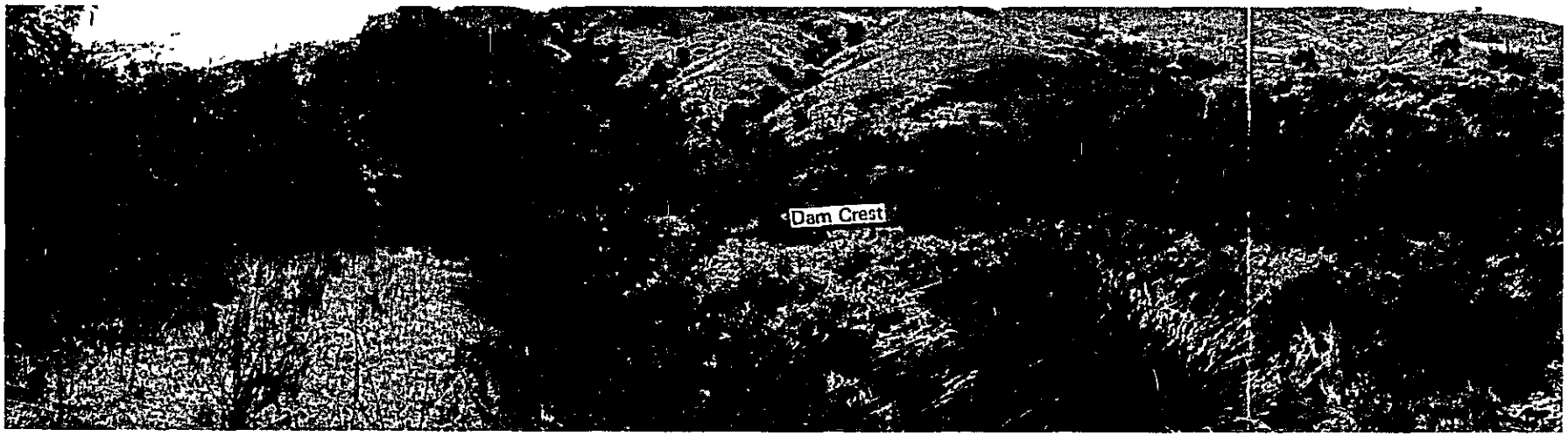
Site of Bonga Power Station to be built under the Ground



Existing Piding Diversion Dam which is to be utilitied after the Project



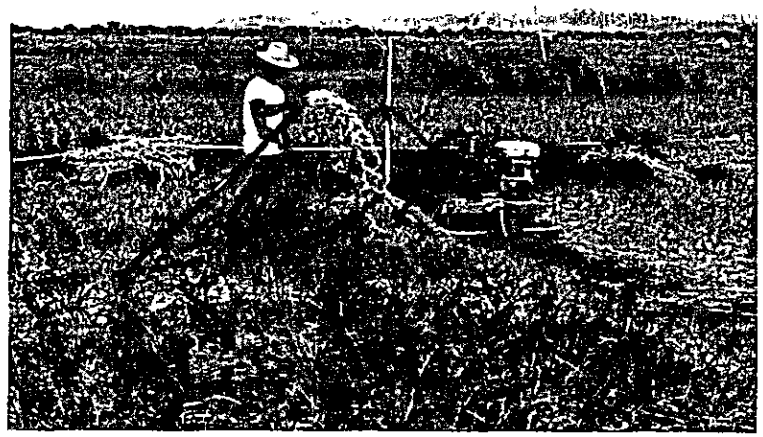
Proposed Tibangran Diversion Dam



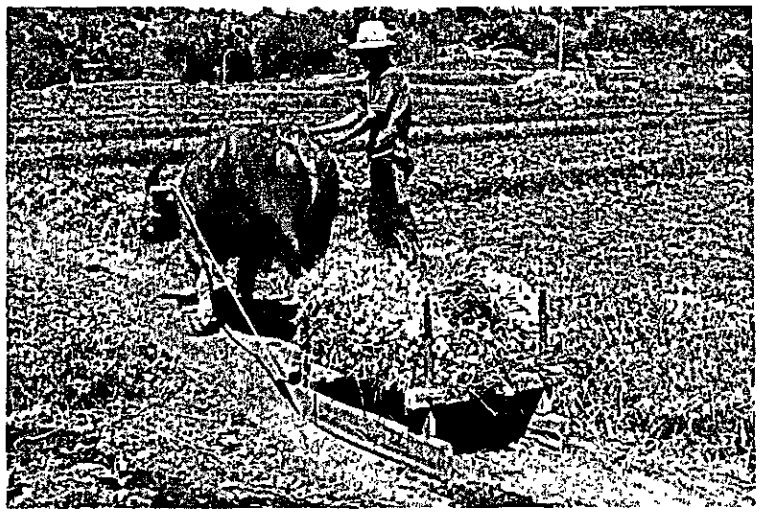
Proposed Madupayas Diversion Dam

General View of Dry Season Crops by Communal Irrigation System

Irrigated Tabacco by Groundwater

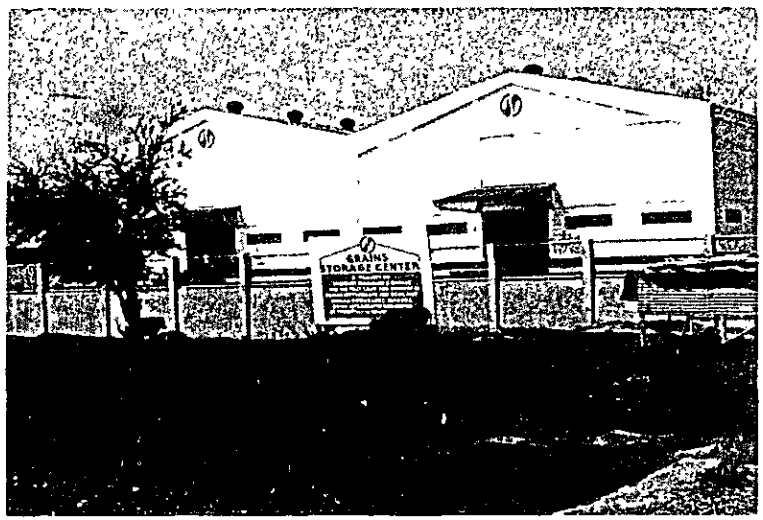


Irrigation of Garlic by Groundwater

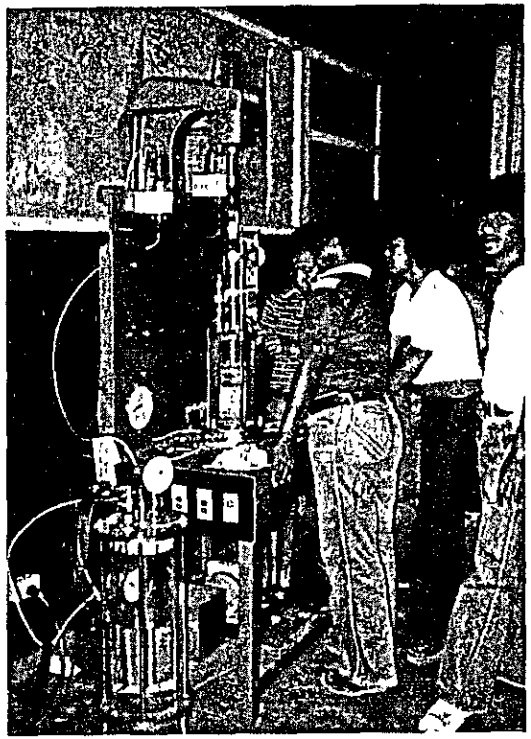


Transportation of the Garlic harvested

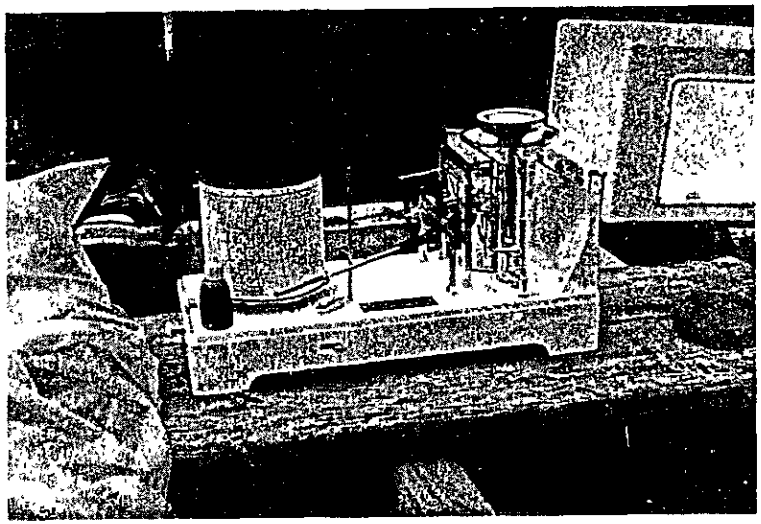
Harvesting of Mungbean



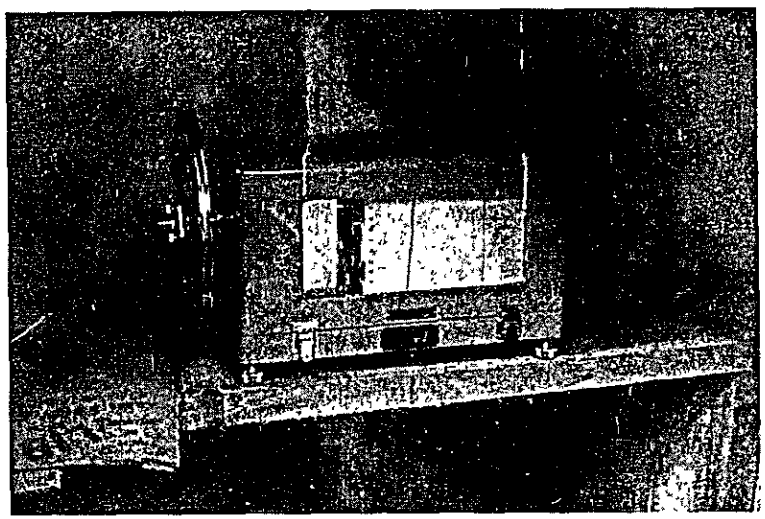
Grain Warehouse in Dingras



Triaxial Shear Machine



Automatic Evaporation Recording Gauge



Automatic Water Level Gauge

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ABBREVIATIONS AND GLOSSARY

Agencies

ACA	:	Agricultural Credit Administration
ADB	:	Asian Development Bank
AMC	:	Area Marketing Cooperatives
BAI	:	Bureau of Animal Industry
BAEcon	:	Bureau of Agricultural Economics
BAEx	:	Bureau of Agricultural Extension
BPI	:	Bureau of Plant Industry
BS	:	Bureau of Soils
CB	:	Central Bank of the Philippines
CRDI	:	Cotton Research and Development Institute
FPA	:	Fertilizer and Pesticide Authority
FaCoMa	:	Farmers Cooperatives Marketing Association
IBRD	:	International Bank for Reconstruction and Development
IDA	:	International Development Assocation
INECO	:	Ilocos Norte Electric Cooperative Inc.
ISECO	:	Ilocos Sur Electric Cooperative Inc.
JICA	:	Japan International Cooperation Agency
MA	:	Ministry of Agriculture
MAR	:	Ministry of Agrarian Reform
MERALCO	:	Manila Electric Cooperative Inc.
MF	:	Ministry of Finance
MLGCD	:	Ministry of Local Governments and Community Development
MNR	:	Ministry of Natural Resources
MOTC	:	Ministry of Transportation and Communication
MPH	:	Ministry of Public Highway
MNR	:	Ministry of Natural Resources
MPW	:	Ministry of Public Works
NACIAD	:	National Council of Integrated Area Development
NCSO	:	National Census and Statistics Office
NFAC	:	National Food and Agricultural Council
NEA	:	National Electrification Administration
NEDA	:	National Economic and Development Authority
NGA	:	National Grains Authority
NIA	:	National Irrigation Administration
NISIS	:	National Irrigation System Improvement Study
NPC	:	National Power Corporation

OECF	:	Overseas Economic Cooperation Fund
PAGASA	:	Philippines Atomospheric Geophysical and Astronomical Services Administration
PCARR	:	Philippine Council for Agriculture and Resources Research
PNB	:	Philippine National Bank
PTRTC	:	Philippine Tobacco Research and Training Center
PVTA	:	Philippine Virginia Tobacco Administration
RB	:	Rural Bank
SN	:	Samahang Nayon
UPIP	:	University of the Philippines, Institute of Planning
USAID	:	United Stated Agency for International Development
USBR	:	United States Department of Interior, Bureau of Reclamation

Unit of Measurement

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
sq.cm, cm^2	:	square centimeter
sq.m, m^2	:	square meter
sq.km, km^2	:	square kilometer
MSM, $10^6 m^2$	:	million square meter
ℓ, lit	:	liter
cu.m, m^3	:	cubic meter
MCM, $10^6 m^3$	:	million cubic meter
lit/sec	:	liter per second
m/sec	:	meter per second
PPM	:	part per million
g	:	gram
kg	:	kilogram
ton, m.t.	:	metric ton
cavan	:	50 kg
EL	:	elevation above mean sea level
MSL	:	mean sea level
FWL	:	full water level
HWL	:	high water level
LWL	:	low water level

Unit of Measurement

sec	:	second
minu	:	minute
hr	:	hour
min	:	minimum
max	:	maximum
%	:	percent
No.	:	number
°C	:	degree centigrade
°F	:	degree fahrenheit
Cl	:	chlorine
HP	:	horse power
GWH	:	gigawatt hour
ET	:	evapotranspiration
N	:	nitrogen
P	:	phosphorous
K	:	potassium
HYV	:	high yielding variety
O & M	:	operation and maintenance
IRR	:	internal rate of return
B/C	:	benefit cost ratio
FY	:	fiscal year
₱	:	Peso, ₱ 1 = approx. US$0.135
$	:	Dollar, US$ = approx. ₱ 7.4

Conversion Factors

Unit	Comparison	English Equivalents
Units of Length		
Millimeter (mm)	0.001 meter	0.0394 inch
Centimeter (cm)	0.01 meter	0.3937 inch
Meter (m)		3.2800 feet
Kilometer	1,000 meters	0.6213 mile
Units of Area		
Square centimeter (cm^2)	0.0001 m^2	0.155 square inch
Square meter (m^2)		10.764 square feet
Hectare (ha)	10,000 m^2	2.471 acres
square kilometer (km^2)	1,000,000 m^2	0.3861 square mile

Unit	Comparison	English Equivalents
Units of Volume		
Cubic centimeter (cm^3)		0.061 cubic inch
Liter (1,000 cm^3)	0.001 m^3	1.0567 quarts (liquid)
Cubic meter (cu.m)	1,000 liters	35.3145 cubic feet
Unit of Weight		
Gram (g)		0.0353 ounce
Kilogram (kg)	1,000 grams	2.2046 pounds
Metric Ton (mt)	1,000 kg	2,204.6 pounds

Miscellaneous

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

Terminology

Arable land:	Land identified in the land classification investigation as having adequate productivity to warrant consideration for irrigation
Bamboo:	Bambusa Spinosa Roxb. a woody grass with a big hollow in the center of the internodes, growing in groves or clumps reaching a height of 25 meters or more
Barrio:	A political subdivision of a town
Bolo:	A large single-edged knife for a variety of uses like clearing the field, harvesting and household work
Calesa:	A light, two-wheeled, horse-drawn vehicle commonly used to transport passengers of farm produce for short distances
Carabao:	The animal that most farmers used for plowing and other farm work. It is about the size of an ox and is similar to the water buffalo in other Asian Countries.

Cogon:	Imperata cylindrica (Linn.) Beauv. a coarse grass which usually covers idle lands or abandoned clearing
Fiesta:	Spanish term for feast, celebrated pompously once a year to honor the patron saint
Ganta:	A common unit of volume for rice equivalent to 2.24 kilograms of milled rice.
Hectare:	A metric measure containing 10,000 square meters equivalent to 2.471 acres
IR-8, IR-5, IR-20	High yielding rice varieties from the IRRI, Los Banos, Laguna, Philippines
Irrigable land:	That portion of the arable land which is included in the irrigation service plan
Monsoon:	Periodic wind that blows from the sea to the continent and oppositely in winter
Nipa:	Heavy-leafed type of reed used in thatching huts
Palay:	The rice plant which bears a staple cereal, or the cereal itself unhulled. Sometimes called rough rice
Province:	A political subdivision of a country comprising several towns
Share tenancy:	A practice where operators rent the land they work and pay as rent a share of the cash or crops grown.
Trade wind:	One of the three Philippine air currents, comprising from a generally easterily direction reaching the islands during the period from February to April
Typhoon:	A storm or system or winds occurring in the Philippines and China Sea regions, known as hurricane in the West Indies and South Pacific, cyclone in the Indian Ocean

BACKGROUND

SUMMARY, CONCLUSION AND RECOMMENDATION

BACKGROUND

1. Ilocos Norte province is situated in the north-western portion of Luzon island, the main island of the Philippines, and is a province left behind others in the aspect of economic development. In spite that agriculture is the most important industry in the regional economy, only 17 percent of paddy fields is irrigated in dry seasons. Furthermore, some existing irrigation facilities have been deteriorated to a considerable extent. Under the circumstances, the per capita income in this region as of 1975 is only 780 pesos which is much lower than the national average per capita income of 895 pesos and about 1,590 pesos of Metro-Manila in the same year. A considerable number of population has, therefore, transmigrated from this region to the Metro Manila and other big cities, resulting in a low population growth rate of the region. To improve such economic conditions, the Government of the Philippines has drawn up an economic development plan for this region.

2. The National Irrigation Administration (NIA) conceived a plan for possible irrigation projects in the region in early 1975, and developed it into an integrated rural area development project in 1976 putting emphasis on agricultural development, which would be implemented under the direct supervision of the Government. For this agricultural project, NIA furthered the study, and formulated Palsiguan River Multipurpose Project in March 1977 under close cooperation of the National Economic Development Authority (NEDA).

3. In may 1977 NEDA made a request to the Government of Japan for technical assistance to the subject Project. In accordance with the request, the Ministry of Foreign Affairs, Japan, dispatched a Japanese Governmental Mission headed by Mr. Mitsuo Iijima to the Philippines. In August 1977 the Government of the Philippines made an official request for technical assistance to this Project through the Embassy of Japan in Manila.

In response to this request, the Japan International Cooperation Agency (JICA) dispatched a preliminary survey team for Ilocos Norte Irrigation Project headed by Mr. Tatsuo Asahara to the Philippines for the period of October 30 to December 2, 1977. The preliminary survey team recommended a phased development in order to comply with the strong desire of the Government of the Philippines for early implementation of the Project, taking into consideration that data and information required for finalization of an overall development plan were not fully available. In other words,

the survey team proposed to formulate, in the Phase I study, a provisional overall project plan for the Project and conduct a feasibility study in the areas for which data and information required are available, and to conduct, in the Phase II study, a feasibility study for the remaining areas inclusive of Palsiguan dam for irrigation water storage and hydropower generation. In this respect, the both Governments mutually agreed to the above-mentioned development strategy for this region.

4. Taking into consideration the aforementioned facts. JICA dispatched a survey team to the Philippines from August 9 to November 9, 1978 for the Phase I study and from January 7 to March 27, 1980 for the Phase II study under the scope of works of which brief descriptions are hereinafter made;

i) Formulation of an overall development plan for the whole Project Area premising Palsiguan dam as irrigation water source, based on basic data and information so far collected.

ii) Within the framework of the overall plan mentioned above, the Phase I feasibility study on provisional water supply plan for the area of about 10,200 ha located on the right bank of the Bonga river and Phase II feasibility study on water supply for the remaining area of about 12,400 ha in Cura and Batac-Badoc areas and hydropower generation.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

A. SUMMARY

1. Project Area

The Phase II development in Ilocos Norte Irrigation Project has been planned for the service area of about 12,400 ha scattered over five irrigation blocks located about 20 km to 35 km south of Laoag city, the capital of Ilocos Norte province. This province is situated in the north-western part of Luzon island and the distance to Manila is about 480 km. The Area covers parts of eight municipalities of Solsona, Dingras, Batac, Paoay, Pinili, Badoc, Nueva Era and Sinait, and is bordered on the west by the South China sea and on the east by the Cordillera Central Mountains and Ilocos Mountain Range.

As for transportation from Manila to the Project Area, three means by land, ocean and air are available. In land transportation, National Highway Route No.3, completely paved, runs across Batac-Paoay area, and most parts of the Project Area are accessible from this national highway. However, the existing road networks in the Project Area are mostly poor, and traffic by vehicle is difficult during wet season.

The Project Area can be topographically classified into two categories. One is lowlying alluvial plains with an elevation from 50 m to 5 m above mean sea level, and the other is undulating and rolling hilly lands. Batac-Paoay area belongs to the former whereas Cura, Nueva Era and Madupayas belong to the latter.

2. Rivers

As for the major rivers running in the Project Area, the Badoc river flows through Badoc-Pinili-Sinait area, and the Cura river flows along Cura area. In addition, there run many small rivers and creeks, but these water sources have not been used for irrigation due to their limited water quantity in dry seasons.

3. Climate

The climate in the Philippines can be classified into four types according to the rainfall pattern. Ilocos Norte and Ilocos Sur are classified under Type I characterized by two clearly different seasons, wet seasons from May to October and dry seasons from November to April.

The annual average temperature is 27.0°C in Laoag, and the averaged relative humidity is 76 percent in Laoag and 81 percent in Vigan during 1949 to 1974. The annual averaged rainfall is 2,016 mm in Laoag, 2,474 mm in Bonga and 3,262 mm in Abra, which indicates that it rains much in mountainous area and less in the plain. The observation data at Laoag and Bonga show that about 96 percent of the annual rainfall concentrates in the wet season.

4. Hydrology

The main potential water sources for irrigation in the Area are the Madupayas and Tibangran rivers, branches of the Badoc river having the annual run-off of 62.0 MCM and 89.2 MCM, respectively. However, out of the total discharge of 151.2 MCM, 95 percent concentrates during wet seasons from May to October whereas no water is available at present during dry seasons. This fact has led the agriculture to the low productivity together with unstabilized irrigation even in wet seasons. Under the situations, development of water sources is one of the essential requirements for irrigation in the Area.

5. Soils

Soils of the Project Area are topographically and physiographically classified into four main groups, namely, i) soils of the alluvial plain, ii) soils of the upland, iii) soils of the dune land and iv) soils of the riverwash. Soils of the alluvial plain are mainly formed by alluvial deposites. Most upland soil areas are covered with grasses, brush and secondary forest. Only a small portion is cultivated with paddy rice, corn, tobacco and vegetables. Soils of the dune land are composed of clean sand and loamy sand with a low productivity though the fertility and structure of the surface soils can be improved through organic matter supply. Soil of the fourth group are not suitable for cultivation.

6. Population and Farm Families

The population in the Project Area as of 1975 is about 72,800 of which 55,900 fall in the agricultural population with about 10,600 farm families. One farm family consists of 5.3 persons on an average. The population growth rate is 1.6 percent (1970 to 1975) which is far less than the national average of 2.7 percent. This low population growth rate is brought about by the outflow of population.

7. Irrigation and Drainage Conditions

The area of about 4,250 ha or 33 percent of the total cultivated lands of 12,830 ha is equipped with irrigation facilities of communal irrigation systems, and fully irrigated by gravity in wet seasons, however, the irrigation area in dry seasons

is only about 680 ha. In addition to paddy irrigation in dry seasons, groundwater irrigation for upland crops such as garlic, tobacco and mungbeans is predominantly made in the Area by small private pump. An area irrigated by one unit of pump is one to two hectares because of a low recovery of groundwater. The total irrigation area for upland crops is estimated about 6,480 ha as of 1980.

From the viewpoint of drainage, adequate measures to improve drainage conditions should be planned for the lower Paoay area suffering from habitual floodings in wet seasons due to the shortage of rationalized drainage facilities and systems.

8. Present Land Use

Out of the total area of 21,900 ha, an area of about 12,830 ha is utilized for agricultural production, and the remaining 9,070 ha consist of marshy lands, brush lands, village areas, roads, canals and river areas, etc. All farm lands are planted with paddy in wet seasons covering 4,250 ha of the irrigated land under communal irrigation systems and 8,580 ha of the rainfed areas. On the other hand, in dry seasons paddy cultivation is made only in 680 ha and upland crops such as tobacco garlic and mungbeans are grown in 6,540 ha, approximately.

9. Present Cropping Pattern and Crop Production

The cropping intensity is estimated at 162 percent on an average in the whole Project Area, although it is different among sub-areas, for instance, 109 percent in Cura and Nueva Era and 173 percent in Batac-Badoc area. The former areas are a paddy mono-culture area under extensive cropping pattern whereas the latter is a multiculture area under comparatively intensive cropping pattern with paddy and upland crops of garlic and tobacco as major crops which are grown in about 60 percent of paddy harvested area. Since groundwater is the major source of irrigation for dry season crops, problems have arisen from irrigation costs borne by farmers as well as limited resources in groundwater irrigation.

Yields of the major crops in the Project Area are 1.8 ton/ha of paddy, 1.0 ton/ha of tobacco, 1.4 ton/ha for garlic and 0.4 ton/ha of mungbean. The current extensive cropping pattern with considerably low yields has fundamentally resulted from unfavorable irrigation and drainage prevailing in the Area.

10. Farm Size and Land Tenure

The averaged farm size in the Area is about 1.2 ha per farmer. The agricultural census in 1971 found that the farmers cultivating less than 1.0 ha occupied about 41 percent of the total farmers in the Area, and in terms of land tenure owner farmers

occupied about 33 percent, owner-tenant farmers 42 percent and tenant farmers 25 percent of the total, respectively.

Accomplishment rate of the agrarian reform in the Area is about 40 percent in Land Transfer Operation, and about 15 percent in Lease Holder Operation, respectively, as of 1979.

11. Processing and Marketing of Agricultural Products

Mungbean as well as paddy rice produced in the Area will be marketed through the NGA in future, too. The marketing of Virginian tobacco has been controlled by PVTA. Consequently, these two governmental organizations are fully responsible to establish effective policies and provide necessary facilities for securing stable marketing of these products. In contrast, garlic to which the government does not have any concern with the control, has been exposed to keen competition in the free and intricate marketing channels, and the farmers have suffered from beat-down by middlemen whereas the consumers price is comparatively high. Under the situations, the MA proposed in its survey report to establish a cooperative organization for collective seales of garlic by farmers concerned.

12. Agricultural Extension Service and Related Organization

The BPI's production technicians and the BAEx's farm management technologists have been densely mobilized to the Area, and engaged devotedly in extension works. These two organizations are the major power for extension works in the Area.

In Ilocos Norte province, the objective areas for the agricultural crediting under Masagana 99 occupies less than 10 percent of the total farm lands. About 62 percent of the barangays in the Area has provided with the Samahang Nayong under the guidance of the MLGCD for rural development including agricultural cooperative activities.

13. Present Electric Power Supply

Electric power supply to Ilocos area is made through the Luzon grid from Baguio. In the neighborhood of the Project Area, no power source development has been planned yet. Therefore, electrification of the area, coupled with the poverty of farmers, is left behind, and only a quarter of households enjoys electric power supply. Each of Ilocos Norte, Ilocos Sur and Abra provinces has the Electric Cooperative, Inc. to distribute power to houses with the power supply by NPC. The annual total power consumption in 1979 was only about 52.8×10^6 KWh whereas the total demand was 22.1×10^3 KW. The load factor in this case is 39 percent.

14. Objectives and Components of the Project

The Project aims to increase agricultural production, to generate hydropower, to create the employment opportunity, to improve the socio-economic conditions, etc. In order to achieve these purposes and to obtain benefit quickly, the followings are proposed in the Project of which the major components are irrigation and hydropower generation.

Engineering Works:

1) Water resources development:
   Construction of dams and diversion dams

2) Irrigation and drainage development:
   Construction of irrigation and drainage canals

3) On-farm development:
   Construction of terminal irrigation and drainage canals and farm roads in fields

4) Road plan:
   Construction of service roads along main and lateral canals

5) Hydropower generation plan:
   Construction of dam and installation of hydropower plants and related facilities

Agricultural Development Works:

1) Agricultural development plan:
   Establishment of irrigated agriculture by Paddy double cropping with high yielding varieties and introduction of cash crop in the dry season in a part of area.

2) Agricultural extension services:
   Strengthening of extension services and training, and reinforcement of supply of agricultural input materials, financial aids, marketing and processing

3) Farmers' Organizations:
   Establishment of farmers' organizations such as Farm Irrigators' Association, Agricultural Cooperatives, etc.

15. Proposed Scheme of Development

Ilocos Norte Irrigation Project has been planned in two stages of Phase I and Phase II as a result of various alternative studies for formulating an overall plan.

Phase II development of the Project is focused on the reservoir plan to make possible the introduction of the double cropping and partially the triple cropping in

the Project Area with sufficient irrigation in the service area of about 19,640 ha inclusive of the Phase I service area[1/] as well as the hydropower generation.

Palsiguan dam water in the Abra province will be diverted to Ilocos Norte province through the tunnel, and conveyed to the Phase I and Phase II areas through link canals. The major dimensions of development are shown below;

Project area	:	12,400 ha
Service area	.	19,640 ha
Phase I	:	7,240 ha
Phase II	:	12,400 ha
Major construction works:		
Palsiguan dam	:	232 MCM
Headrace	:	6.15 km
Diversion dam	:	2 places
Link canal	:	96.0 km
Irrigation and drainage canals		459.9 km
On-farm development	:	12,400 ha
Power station	·	42,800 KW installed capacity (2 places)

16. Irrigation Plan

The Project Area of 12,400 ha is topographically divided into five irrigation blocks, namely, Cura area of 1,410 ha, Nueva Era area of 670 ha, Madupayas area of 160 ha, Batac-Paoay-Pinili area of 6,590 ha and Badoc-Sinait area of 3,570 ha. These areas will be connected by link canals to be constructed.

In the reservoir operation study of Palsiguan dam inclusive of hydropower generation aspect, the required reservoir capacity has been determined at 232 MCM to meet the irrigation requirement in a droughty year with the frequency by once a 10-year.

Rotation irrigation is recommended for water distribution in the farm level. One rotation area has been planned at 30 ha on an average for Cura-Nueva Era area and at 40 ha for Batac-Badoc area. The water management in one rotation area served by one turnout during the land preparation period will be made within 25 days for the former area, and within 35 days for the latter area. Based on the above-mentioned

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1/ Out of the Phase I Project Area of 10,200 ha, the area of 2,120 ha in wet seasons and 7,240 ha in dry seasons have not been counted as beneficial area due to shortage of river water, and these areas are included in the service area of Phase II Project.

cultivation method and the proposed cropping pattern, the maximum diversion water requirement is estimated at 2.33 lit/sec/ha for the former area, and 2.16 lit/sec/ha for the latter, respectively. Such maximum diversion water requirement will occur in the later half of land preparation periods.

17. Hydropower Generation Plan

The reservoir water will be led to the underground Bonga power station with 36,000 KW capacity through the headrace with 6,150 m long. The discharge from Bonga turbine will be regulated at the afterbay, and released to the low head Nueva Era power station with the generating capacity of 6,800 KW. The annual energy production at Bonga and Nueva Era power stations will be 159.7 GWh and 39.5 GWh, respectively. The both power stations will be connected to the Luzon grid of NPC in Badoc by the transmission line of about 35.5 km.

18. Major Facilities

The major facilities of the Project are Palsiguan dam, Nueva Era dam (afterbay), diversion dams, irrigation and drainage canals, roads, on-farm facilities and hydropower plants. The major dimensions of these facilities are tabulated in CONCLUSION.

19. Proposed Cropping Pattern and Production

The proposed cropping pattern in the Project is shown in the following table.

Proposed Cropping Pattern

(Unit: ha)

		Phase II Area			
		Cura-Nueva Era Area		Madupayas-Batac-Badoc Area	
Wet Season	Dry Season	Area	Cropping Area	Area	Cropping Area
Paddy	+ Paddy	1,870	3,740	3,100	6,200
Paddy	+ Tobacco	70	140	2,060	4,120
Paddy	+ Garlic	140 1/	280	2,065	4,130
Paddy	+ Garlic + Mungbean	–	–	2,065	6,195
Paddy	+ Cotton	–	–	1,030	2,060
	Total	2,080	4,160	10,320	22,705

Note: 1/ inclusive of 70 percent of onion.

Wet Season	Dry Season	Phase I Remaining Area	
		Area	Cropping Area
Paddy +	Paddy	2,120	4,240
(Paddy) +	Paddy	4,410	4,410
(Paddy) +	Tobacco	210	210
(Paddy) +	Garlic	250	250
(Paddy) +	Onion	250	250
	Total	7,240	9,360

The averaged yield of paddy per hectare at present is 1.8 tons whereas the target yield after the completion of the Project is 4.2 tons in wet seasons and 4.5 tons in dry seasons, respectively. Consequently, the present total paddy production of 27,510 tons will increase to 109,960 tons, that is, about 4.0 times as much as the present production, resulting in the increment of about 82,450 tons, as shown below;

Crop Production[1/]

(Unit: ton)

Crop	Present	With-Project	Incremental Production
Paddy	27,510	109,960	82,450
Tobacco	2,350	3,890	1,540
Garlic	5,360	11,780	6,420
Others[2/]	420	4,850	4,430

Note: 1/ Phase II Area and Phase I Remining Area.
2/ Mungbean, cotton and onion.

20. Farmers' Organizations

The farmers' organizations will function for water management, operation and maintenance of on-farm facilities, farm management and supporting services such as input material supply, credit, marketing and processing under the assistance of Samahang Nayon and Kilusang Bayon. At the same time, agricultural extension services will be strengthened by the Farmer Irrigators' Association (FIA) to be newly established covering the existing communal irrigation systems through the aforesaid cooperative activities such as Samahang Nayon and Kilusang Bayon.

21. Project Cost

The Project cost exclusive of the price escalation during the construction period and related interest is estimated at 2,450 million pesos (US$331 million) on the price basis in January 1980 with the breakdown as follows;

Foreign cost	:	₱ 1,557.6 million (64%)
Local cost	:	₱ 892.3 million (36%)
Total		₱ 2,449.9 million (100%)

22. Project Implementation and Operation

The scheduled construction period of the Project is the seven years from June 1981 to December 1987 including one year for final design.

Ilocos Norte Irrigation Project involving the irrigation and hydropower components is a part of the Ilocos Norte Integrated Rural Area Development Project (INIDP), so that the executing agency of the project will be organized and operated, prior to the establishment of the executing agency of the said INIDP. Under the situation, the NEDA will make overall coordination of the project and NIA and NPC will function as the executing agencies for implementation of irrigation and hydropower components respectively. In order to make a good coordination between above agencies, Joint NIA/ NPC Technical Committee will be organized.

The entire Project Works, upon completion of the Project, will be handed over to the NIA Regional Office No. 1, and the responsibility of operation and maintenance of all irrigation and drainage facilities will be placed on the Ilocos Norte Irrigation System Office (INISO) which will be newly organized.

23. Method of Economic Evaluation

The measurable economic benefits and costs are expressed in monetary terms and the both streams of benefits and costs in annual forms over the evaluation period are converted to the respective present worth values. The economic prices presented by the border prices were applied. 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.

24. Evaluation of Agricultural Benefit

The formulation of annual agricultural benefit was determined to match the annual construction schedule of the Project facilities. The annual gross cropping area in the Project for both seasons would become 1,410 ha in 1984, 6,180 ha in 1986, 7,210 ha in 1987, and 36,225 ha in 1988, respectively. The incremental productions in the full development stage are expected to arrive at about 80,000 tons by paddy,

5,600 tons by garlic, 1,080 tons by tobacco, 2,580 tons by cotton and 1,780 tons by mungbeans by 1992.

The economic farm gate prices in 1990 are 2,115 ₱/ton of paddy, 20,190 ₱/ton of Virginia tobacco, 5,930 ₱/ton of garlic, 18,550 ₱/ton of cotton and 4,180 ₱/ton of mungbeans. Based on these increased productions, the incremental net production value in 1992, full development stage, is estimated about ₱ 245 million (US$33.1 million).

25. Evaluation of Hydropower Benefit

The annual power benefit is evaluated by employing the standard capacity energy approach. The dependable capacity and averaged annual energy production have been evaluated based on the cost of an alternative oil thermal plant. The unit power value is estimated at the capacity cost of 700 ₱/KW (94.6 US$/KW) and the energy cost of 0.429 ₱/KWh (0.058 US$/KWh). Applying the unit values of power and energy, the annual power benefit in 1996 is estimated at ₱110 million (US$14.9 million).

26. Economic Cost

The economic costs to be employed in the Project economic study consist of the construction cost of relevant facilities, the O/M cost for irrigation and power and the replacement cost for electric power plants. The economic cost is revised from the financial cost economically taking into consideration the items of interest, tax, depreciation cost, unskilled labor cost, oil cost and land acquisition cost. The re-estimation of the Project cost has been made by applying conversion factors. Following the procedures mentioned above, the economic cost including a depreciation cost of equipment is estimated at ₱1,873 million (US$253.1 million) from the financial Project cost of ₱2,270 million (US$306.7 million) exclusive of the escalation factor.

27. Internal Rate of Return

The internal rate of return (IRR) of the Project in the linear interpolation method is computed by 14 percent, irrigation component by 15 percent and hydropower component by 12 percent. As a result, this multipurpose Project would be considered justifiable in the economic aspect.

28. Sensitivity Analysis

The sensitivity analysis in the following cases has been made, namely, i) falling of paddy price, ii) increase of construction cost, iii) slower built-up of the target yield, iv) delay in starting the construction, v) costly farm labor and vi) costly construction equipment, etc. Case ii), Case iii) and Case vi) are considered to be comparatively sensitive.

29. Farm Budget Analysis

The financial analysis has been made on farmers' economic capability to pay irrigation fees premising farmers having the standard farm size. The remaining value out of the net production value after deducting the irrigation fee and annual payment for land would increase to about 22,600 pesos in case of amortization owners and to 16,900 pesos in case of lease holders in the Project, whereas these amounts without the Project are about 8,800 pesos and 7,700 pesos, respectively.

30. Cost Recovery

The extent of cost recovery is evaluated by measuring the cost recovery index. The cost recovery index of 3.4 percent has been obtained based on the water charge, which was estimated at the value equivalent to the proposed operation and maintenance cost of 465 pesos/ha (62.8 US$/ha) at the maximum rate. The lower index would be derived from the relatively high Project cost.

31. Socio-economic Impact

From the viewpoint of national or provincial economy, the following indirect benefits would be expected from the Project, that is, 1) contribution to self-sufficiency of staple food, 2) increase in employment opportunity, 3) correction of income inequality, 4) relief in energy, 5) effect to improve the transportation networks, 6) increase in income during construction period and 7) benefit of inland fishery in the Nueva Era reservoir, etc.

B. CONCLUSION

1. The development programs of Ilocos Norte revolve around the low production of rice and upland crops, which has been aggravated by inadequate irrigation facilities, poor road networks and inadequate power conditions. To cope with these present situations, the Government has taken up the development strategy, that is, Ilocos Norte Integrated Development Project, specially putting emphasis on rural development so as to remove the income gap between the rural and urban levels.

2. Following the prudent study on the overall and Phase I Project which were carried out in 1978, the Phase II Project whose components are irrigation and hydropower generation has been revealed technically recommendable with the Project plan. With the Project, an area of about 19,640 ha will enjoy irrigation in addition to the power benefit, which will contribute not only to the acceleration of the regional development as well as enhancement of the people's living standard in the Area but also to the future socio-economic development of Ilocos Norte region and all over the country.

As a conclusion, the Project is technically feasible and economically viable.

3. The scope of the Project is as follows;

a) Area

1) Project Area

Cura area	:	1,410 ha
Nueva Era area (Left bank)	:	670
Madupayas area	:	160
Batac-Paoay area	:	5,190
Pinili area	:	1,400
Badoc-Sinait area	:	3,570
Total		12,400 ha

2) Service Area

	Wet Season (ha)	Dry Season (ha)
Phase II Area	12,400	12,400
Phase I Remaining Area	2,120	7,240
Total	14,520	19,640

b) Agricultural Aspects

1) Cropping Pattern and Cropping Areas

Phase II Area:

- Cura and Nueva Era area

Cropping Pattern			Service Area (ha)	Cropping Area (ha)
Wet Season		Dry Season		
Paddy	+	Paddy	1,870	3,740
Paddy	+	Upland crops	210	420
		Sub-total	2,080 (16.8%)	4,160

- Madupayas, Batac-Paoay, Pinili and Badoc-Sinait areas

Cropping Pattern			Service Area (ha)	Cropping Area (ha)
Wet Season		Dry Season		
Paddy	+	Paddy	3,100	6,200
Paddy	+	Garlic	2,065	4,130
Paddy	+	Garlic + Mungbean	2,065	6,195
Paddy	+	Tobacco	2,060	4,120
Paddy	+	Cotton	1,030	2,060
		Sub-total	10,320 (83.2%)	22,705
		Total	12,400 (100%)	26,865 (217%)

Phase I Remaining Area:

Cropping Pattern			Service Area (ha)	Cropping Area (ha)
Wet Season		Dry Season		
Paddy	+	Paddy	2,120	4,420
(Paddy)	+	Paddy	4,410	4,410
(Paddy)	+	Tobacco	210	210
(Paddy)	+	Garlic	250	250
(Paddy)	+	Onion	250	250
		Total	7,240 (71.0%)	9,360 (91.8%)

2) Agricultural Production

Crops	Yield (ton/ha)		Production (ton)		
	Phase II	Phase I	Phase II	Phase I	Total
Paddy					
Wet Season	4.2	3.7	52,080	8,090	60,170
Dry Season	4.5	4.2	22,370	27,420	49,790
Tobacco	1.7	1.3	3,620	270	3,870
Garlic	2.6	2.7	11,080	700	11,780
Mungbean	1.1	–	2,270	–	2,270
Cotton	2.5	–	2,580	–	2,580

c) Engineering Aspects

1) Major Dimensions of Facilities

Palsiguan dam

Catchment area	:	153 sq.km
Dam type	:	Earth and rockfill dam
Dam height	:	143.5 m
Total capacity	:	232 MCM
Embankment volume	:	9.1 x 10^6 cu.m
Spillway capacity	:	3,070 cu.m/sec
Diversion works		
Tunnel length	:	740 m
Discharge	:	950 cu.m/sec

Headrace

Length	:	6.150 m
Capacity	:	28.225 cu.m/sec (max.)

Tailrace

Length	:	2,950 m
Capacity	:	28.225 cu.m/sec (max.)

Nueva Era dam (afterbay)

Dam type	.	Concrete dam
Dam height	:	45.5 m
Storage capacity	:	4.99 MCM
Effective capacity	:	0.50 MCM

Hydropower plants

	Bonga Station	Nueva Era Station
Installed capacity	36,000 KW	6,800 KW
Annual energy production	159 7 GWh	39.5 GWh

Diversion dams

	Madupayas	Tibangran
Catchment area	24.3 sq.km	72.7 sq.km
High water discharge	320.0 cu.m/sec	950.0 cu.m/sec
Intake discharge	4.00 cu.m/sec	7.71 cu.m/sec
Intake water level	86.00 m	36.50 m
Dam height	3.00 m	2.50 m
Dam type	Floating type	Floating type

Irrigation and drainage canal

	Irrigation	Drainage
Link canal	96.0 m	–
Main canal	96.6	75.3 km
Lateral canal	240.2	47.8

Road

Service road (A)	(B = 6.0 m) :	191.4 km
Service road (B)	(B = 4.0 m) :	240.2

On-farm facilities

	Cura-Nueva Era area	Madupayas-Batac-Badoc area
Rotation area	30 ha	40 ha
Rotation unit	6 ha	8 ha
Land preparation period	25 days	35 days
Design discharge		
Irrigation	1.78 lit/sec/ha	1.64 lit/sec/ha
Drainage	8.72 lit/sec/ha	8.66 lit/sec/ha

2) Project Cost (excluding price escalation)

Foreign cost (F.C.)	₱ 1,557.6 million (US$210.5 million)
Local cost (L.C.)	₱ 892.3 million (US$120.6 million)
Total	₱ 2,449.9 million (US$331.1 million)

d) Project Benefit (Economic value)

	Irrigation	Hydropower
Without the Project	₱ 129.5 million	-
With the Project	₱ 374.0 million	₱ 110.1 million
Incremental Benefit	₱ 244.5 million (US$33.0 million)	₱ 110.1 million (US$14.9 million)

e) Economic Evaluation of the Project (IRR)

Irrigation	15%
Hydropower	12%
Average	14%

C. RECOMMENDATIONS

1. For the final design of the Project, the following additional surveys and investigations will be essentially required to obtain sufficient information before proceeding to the final design;

i) Topographic survey
ii) Hydrological observation
iii) Geological investigation
iv) Agricultural survey

Further detail descriptions on the above items are given in Appendix 5B-2.

2. Establishment of Joint NIA/NPC Technical Committee is recommended to be established for smooth implementation and operation of the Project covering all the related activities of the agencies concerned.

Furthermore, the Phase II development will be carried out in three provinces of Ilocos Norte, Ilocos Sur and Abra. It is, therefore, important to make various legal pre-arrangements at provincial level prior to the implementation of the project construction works.

3. The Phase II development aims to increase the agricultural production by means of the stabilized irrigation water supply to the area of 12,400 ha both for wet and dry seasons and to generate the hydropower by making use of the Palsiguan dam water. In addition to the benefit to be created from the above-mentioned sectors, further irrigation benefit can be expected from the Phase I area of 7,240 ha since the Palsiguan

dam water will be conveyed to the Phase I area where the irrigable area in dry seasons at present is estimated at only 20 percent of the total cultivation area.

Therefore, the target agricultural production in the Project will be obtained after the completion of the water resources development including the construction of Palsiguan dam. Taking into account such stage development, the early commencement of Phase II development for the area is emphatically recommended to attain the objects of the Project.

4. There is no road to approach to the proposed Palsiguan dam site in Abra province though vehicles are passable up to the village of Lagayan which is located about 15 km downstream of the dam site. Aparting from it, as for the access to the dam site from the side of Ilocos Norte province, the construction of a new national road is on the way by the MPH from Nueva Era, and nine kilometers portion of the road has been already constructed out of the total length of 29 km.

Under the situations, it is recommended that the construction of roads and related bridges should be completed before the commencement of the Project construction works for transportation of construction materials and equipment for the dam and headrace tunnel.

5. Since the Project facilities such as Palsiguan dam, headrace tunnel, Nueva Era dam, link canals and diversion dams will be constructed in the wide area, it would become difficult to operate functionally these facilities if manually done. For smooth operation and maintenance of facilities and to realize an effective water distribution in the Areas, an automatic water management and control system for the facilities should be introduced.

6. There are numerous intermediaries in the garlic marketing channel. Garlic farmers sell their product to middlemen at an unreasonable price because of their poor market information and lack of bargaining power of producers. In order to solve the problems, a cooperative of garlic producers should be organized. Furthermore, establishment of such Marketing Board for garlic is desired.

Mungbean farmers also suffer from an unreasonably marketing system as same as garlic farmers. A cooperative would be necessary to help small mungbean producers to sell mungbean at a favorable price.

To protect mungbean from weevils is a serious to producers. Government technicians should lead farmers on the proper procedures in storing mungbean.

7. Regarding the Phase II development, an alternative plan considering the staged development has been studied in the report as shown belows;

Stage I : to irrigate a part of the Project Area by means of Madupayas and Tibangran diversion dams as well as Nueva Era storage dam, taking into account an effective utilization of water resources in their own catchment area.

Stage II : to irrigate the whole Project Area of 22,600 ha including Phase I area by the stored water in the Palsiguan dam and each run-off discharge from the river basins, and also to generate hydropower by using an effective head between the Palsiguan reservoir and the Bonga river bed.

The Stage I project aims at supplying the irrigation water stably in the wet season, that is, no water is supplied in the dry season due to no river discharge available, except the stored water in the Nueva Era dam by the end of the wet season. The main purpose of the Nueva Era dam is to regulate the released water from Palsiguan dam for power generation. However, in the Stage I period, this dam will function as reservoir with an effective storage capacity of 4.60 MCM, out of total capacity of 4.99 MCM.

Through the ten year water balance studies (1960 - 1969), the area of 7,210 ha has been determined as the stage I irrigable area in the wet season under the return period of five-year, as shown below;

Irrigation Area in Stage I Period

(Unit: ha)

Sub-Project Area	Project Area	Irrigable Area	
		Wet Season	Dry Season
Cura	1,410	1,410[1/]	–
Nueva Era (Left Bank)	670	670	630[2/]
Madupayas	160	160	–
Batac-Paoay	5,190	0	–
Pinili	1,190	1,190	–
Piding	210	210	–
Badoc-Sinait	3,570	3,570	–
Total	12,400	7,210	630

Note: 1/ Cura area will be supplied with the diverted water from Labugaon diversion dam constructed in the Phase I Project

2/ Dry season irrigable area commanded by the stored water in the Nueva Era dam. This area will be used for upland crops in the Stage I period.

The major civil works in each stage are described as follows;

Stage I

- Nueva Era dam
- Madupayas and Tibangran diversion dams
- Link canal-2, -4 and a part of Link canal-3.
- Irrigation & drainage canals, roads and on-farm facilities for the area of 7,210 ha (Cura, Nueva Era (L.B.), Madupayas, Pinili, Badoc and Sinait).

Stage II

- Palsiguan dam
- Headrace and tailrace tunnels and hydropower facilities
- Main link canal, Link canal-1, and a part of Link canal-3.
- Irrigation & drainage canals, roads and on-farm facilities for the remaining area of 5,190 ha (Batac and Paoay).

Construction period of the Stage I is planned to take six years from June 1981 to May 1987, including one year for final design from June 1981 to May 1982, and the Stage II is planned to start its construction from January 1985, taking into account long constrcution period of the Palsiguan dam and tunnel, and will be completed by the end of 1990.

Following table indicates the result of the evaluation of the plan;

Item	Staged Development (Alternative Phase II)			Phase II Project Plan
	Stage I	Stage II	Overall	
Irrigation Area (ha)	7,120	15,390	22,600	22,600
Project Cost				
Total Cost (million pesos)1/	518.5	1,943.5	2,462.0	2,449.9
Cost per Hectare (pesos/ha)2/	–	–	68,720	60,130
Internal Rate of Return (%)3/	8	15	13	14

Note: 1/ Project cost estimated by the purchase basis of construction equipment and exclusive of price escalation.

2/ Exclusive of allocated hydropower cost

3/ The IRR in the stage development is evaluated on the basis of the incremental benefit created from agriculture and fishery.

As is seen in the above table, the project economy of the staged development plan is a little lower than that of the Phase II project plan, that is, the IRR of the

former is 13 percent against 14 percent of the latter. And also, Stage I development plan is not always feasible from the viewpoint of economy with low IRR of 8 percent. However, from the financial aspect of the project cost, the staged development plan is deemed to be much more recommendable for the project with a relatively low initial investment cost, about 520 million pesos in Stage I and about 1,940 million pesos in Stage II respectively, than the Phase II Project plan which will be developed in full scale implementation as a whole.

The detail studies of the staged development are attached in Appendix 7A-1.

CHAPTER I. INTRODUCTION

CHAPTER I. INTRODUCTION

In May 1977 the Government of the Philippines made a request to the Government of Japan for technical assistance to Palsiguan River Multipurpose Project, which is a part of Ilocos Norte Integrated Rural Development Project. In response to the request the Government of Japan dispatched a preliminary survey team to the Philippines. Based on the field survey conducted by the preliminary survey team, a series of discussions was made on the plan of approach on the Project between the two Governments. Finally, Ilocos Norte Irrigation Project has been selected, because of its promising plan, among others involved in the initial development plan. This Project aims at a large-scale development. Therefore, a relatively long period is required for various basic surveys inclusive of water source study before formulation of the final development plan. However, taking into account the strong desire of the Government of the Philippines and local people in the region for early implementation of the Project, the project development study was staged into two phases as follows;

i) Formulation of an overall project plan for the area of 22,600 ha based on the data and information available. At the same time, within the framework of the overall plan, feasibility study of a provisional water supply plan for about 10,200 ha on the right bank of the Bonga river.

ii) Feasibility study for Cura and Batac-Badoc areas covering a total benefit area of about 12,400 ha inclusive of the plan for Palsiguan dam and hydropower generation.

In compliance with the above strategy, the Team conducted, in the Phase I study, a feasibility study for the area of about 10,200 ha located on the right bank of the Bonga river and formulated an overall development plan for the whole area of about 22,600 ha from August to November 1978, and submitted the final feasibility study and draft overall development plans in May 1979. Furthermore, the Team carried out the Phase II study for the area of about 12,400 ha together with the Philippines Governmental staff from January to March 1980. This report covers results of the feasibility study for the area, and also incorporates all the discussions made between the Government of the Philippines and the Team.

Listed herein are the Advisory Group, Team members and Counterpart personnel of NIA assigned to the Project.

Advisory Group Assigned to the Project

1.	Chief Advisor (Mr. Tatsuo ASAHARA)	Director of Construction Dept., Agricultural Structural Improvement Bureau, Ministry of Agriculture, Forestry and Fishery (M.A.F.F.)
2.	Advisor (Irrigation) (Mr. Yasuo SUDA)	Deputy Director of Design Div., Construction Department, Agricultural Structural Improvement Bureau, M.A.F.F.
3.	Advisor (Dam) (Mr. Tadashi YOSHIMITSU)	Project Manager, Agricultural Water Utilization Office in Lower Tenryu River Basin, M.A.F.F.
4.	Advisor (Agronomy) (Mr. Toshihide SHIBATA)	Deputy Director of Planning Div., Planning Dept., Agricultural Structural Improvement Bureau, M.A.F.F.
5.	Advisor (Economy) (Mr. Masakazu ISHIGURO)	Assistant Manager, 2nd Div., Loan Dept. II, the Overseas Economic Cooperation Fund (OECF)

Mission Members Assigned to the Project

1.	Team Leader (Mr. Susumu TAKAMINE)	7 January –	27 March 1980
2.	Meteorology and Hydrology (Mr. Fumimichi OHBU)	7 January –	27 March 1980
3.	Hydrological Observation (Mr. Kiyoshi OGAWA)	20 August –	23 September 1979
4.	Soil (Mr. Hajime TAKAHASHI)	18 January –	17 March 1980
5.	Geology (Mr. Yukio YAMAGISHI)	20 August – 7 January –	23 September 1979 16 March 1980
6.	Irrigation (Mr. Seiji TAKEUCHI)	7 January –	27 March 1980
7.	Drainage and On-farm (Mr. Hiroshi KONDO)	7 January –	27 March 1980
8.	Dam (Mr. Tadao INABA)	7 January –	27 March 1980
9.	Canal and Diversion Dam (Mr. Tsutomu IWAMURA)	18 January –	27 March 1980
10.	Agronomy, Agricultural Supporting Services (Mr. Yasunori HASEGAWA)	7 January –	27 March 1980

11.	Electric Hydropower (Mr. Yuhya HIRASE)	18 January –	24 March 1980
12.	Agro-Economy (Mr. Shoji YAMADA)	18 March –	27 March 1980

Counterpart Personnel Assigned to the Project

1.	Mr. Jose B. del Rasario, Jr.	Director, Project Development Dept., NIA (Overall Coordinator)
2.	Mr. Isidro R. Digal	Head, Planning Section, PDD, NIA
3.	Mr. Erdolfo B. Domingo	Senior Planning Engineer, PDD, NIA, (Project Coordinator)
4.	Mr. Deoloses Suelen	Senior Agro-Economy PDD, NIA
5.	Mr. Alfonso V. Galapaon	Senior Agronomist, Land Use Section, PDD, NIA
6.	Mr. Wiliam L. Reodica	Senior Planning Engineer, PDD, NIA
7.	Mr. Jovito A. Navarro	Supervising Hydrographic Engineer, PDD, NIA
8.	Mr. Francisco A. Alhambra	Senior Drainage Engineer PDD, NIA
9.	Mr. Manuel U. Estefanio	Senior Design Engineer, PDD, NIA
10.	Mr. Orlando F. Gascon	Senior Electrical Engineer, PDD, NIA
11.	Mr. Orlando C. Villalon	Geologist, PDD, NIA
12.	Mr. Teofilo C. Anyaya	Senior Soil Technologist, PDD, NIA

CHAPTER II. ECONOMIC BACKGROUND

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A. National Economy

The Philippines has the national land area of about 300,000 sq.km, and population of about 42.50 million (as of 1975), from which the population density is estimated at 140 persons/sq.km. The population had increased at the rate of 2.9 percent annually between 1960 and 1969, but the annual growth rate has been reduced to 2.7 percent since 1970. An average family is composed of 6.1 persons, among whom persons 15 years of age and over can be counted as workable population. The estimated workable population in 1975 in the country was about 23.58 million, about 61 percent of which, 14.43 million were occupied persons. The sectoral ratios to the total occupied persons recorded in 1975 were 53.5 percent for agriculture and fisheries, 15.2 percent for industry, 31.0 percent for commerce and service and 0.3 percent for others, respectively. Comparison of this composition with that in 1960 revealed the tendency of decreasing in agricultural and fisheries sector, increasing in commerce and service and remaining uncharged in industry.

The Philippines has 12 administrative Regions, which are composed of many provinces. The gross national product (GNP) of the nation amounted to 77.28 billion pesos in 1977 on the 1972 price basis and reached 81.96 billion pesos in 1978 with the annual growth rate of 6.1 percent. The economic growth, however, has shown a slightly decreasing tendency as learnt from the comparison of GNP growth rate by 6.9 percent in 1975 - 1976 and 6.3 percent in 1976 - 1977. GNP per capita was increased by 3.1 percent for 1977 - 1978, exceeding the population growth rate in the same period. GNP per capita in 1978 was converted into ₱ 3,745 on the current price basis.

The prices of commodities in the country, although being stable up to 1978, has begun to show upward tendency since 1979, and the price hike of the petro-chemical goods in February, 1980, has resulted in instability of the prices of the general commodities. The price index for consumer goods has been increasing gradually on the national on the 1972 price basis by 9.6 percent in February, 1978, 8.4 percent in February, 1979 and 21.9 percent in February, 1980, respectively. The retail price index for the general items in Metro Manila has also been increasing annually by 3.8 percent in February, 1978, by 10.2 percent in February, 1979 and 26.3 percent in February, 1980, respectively, on the 1972 price basis. The price increasing rates of construction materials are recorded by 3.8 percent, 21.4 percent and 20.5 percent in the respective years as above, and those of fuel oil by 3.5 percent, 2.9 percent and 54.1 percent respectively. The indexes of the above two items have been marked considerably higher than those of the general items.

In the national economy in 1975, the revenue was 15.7 billion pesos, while the expenditure 17.0 billion pesos. Approximately 88 percent of the total revenue was earned in tax, and the major items of expenditure were those cost for economical developments of 49 percent, social developments of 17 percent, defense of 16 percent, etc.

Gross domestic product (GDP) in 1978 amounted to 82.09 billion pesos on the 1972 price basis, and the sectoral ratios were 26.4 percent for agriculture and fisheries, 24.4 percent for manufacturing industry, 7.3 percent for construction, 2.2 percent for mining, 0.9 percent for electricity/gas/water supply, 5.2 percent for transportation and communication, 20.8 percent for commerce, and 12.9 percent for services.

Comparison of annual GDP growth rates in 1975 - 1976 and 1977 - 1978 on the 1972 price basis suggests that declining tendency has appeared in construction sector from 28.1 percent to 6.8 percent and agriculture and fisheries from 8.0 percent to 4.8 percent, whereas upward tendency in manufacturing from 5.7 percent to 6.8 percent and services from 5.5 percent to 6.3 percent.

The major farm products of the Philippines are paddy rice, sugar cane, coconuts (including copra) and banana.

The study on these products in terms of shares by values added on the 1972 price basis reveals that the shares of sugar cane and coconuts have been decreasing whereas that of banana has been increasing. On the other hand, the share of paddy shows steady upward tendency by 28 percent in 1976 and 30 percent in 1978 to the total value added of these products.

The international trade of the Philippines is characterized by export of primary products and import of industrial manufactured goods, and the balance of payment is in deficit by over import every year. The turnovers in 1976 were 2.57 billion dollars in export and 3.63 billion dollars in import.

Sugar and copra have been decreasing in their export since these few years. Fuel oil occupies about 25 percent and machinery 17 percent of the total import amount. Of the total import in 1976, about 27 percent was occupied by Japanese origin goods, 22 percent by American origin, 17 percent by near-and mid-eastern countries origin, 12 percent by EC origin and 13 percent by ESCAP member countries origin, respectively.

The Philippines has recently accomplished its target of self-sufficiency in paddy, which has resulted in enabling the nation to export paddy by about 230,000 tons

annually since 1977. And it is reported that about 250,000 tons of exportable surplus will be secured from June, 1980 to March, 1981.

In compliance with the Presidential Decree issued on January 1, 1978, the Philippine Authorities concerned have established the development plans for the short range, the medium range and the long range, covering five years between 1978 and 1982, 10 years between 1978 and 1987 and the long term up to the year of 2000, respectively. All of these plans are consistent with the philosophy of development of pursue the New Society.

An old concept for the developments merely implied that the development was a movement toward economic growth represented by GNP and income per capita. The new development programs prepared under the Presidential Decree, however, aim at not only economic development but improvement of social welfare. Such an intention of the Government can be learnt from the fact that the projects planning involves pursuit of Social Justice as nucleus of the development.

One of the characteristic features of these plans is that agricultural development shall go together with industrial development with the same magnitude of stress placed on. A steady increase in agricultural productivity will allow farming labor to transfer to the industrial sector, and furthermore, an increase in farm income will raise the demands for the industrial products, giving impacts to manufacturing industries in their production promotion, as a result, as well as resulting in expansion of not only the domestic market but the international market.

The weights to be placed on the agricultural sector and the industrial sector will be identical in their levels by 1987. The industrial development is never realized at the expense of agricultural sector, but the incessant development of agriculture will maintain its vitally important role in the national development as supplier of foods and primary products, creator of effective demands and offer of additional labor opportunity.

The water resources development plans have a prospect that the irrigated paddy fields to be required for meeting the national food demand are 1.77 million hectares in 1977 and 1.92 million hectares in 1987, respectively. The irrigated field available, however, are short in acreage of 770 thousand hectares at present, and the 10-year development plan states that about 1.4 million hectares of paddy fields will have to be additionally turned into irrigable field by 1987. The irrigated paddy fields available in 1987 are expected to reach 2.17 million hectares, accordingly. The investment to be required for accomplishing the said irrigated field development program will

have to be made by 11.86 billion pesos from 1978 to 1982 and 12.74 billion pesos from 1983 to 1987, respectively. The sum of these two investments occupies about 50 percent of the total investment amount allotted for the water resources development plan, including water works, sewerage, flood control, etc.

The water resources development plan involves a power generation scheme. According to the Government's energy development program, the energy consumption was 83.4 MMB in oil equivalence in 1977, and the prospective value in 1987 will be 190 MMB in oil equivalence. In order to cope with the situation, the authorities concerned have made an energy supply plan that the oil-thermal powers generation, the share of which was about 94.3 percent in 1977, will be reduced to 68.1 percent in 1987 by substituting hydropower, coal-thermal and geo-thermal powers in increasing from 5.3 percent to 10.9 percent, 0.6 percent to 7.4 percent and 3.8 percent to 5.6 percent, respectively.

The major economic indices of the relevant 10-year development plan are shown as follows.

The annual growth rate of GNP and GNP per capita from 1977 to 1978 were 7.0 percent (1972 price basis) and 3.9 percent and those rate from 1982 to 1987 are set at 8.0 percent and 5.0 percent, respectively. When converted into current prices, GNP per capita in 1987 will be raised up to 10,580 pesos from 3.376 pesos in 1977.

The sectoral annual growth rates of the NDP (Net Domestic Production) in the period from 1978 to 1987 are expected to be 5.3 percent in agriculture and fisheries, 10.8 percent in industries, and 7.4 percent in services.

B. Regional Economy

The Ilocos Norte province is located in the northwestern part of the northern Luzon. The total land area of the province is 3,399.3 sq.km, equivalent to 1.1 percent of the total national land area. It takes about 1.5 hours by plane and about 11 hours by bus from Manila to Laoag, the Provincial capital.

Population of the Province was 371,724 persons in 1975, and its density per square kilometer was estimated at 109 persons. The population growth rate from 1970 to 1975 was marked by 1.6 percent, which is below the growth rate of 1.8 percent from 1960 to 1970.

The population growth rates in the related municipalities with project were found by increase from 1.2 percent to 1.8 percent in the Phase I Area and decrease from 2.4 percent to 1.3 percent in the Phase II Area.

The population of people in fifteen years of age and over in the Province was estimated at 226,772 persons, about 45 percent of which was occupied person. Furthermore, the population of these gainful occupations was specified into those engaged in the primary industry by 65.5 percent, the secondary industry by 10 percent and the tertiary industry by 24.5 percent, respectively. The mining and manufacturing industries include the industrial establishments of mining by 420 firms, manufacturing by 2,929 firms and electricity supply by 11 firms. Scarcity in number of electricity enterprises has resulted from inability to easily secure electric power in the most part of the Province. The Ilocos Norte Province is famous for its hand weaving cottage industry holding about 3,000 weavers who are working in mainly Paoay, Batac, Espirit, Solsona, Dingras, San Nicolas and Laoag. Other cottage industries comprise ceramic manufacturing, salt manufacturing, mat weaving, bamboo craft works, and processing of local alcholic drinks.

Non-industrial establishments include wholesaling by 3,540 firms, transportation by 1,001 firms and money lenders by 61 firms.

The Ilocos Norte provides a great deal of potential for mining development with plenty of resources such as copper, manganese, silver, cement, feldspar, iron, limestone, graphite, etc.

The Ilocos Norte province involves about 32,300 ha of arable lands, 2,700 ha of perenial crops growing fields and 4,100 ha of permanent grass lands. The arable lands included in the Project related municipalities occupy about 28 percent of the total provincial arable lands in the Phase I Area, and 26 percent in the Phase II Area.

The agricultural census conducted in 1977 revealed that the respective actual cropping acreages of paddy, tobacco, garlic and mungbeans in the Province are about 31,500 ha, 3,050 ha, 1,920 ha and 1,680 ha. And the shares of the respective cropping acreages in the Project Area (Phase I Area plus Phase II Area) of the above are 53 percent, 77 percent, 72 percent and 55 percent. In particular cropping acreages of tobacco and garlic in the Phase II Area occupy about 66 percent and 76 percent of those in the Province.

The paddy rice produced in the Province has been consumed locally, and the good harvest of paddy in 1979 allowed to export about 1,300 tons of rice in surplus.

Tobacco and garlic, being major cash crops in the Province, have contributed to the national economy as foreign exchange earners. The agricultural production in the Province, however, has been said not to meet with the provincial demand. The farm management survey has revealed that lowness in productivity and growing ratio of the dry season paddy as well as high land rents for the tenants have reduced the amount of disposable rice by farmers. The major cash gainers in the Phase II Area are tobacco and garlic. The originally small farm-size per farmer in Ilocos Norte has accelerated discharge of the labour to some extent. This will come from the fact of imbalance between human resources and land resources.

Of 3,399.3 sq.km of the total land area of the Province, the public forest land occupies 1,950 sq.km, and a reforestation plan is made for 562 sq.km of the above public forest land. The said reforestation plan covers 16 municipalities out of total 23 municipalities in the Province, and all of nine municipalities of the Phase I and II Area are involved. The reforestation plan, however, has not been smoothly promoted, resulting in insufficiency of water supply due to basin conservation.

Passengers cars, trucks, buses, jeeps, trailers, motorcycles and tricycles are the major means of transportation, but no railway services available at present. The Laoag airport is in the Laoag city and two flights a week are available in the route of Manila-Appari-Laoag-Basco.

The total extension of roads in the Province is about 2,657 km, which include 291 km of the national highway, 434 km of provincial roads and 1,932 km of community roads (municipality and village roads). The national highway is specified to concrete paved roads of 79 km, asphalt paved roads of 46 km and gravel paved roads of 166 km. In the province, navigation is not so popular means of transportation at those by land, and Crimao is only one port site available in the Province.

The major farm products in the Province are paddy, Virginian tobacco and garlic. The marketing of rice has been carried out by NGA and some rice merchants. The NGA has been handling about 12 percent of rice in the market in the Province, providing the warehouses in Laoag and Dingras. The former warehouse is used for controlling rice produced in the Phase II Area, while the latter in the Phase I Area. Furthermore, rice produced in the north of the Province will be controlled by the warehouse to be constructed in Bangui.

The so-called trading centers, which are located concentratively in the Phase II Area, are the facilities to handle Virginian tobacco produced in the Area.

Garlic has been marketed through very intricated channels. The public markets in Laoag, Batac, Pinili, Badoc and Sinait are the trading centers for collecting garlic. Tobacco and garlic are forwarded to Manila through national highways. Rice produced in the Area is supplied to the Region I, La Union and Baguio, which tends to suffer from shortage in rice, and any surplus rice, if produced, will be exported from the port of San Fernando.

The Region I has established a five-year Regional Development Investment Program (1981 - 1985) for seven provincies and five municipalities under its jurisdiction, and the authorities of the Ilocos Norte province has announced the Provincial Development Investment Plan as a component of the above regional program. This plan aims at accomplishing the following targets; i) to increase the labor opportunity, ii) to increase income and wealth with their reasonable distribution, iii) to expand infrastructures as well as to upgrade them, iv) to make social development and to promote the social justice and v) to keep ecological balance and to conserve the environment.

The planned investment for five years is 6.56 billion pesos for the Region I, and 550 million pesos will be invested to the Ilocos Norte province. The sectoral investments to the Province can be specified as 49.7 million pesos for crops production, 7.7 million pesos for fisheries, 11.6 million pesos for animal husbandry, 56.5 million pesos for forestry, 14.4 million pesos for soil and land conservation, 20.6 million pesos for industry, trading and tourism, 20.0 million pesos for social services, and 372.0 million pesos for infrastructures.

The investment for infrastructures occupies about 68 percent of the total investment, and 20 irrigation development projects are involved, comprising the Palsiguan River Multipurpose Project. The first priority is assigned to these 10 projects in the general planning.

Major figures mentioned in National and Regional economy are referred to in Appendix 2A-1 and 2B-1.

CHAPTER III. THE PROJECT AREA

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A. Location and General Features

1. Geographical Location and Road Systems

The Project Area is located in the north-west region of the Luzon Island, about 480 km far from Manila and 20 km to 35 km south to southeast of Laoag City, the capital of Ilocos Norte Province, and covers approximately 12,400 ha composed of respective municipalities of Solsona, Dingras, Batac, Paoay, Pinili, Badoc, Nueva Era and Sinait. The Project Area is bordered on the west by the South China Sea and on the east by the Cordillera Central Mountain and Ilocos Mountain Range.

The Project Area is divided into the sub-areas of Cura, Nueva Era (left bank), Madupayas, Batac-Paoay, Pinili and Badoc-Sinait areas. Cura area is located on the right bank of the Cura river. Nueva Era area is situated in the high land on the left bank of the Bonga river. Madupayas area is located in the upstream basin of the Badoc river. Batac-Paoay area is an alluvial plain facing the South China Sea, Pinili area is situated on the right bank of the Badoc river. Badoc Sinait area is an alluvial plain facing to the South China Sea.

Regarding road networks, national roads, Routes No.2 and No.3 which are mostly paved by concrete, run across the area. Cura area located on the right bank of the Cura river is accessible along Route No.2. A new concrete bridge is under construction across the Cura river by the Ministry of Public Highway (MPH). Route No.3 runs across the hearts of Batac-Paoay area and Badoc-Sinait area. Being connected to the national road by provincial roads, these areas are relatively convenient in transportation. In the Project area, village roads are partly available.

2. Population and Living Standard

a) Population

The Project Area is under jurisdiction of eight municipalities. The total population of these eight municipalities is about 150,000 persons as of 1975. About 49 percent of it, or 72,800 persons, lives within the Project Area. The number of households is about 13,800 in total of which about 10,600 are farm households. The population density of the Project Area is higher than that of the Phase I Area because of its convenience in transportation among municipalities.

b) Living standard

The number of villages in the Project Area is 106. These villages are mostly located along the coastal National Highway No.3, provincial roads and municipality roads branching off from the said national highway. Such road networks are effectively utilized by inhabitants to lead their life throughout the year, although transportation from and to Cura sometimes suffers from floodings of the Cura and the Bonga rivers in wet seasons.

Batac is the second busiest city in the Project area and its neighborhood in wholesaling business to Laoag City. About 30 percent of the handcraft business and cottage industry of Ilocos Norte province is distributed in Badoc, Batac, Paoay and Pinili. In particular Paoay gathers about 23 percent of these small enterprises in the Province.

The Project Area is the major producer of garlic and Virginian tobacco in the country, and the central part of each municipality becomes busy with farmers and merchants to trade these crops in the highest time of harvesting.

Every municipality has been provided with its own Rural Health Units to render medical to farmers.

Elementary education has been considerably diffused through a well established organization. A college is located in Batac, and elementary and secondary schools in every municipality.

B. Physical Conditions

1. Topography

Topographic features of the Project Area can be described as follows;

Cura Area

The predominant topographic features of Cura area are an alluvial plain with riverwash along the Cura and Bagbag rivers. Its relief is very flat and has an incline of 1:200 on an average. The topographic features of this sub-project area are very similar to those of the western area of Solsona in the Phase I area.

Madupayas Area

This sub-project area is located on the upstream reaches of the Madupayas river, and its major topographic features are an alluvial plain with riverwash. Its relief is very flat. The mountains bound this service area.

Batac-Paoay Area

This service area consists of the three topographic units; i) alluvial plain ii) sand dune land and iii) hill and terrace. The alluvial plain is well developed in the vicinity of Batac and Paoay towns. This alluvial plain has been mainly formed by silting of alluvial sediments in the back marsh of dune land. The river and creek meander on this alluvial plain. Most remarkable dune land extends in parallel with the sea shore line. This dune land is characterized by undulating to rolling topography, and its highest part is 50 meters above sea level. The greater portion of this dune land is unstabilized because of sand movement. The other small dune lands are developed in the alluvial plain. Paoay town is located on this inner small dune land. The hill and terrace border the sub-area. Their height is 10 to 70 meters above the sea level.

Pinili Area

This sub-project area is situated on the right bank of the Badoc river, and topographically consists of an alluvial plain, hill and small dune lands. The relief of alluvial plain is very flat in the downstream area, but in the upstream area it gently undulates.

Badoc-Sinait Area

This service area is composed of two topographic units. One is a hilly undulating and rolling upland, and the other is an alluvial plain. Dune land is developed in the downstream of the Badoc river. Riverwash is located along the Badoc river and its tributary.

2. Climate and Hydrology

a) Climate

According to Coronas, climatic classification of the Philippines is made on the basis of the rainfall characteristics, taking into consideration that temperature differences in the Philippine Archipelago are very small while rainfall variations are large.

The monthly distribution of rainfall is divided into four types of which two are altogether opposite types and the other two are intermediates.

Type I has two pronounced seasons, i.e., dry one from November to April, and wet one during the rest of the year. All the regions of the western Luzon including the Project Area, Mindoro, Negros and Palawan have this type of climate.

Type II has no dry season and is characterized by a clearly pronounced maximum rain period from November to January. Catanduanes, Sorsogon, eastern Albay, eastern and northern Camarines Norte and Camarines Sur, a great portion of eastern Quezon, Samar, eastern Leyte, and a large portion of eastern Mindanao have this type of climate.

Type III has not clearly pronounced seasons i.e., relatively dry season from November to April and wet season during the rest of the year. The maximum rain periods are not clearly pronounced, with short dry seasons lasting only from one to three months. The western Cagayan (Luzon), Isabela, Nueva Vizcaya, eastern Mountain Province, southern Quezon, Masbate Romblon, northeastern Panay, eastern Negros, central and southern Cebu, part of northern Mindanao and most of eastern Palawan.

Type IV has a more or less evenly distributed rainfall throughout the year. The Batanes province, northern Luzon, southwestern Camarines Norte, western Camarines Sur and Albay, Bondoc Peninsula, eastern Mindoro, Marinduque, western Leyte, northern Cebu, Bohol and most of central, eastern and southern Mindanao.

The above climatic types are illustrated in Figure 3B-1, Appendix 3B-1.

b) Climatic Conditions in the Project Area

Rainfall

Rainfall records observed at Laoag station during the period of 1949 to 1979 present that annual rainfall ranges from 3,245 mm in 1961 to 1,163 mm in 1976 with the mean value of 2,016 mm, of which 96 percent concentrates in wet season from May to October (see Table 3B-1, Appendix 3B-2).

Temperature and Relative Humidity

Mean annual temperature during the period of 31 years, 1949 - 1979, is 27.0°C and January is the coolest at 24.4°C and May is the warmest at 29.2°C; hence, the annual range of temperature is small.

Mean annual relative humidity during the said period is 76% and the middle of dry season from March to April has the mean lowest value at 71%. The mean highest value is obtained at 86% in August (see Table 3B-2 and Table 3B-3, Appendix 3B-2).

Wind

The wind direction over the area tends to be north or north-easterly in October to February. With the coming of wet seasons, winds blow from north-west. In the wet season, specially in June to September, the area is affected by south-east monsoon. The maximum wind speed extending over the year ranges from 27 to 145 kilometers per hour.

In general, April and May are the calmest period of the year and wind speed variations are not frequently observed in dry seasons (see Table 3B-4 and Table 3B-5, Appendix 3B-2).

Evaporation

Long-term observation has not been made within the Project Area, thus, evaporation is estimated on the basis of data computed by Penman Method, using climatic factors recorded at Vigan station and monthly mean ratio of observed open-pan evaporation at Vigan and Laoag.

Mean annual evaporation is obtained at 2,292 mm and seasonal variation of mean monthly evaporation ranges from 168 mm in July to 214 mm in October (see Table 3B-6 to Table 3B-8, Appendix 3B-2).

Typhoons

Typhoon frequencies are rather latitudinal in type whereas climatic types prevailing in the Archipelago are distributed mainly longitudinally. As shown in Figure 3B-2, Appendix 3B-2 the northern parts of the Archipelago up to Formosa are most visited by typhoons. The Project Area is located in the northern Luzon island which typhoons visit frequently in June to October. According to the data, about 50 major storms passed through the region from 1968 to 1975.

c) Available Data

Hydro-meteorological observations relating to the Project have been made under the control of NIA, MPW and PAGASA. Main observation stations in which equipments provided by JICA are listed in Table 3B-9 and Figure 3B-3, Appendix 3B-2.

Concerning rainfall, eight stations are provided for the Project. A long-term observations have been made at Laoag, Bonga and Alaban stations; however, continuously observed records are only obtained at Laoag station. Therefore, computation of irrigation water requirements taking into account effective rainfall, drainage modulus and flood analysis in the Project Area has been made based on records at this station.

In the Palsiguan river basin, the major water resources for the Phase II project, rainfall observations have been made since September 1978, and approximately one year records with good accuracy are in hand.

Due to the lack of a long-term record of open-pan evaporation, adjusted total evaporation is estimated in the Penman method.

Stream flow gauging stations have been newly installed in the vicinicy of proposed structure sites under the control of NIA and observations have been continued since 1978. At those stations, discharge measurements were executed only at the time of low river stage due to the lack of cable ways; hence, river-stage discharge relations were not given. To solve such problems, cable wasy were installed by NIA for Palsiguan and Tibangran stations in accordance with recommendations made by the JICA Mission in January 1979.

At Palsiguan station, discharge measurements during the high river stage up to 1.7 m gauge height, which is equivalent to 62 cu.m/sec, were made. At present, within the limit of such gauge height fairly accurate rating curve has been obtained. However, further measurements specially under the higher river stage are required in order to estimate the more accurate inflow to the Palsiguan reservoir.

Available records for estimation of river run-off and flood analysis are those from Solsona, Bangay and Poblacion stations in the Laoag river basin.

Observations at Solsona station under MPW have been made since April 1946. Obtained data regarding annual run-off in some years during the period of 1946 to 1959 have a tendency to present excessive values in comparison with its catchment area.

On the contrary, run-off since 1971 indicates too low values due to insufficiency of discharge measurements and rating curve.

In consideration of the above mentioned conditions, available data for Project studies such as computation of water balance are limited to the end of 1959 to 1970. Regarding run-off estimation of the Palsiguan river, specific discharge obtained from run-off of the Tineg River at the Pang-ot station is primarily applied, judging from the observed run-off of the Palsiguan river during 1979.

Data available for Project studies, however, are limited for May 1959 to 1970 due to the same tendency as appeared in the Solsona river.

d) Water Resources for the Phase II Area

Water resources to be developed for the irrigation water supply to the Phase II area depend upon run-off of the Tibangran and Madupayas rivers in Ilocos Norte province and the Palsiguan river in the Abra province.

At present, irrigation water is taken from small streams, creeks and rivers in the wet season through primitive intake structures under the communal irrigation system. During the dry season, such surface water exceedingly decreases, in consequence, irrigation is mostly made by small movable pump to lift groundwater. It is, however, insufficient to cover the whole irrigation area proposed in Phase II Project.

In the proposed irrigation plan, the surface water utilization is taken up as a main subject from the economic point of view.

The amount of water resources in the Tibangran and Madupayas rivers for 1960 to 1969 water years have been estimated on the basis of correlation between recently observed discharge and the Solsona river discharge. On the other hand, estimation of the Palsiguan river run-off is basically made depending upon observed discharge at the Pang-ot station installed in the Tineg river which is adjacent to the Palsiguan river.

The Tineg river discharge was continuously observed from May, 1959, however, date available for the studies are limited for 10 water years from 1960 to 1969 due to the same tendency appeared in the Solsona river (refer to Phase I Main Report).

Annual river run-off of the above three rivers including run-off of the Madupayas river at the existing weir, Piding amounts to 535 MCM which is abundant to meet the water demand including water shortage in Phase I area. However, 80 percent of it is concentrated in the wet season and this fact reveals that crop cultivation in the dry season is so limited unless the reservoir is provided.

To store surplus water in the wet season and to supply this stored water to the areas suffering from water shortage have a great effect on agricultural development in the area, in addition to the reduction of flood damages.

The river run-off at the proposed Palsiguan dam site was computed mainly on the basis of the Tineg river run-off in order to estimate the availability of water resources. At present, river run-off at Palsiguan station located at about 10 km downstream of the site is under observations. Available records during the short period of 1979 show that annual run-off of the Palsiguan river amounts to 327 MCM which is equivalent to 2,014 mm of run-off depth.

The following table shows the potential water resources to be developed for the irrigation and hydropower generation under the Ilocos Norte Irrigation Project.

Water Resources for the Project

(Unit: MCM)

Year	Phase I[1/]	Phase II[2/]	Total
1960	733	480	1,213
1961	1,104	615	1,719
1962	1,221	614	1,835
1963	994	505	1,499
1964	1,573	725	2,298
1965	1,017	467	1,484
1966	967	413	1,380
1967	1,417	570	1,986
1968	932	525	1,456
1969	751	512	1,263
1970	637	465	1,102
Mean	1,031	535	1,566

Note: 1/ Labugaon, Solson, Madongan, Papa and Bonga (Nueva Era) rivers (refer to Table 3B-10 to Table 3B-14, Appendix 3B-2)

2/ Madupayas, Tibangran and Palsiguan rivers (refer to Table 3B-15 to Table 3B-18, Appendix 3B-2)

e) Flood Analysis

The basic data subjected to probable flood analysis have been collected on the maximum flood peak during each year of records at three stations in the Laoag river basin, i.e., Manalpac of the Solsona, Bangay of the Bonga and Pablacion of the Laoag and at two stations in the Abra river basin, Pang-ot of the Tineg and Bumagcat of the Abra.

Observed data obtained at the recently installed station, i.e. Madupayas, Tibangran, Palsiguan are not available due to the short recording period.

Flood frequency analysis on each river mentioned in the above is made by plotting peak discharge on the logarithmic probability paper, applying Hazen Formula and and the result is shown as follows;

Probable Flood Discharge in Each River[4/]

i) Laoag River Basin

Return Period	Solsona (73 sq.km)[1/] Q[2/]	q[3/]	Bonga (534 sq.km) Q	q	Laoag (1,355 sq.km) Q	q
5	295	4.0	1,700	3.2	8,600	6.3
10	450	6.2	2,500	4.7	10,500	7.7
50	940	12.9	5,000	9.4	15,000	11.1
100	1,220	16.7	6,400	12.0	17,000	12.5

ii) Abra River Basin

Return Period	Tineg (1,024 sq.km) Q	q	Abra (2,575 sq.km) Q	q
5	1,900	1.9	3,900	1.5
10	2,400	2.3	4,500	1.7
50	3,500	3.4	5,600	2.2
100	4,100	4.0	6,000	2.3

Note: 1/ Figure in bracket shows the catchment area of the observed station.
2/ Flood discharges, in cu.m/sec
3/ Specific discharge, in cu.m/sec/sq.km
4/ Refer to Figure 3B-5, Appendix 3B-2.

As shown in the above table, the two rivers have a considerably different specific discharge each other in the same return period, i.e. values in the Abra river basin become lower than those in the Laoag river basin.

For estimation of the design flood discharge for the proposed Palsiguan dam to be constructed in the Abra river basin, direct application of specific discharge obtained in the Abra river basin is not suitable and conservative, taking into consideration the scale of the catchment area. Generally, specific discharge has a tendency to decrease in accordance with the increase of the catchment area. The catchment area at Palsiguan dam site is too small at 153 sq.km, comparing with those of rivers except the Solsona as listed in the table. Therefore, design flood discharge for Palsiguan dam is favorable to be estimated on the basis of the specific discharge obtained from the Solsona river, in addition, considering the comparatively poor vegetation of the catchment area and frequent occurrence of concentrated heavy rainfall brought by typhoons.

Concerning the other proposed structures such as Nueva Era dam, Madupayas and Tibangran diversion dams, the hydrologic characteristics of those basins are quitely similar to those of the Solsona. Therefore, specific discharge obtained from the Solsona is directly used for the estimation of the design flood discharge.

The applied return period, allowance and selected design flood discharge for each structure is shown as follows:

Structure	Design Flood Discharge			
	Catchment Area (sq.km)	Return Period (years)	Allowance (%)	Design Flood Discharge (cu.m/sec)
Madupayas Diversion Dam	24.3	50	0	320
Tibangran Diversion Dam	72.7	50	0	950
Nueva Era Dam (Concrete dam)	52.4	100	10	970
Palsiguan Dam	153.0	100	20	3,070 1/
(Earth and Rockfill dam)		10	0	950 2/

Note: 1/ Spillway design flood discharge
2/ Diversion tunnel design flood discharge

The above values premise the following consideration.

- o Out of the design flood discharges applied for the proposed and existing dams prevailing in Luzon Island, the design flood discharge of Palsiguan dam is plotted near the upper limiting line. (refer to Figure 3B-6, Appendix 3B-2)
- o Judging from deficiency of observed data at the proposed site, 20 percent allowance is favorable to be taken.
- o Spillway design discharge for existing large scaled dams in the Philippines is determined on the basis of flood operation studies by application of the design hydrograph and assumed width of spillway. However, in the Palsiguan dam, inflow peak discharge, Q = 3,070 cu.m/sec is directly applied to spillway design discharge under the following reasons.
  - Reservoir surface area is too small at 5 sq.km, comparing with the catchment area of 153 sq.km, i.e., remarkable effect of storage will not be expected.

- In the spillway structures with gates, accidents such as over-topping of flood may happen if the gate operation will not be made carefully after construction of a dam. Palsiguan dam only supplies water for irrigation and hydropower generation and has no function of flood control. Therefore, such flood operation is not necessary.

f) Sediment

No observation has been made on the amount of sediment material brought by the Palsiguan river. Therefore, sediment amount to Palsiguan reservoir is estimated at 1,500 cu.m/sq.km per year on the basis of the existing data measured at Pampanga, Agno and Cagayan river basins and the value being employed by NIA (refer to "Palsiguan River Multi-Purpose Project" Report p.42). This value is also applied for the Nueva Era Dam.

The estimated amount for both structures is as follows:

Structures	Life Time (years)	Sediment Amount (MCM)
Palsiguan Dam	100	23.3
Nueva Era Dam	50	3.9

3. Geology and Soils

a) Geology

The Project Area is geologically underlain by the precious-age-undetermined volcanic products such as dacite and basalt, etc. with the Neogene diorite intruding into the above-mentioned volcanic products. The base is overlain by the Oligocene to Pliocene marine deposits, post-Quarternary alluvial deposits and river and littoral deposits. Andesite rock, which forms the base of the Project Area, is one of the main components of the Cordillera Central Mountains in the Northern Luzon, and is widely distributed in the eastern part of the Project Area.

Proposed sites for the major civil engineering structures such as Palsiguan dam, the pressure headrace tunnel and Nueva Era dam, etc., are underlain by this body.

Diorite is also one of the main components of the Cordillera Central Mountains in the Northern Luzon, and is widely distributed in the upper storage area of the proposed Palsiguan dam. Some diorite has the lithoface of granodiorite.

The Phase I Project Area is located in the composite alluvial fan formed by rivers coming from the Ilocos mountains. Hills having a summit level of about 370 m above mean sea level stand in the direction of the NNE in the western portion of this alluvial fan. The hills are composed of marine deposits such as the Tertiary Miocene to Pliocene shale, sandstone and conglomerate.

Batoc-Sinait area and Batac-Paoay-Pinili which occupy the major part of the Phase II Project Area are situated in the alluvial lowlying area where the above-mentioned hills have been dissected by the Lawa river system and the Badoc river. The littoral portions adjacent to the Project Area suffer from intrusion of sand dune. Such portions have been excluded from the Phase II Project Area.

All of the data of geological investigations conducted at the proposed construction sites of major facilities such as Palsiguan dam, Nueva Era dam and diversion dams, are attached in Appendix 3B-3 and 3B-4.

b) Groundwater

Farmers have dug shallow wells with their owned hand auger, and lifted groundwater for irrigation although such groundwater irrigation is small in scale. Groundwater is lifted from acquifers laid in the alluvial layer. The acquifers are mainly composed of sand and silt as the geological column numbered C-79 indicates (see Figure 3B-45, Appendix 3B-4).

The groundwater survey was conducted from January 26 to 31, 1980. The isohyet map was prepared based on this groundwater survey, and is shown in Figure 3B-46 to 3B-47, Appendix 3B-4. Judging from this isohyet map, the major water sources recharging groundwater in Batac-Paoay area is presumably the Quiaot river, a tributary of the Lawa river.

In Batac-Badoc area there is no distinct groundwater-recharging sources worth mentioning. The groundwater in this area seems to be recharged in the whole mountainous areas surrounding this area.

As a part of the groundwater survey conducted by NIA, groundwater tables of existing wells were observed (see Figure 3B-48, Appendix 3B-4). As a result, it has been found out that a difference of groundwater table in dry and wet seasons is three to four meters in Batac-Paoay area whereas the difference ranges in six to ten meters in Badoc-Pilini area. The recovery of groundwater is relatively large in Batac-Paoay area in comparison with that in Badoc-Pilini area, however, the specific yield of existing wells in the area is extremely small as shown below;

Results of Groundwater Recovery

Well No.	Place	Depth (m)	Initial W.L. (m)	Lifting W.L. (m)	Lifting W.V. (ℓ/min)	Specific Yield (cu.m/m/day)
3	Baan, Batac	28.1	4.3	6.1	30.4	24.0
6	Sanlulian, Batac	91.5	4.6	38.1	266.0	11.0
7	Gen Hospital, Batac	71.7	4.0	6.1	19.0	13.0
13(C-79)	Paoay	152.5	3.0	88.2	88.2	1.4
15	Hagbacsha, Paoay	24.1	13.7	14.0	38.0	180.0
16	Tablang, Batac	36.6	4.6	7.9	950.0	415.0
21-67-1	Binagan, Batac	108.3	3.1	47.3	266.0	9.0

Under the situations, the Project Area has a too small potentiality in groundwater exploitation to formulate a large scaled and systematized groundwater irrigation plan.

b) *Soils*

Soils in the Project Area were classified into four main groups based on landslope and physiographical conditions, namely: i) soils of the alluvial plain which constitutes the lowland, ii) soils of the upland which comprises the rolling and hilly areas, iii) soils of the dune land and iv) soils of the riverwash.

Soils of the alluvial plain are mainly formed by alluvial sediments. Their colour is pale brown to dark gray while their textures vary from sandy loam to fine clayey. The solum thickness is 60 cm to more than 150 cm and the internal drainage changes depending on soil textures. Cation exchange capacity and exchangeable cation content are generally high except soils of Cura Area. The soil reaction (pH-H_2O) in Cura and Nueva Era (left bank) areas ranges from 5.3 to 6.5. On the other hand, that of soils in Batac-Paoay, Pinili and Badoc-Sinait areas ranges from 7.1 to 8.0. This fact suggests that soils in the latter are influenced by the geology with limestone in adjacent hills. Available phosphate content is generally low in the most of the Project Area. Under the application of phosphate, the alluvial soils in the Project Area are considered to be highly suitable for both paddy rice and diversified crop productions.

According to the soil survey and investigation by BS, NIA and JICA team, the four soil series have been identified, namely, San Manuel, Maligaya, San Fernando and Bantog series.

The second soil group constitutes the upland soils. Cervantes series developed in Nueva Era (left bank) area is the residual red soils. The distinguished characteristics of these soils is their very friable A and B horizons and reddish colour. Bantay series mapped on the hills in Batac-Paoay, Pinili and Badoc-Sinait areas is the brownish residual soils developed from weathered shale. Their textures are fine loamy to clayey, friable and well drained soils. Most of the areas composed of these upland soils are covered with grass, brush and secondary forest. Only a small portion is cultivated with paddy rice, corn, tobacco and vegetables.

Soils of the dune land are composed of clean sand or loamy sand. Most of this land is at present under barren strip, grass growth, scattered trees and non-irrigated farm. Paddy rice field is situated on a relatively lowlying area in the land. However, its productivity is very low. The fertility and structure of the surface soils can be improved by the addition of organic matters such as compost. The irrigation water supply is also indispensable.

Soils of the riverwash are the sediments formed by big floods. They are mainly developed along the Cura river, Badoc river and their tributaries. The lands consist of clean sand and gravels. There is no soil profile development, and they are used at present for barren strip, grass growth, brush and scattered trees.

The gross Project Area of 21,900 ha was classified into the following major land categories, namely, about 12,400 ha of arable land and about 9,500 ha of non-arable land, from the result of soil and land classification survey (see Table 3B-30, Appendix 3B-5).

Following table shows the summary of land classification.

Land Classification in the Project Area

Land class			Area (ha)
1.	Arable Land[1/]		
	(a) Diversified Crop Land		–
	(b) Rice Land	1R	3,480
		2R	860
		3R	330
	Sub-total		4,670

(c)	Dual Class Land	1R (2)	6,440
		2R (2)	1,210
		3R (3)	80
	Sub-total		7,730
	Total		12,400
2.	Non-Arable Lands[2/]		9,500
	Total		21,900

Note: 1/ Exclude present and future rights-of-way which is estimated at about 7.5 percent of arable lands "with Project"

2/ Include river, riverwash, dune land, hill, steep slopes, public road and residential areas.

As seen in the above figures, 12,400 ha of arable lands were categorized into two groups of arable lands from their crop suitability by the soil, topography, drainage and other physical factors: namely, 4,670 ha of land (38 percent of total arable lands) are suitable for rice land and 7,730 ha (62 percent of total arable lands) suitable for both paddy rice and diversified crops. The whole arable lands belonging to these lands are classified into the first and second class lands.

As mentioned above, soils in the Project Area are considered to have the potentiality of high yield of both paddy rice and diversified crops in the most of the area. The betterment of cultivation practices with adequate application of fertilizers and organic matters for soil amendment and construction of irrigation and drainage facilities up to on-farm level will develop the potentialities in the whole arable lands.

The detailed resultants of soil classification, land use and land classification studies based on the survey are shown in Appendix 3B-5.

C. Irrigation, Drainage and On-farm Conditions

1. Irrigation Conditions

a) Irrigation Area

In the present cultivated land of about 12,830 ha, there exist about 4,250 ha of irrigated areas served by 105 communal irrigation systems (CIS). Water source for these irrigation areas is river and creek waters. The irrigable areas during the wet season are about 4,250 ha, but those during the dry season are only about 680 by river water and about 1,850 ha by pumping water.

Following table indicates the irrigation area under communal irrigation system in each sub-project area as of 1980.

Irrigation Area in the Project

Sub-Project Area	No. of CIS	Area Covered (ha)	Wet Season Rice[1/] (ha)	Dry Season Rice[1/] (ha)	Dry Season Others[2/] (ha)	Total (ha)
Cure	8	447	447	128		128
Nueva Era (L.B.)	3	3	3	1		1
Madupayas	3	53	53	10		10
Batac-Paoay	43	1,439	1,439	282	767	1,049
Pinili	5	411	411	76	332	408
Badoc-Sinait	43	1,899	1,899	185	755	940
Total	105	4,252	4,252	682	1,854	2,536

Note: Source: Ilocos Norte Integrated Development Project Office.

1/ Irrigated by communal irrigation systems

2/ Such other crops as tobaccos, garlic and corn mostly irrigated by portable pumps.

b) Irrigation Conditions

Even in the communal irrigation areas mentioned above, no systematic water distribution systems have been provided to convey water to the terminal area, and so-called continuous flooding irrigation has been practiced in paddy fields for both the wet and dry season cultivations.

On the other hand, in the Project Area, the paddy fields of 8,580 ha are rainfed throughout the year (rainfed paddy field), resulting in low production of crops. And also, the area of 6,480 ha, equivalent to 61 percent of total area has been used for upland cultivation in the dry season by means of pumping water, of which water source is groundwater. These pumping irrigation, however, is small in scale, being owned by each farmer. Its covering area by pump is one to two hectares with low rechargeability of groundwater, as noted previously.

Under the circumstances, the development of water source as well as the provision of systemized irrigation systems inclusive of those of on-farm level, which will be carried out by upgrading the existing communal irrigation system to NIA standard, are prerequisite to materialize the double cropping of high yield variety rices and upland crops under the Project.

c) Existing Communal Irrigation Areas in the Palsiguan River Basin

There exists three communal irrigation systems of 323 ha in total on the downstream of proposed Palsiguan dam site, that is, Lagayan CIS (255 ha), Calambat CIS (29 ha) and Collago CIS (39 ha). Water sources for these areas are the Palsiguan river, so that the water to be stored in the dam in the Project should be released in order to guarantee the vested irrigation water right for these areas.

2. Drainage Conditions

a) Drainage System

Batac-Badoc area is situated in a lowlying alluvial plain ranging from 50 m to 5 m in elevation. Its average slope is about 1/370. A large number of communal irrigation systems are in the area. In the area, the communal irrigation canals and creeks are used for drainage purposes. The canals and creeks are connected to the neighboring rivers such as the Lawa and the Badoc. On the other hand, Cura, Nueva Era, and Madupayas areas have a slightly steep slope of about 1/70 to 1/240 on an average with an elevation of 20 m to 100 m, so surplus water in fields caused by the heavy rainfall are directly drained to the rivers and creeks through plot to plot in the fields.

In the both areas mentioned above, there exists no drainage canals at on-farm level.

b) Drainage Conditions

There are no severe damages caused by ill-drainage in Cura, Nueva Era and Madupayas areas due to characteristics of alluvial fan mentioned above. However, in Paoay area on the lower reaches, habitual flooding is observed during the wet season. Inundation of flooding water, of which flooding period is one to two days and an average flooding depth is 1.5 m on fields, is recorded in 1976.

The principal causes of the problem are the lack of adequate drainage ways to collect and transport the discharge across the land to the outlets, and also adequate terminal drainage systems. Furthermore, channel overflow of the river which encloses or traverses the areas is observed. The reasons of the overflow are as follows;

i) insufficient cross-section of the rivers with no provisions of protection dike,

ii) meandering of the river course with gentle slope of water surface, and

iii) reverse flow into low-land areas through outlets of existing drainage canals which has no provision of adequate facilities due to rise of river water surface caused by the estuary closing.

Under these situations, it is considered that adequate countermeasures to prevent from flooding to the areas and to improve the drainage conditions should be taken in the project.

3. On-Farm Conditions

a) Terminal Facility Conditions

1) Irrigation and Drainage Canals

At present, irrigation and drainage are served by the communal irrigation canals. In a part of the Project Area, the irrigation is performed by the private owned pumps with capacity of 2 - 4 HP for the shallow well in dry seasons.

Irrigation through communal irrigation canals is mainly for the paddy field in wet season, and its method is plot-to-plot irrigation whose water diverted from the canal flows from the high plot to the low plot. The excess water of irrigation finally reaches the other communal irrigation canals or the drainage canals. According to the pump irrigation during the dry season, the watering is performed directly to the root of crop and this method does not born the excess irrigation water, consequently, drainage canal is not necessary.

Therefore, in the Project Area, there is terminal irrigation canals, but no drainage canals at on-farm level.

2) Farm Roads

There is few systematic terminal farm roads in the Project Area. The reasons are supposed that the irrigation is the plot-to-plot method and farming practices and transportations of agricultural inputs and outputs are mostly made by manpower or carabao.

b) Size and Shape of Farm Fields

Size of existing farm plots ranges from 100 sq.m to 3,000 sq.m and their shapes are very plemorphic by the topographic conditions and land ownership.

Under the conditions mentioned above, the project will require the following, in order to realize the rationalized water management up to the on-farm level and also the systematic mechanized agriculture in the project.

- o Construction of irrigation facilities such as intake and canals;
- o Construction of drainage canals and facilities required;
- o On-farm development inclusive of construction of terminal facilities; and
- o Construction of roads.

D. Present Agriculture

1. Present Land Use

The Project Area includes the farm land of about 12,830 ha, equivalent to almost 58 percent of the total gross area of 21,900 ha, and the rest of about 9,100 ha is occupied by residential lots, roads, canals, swamps, forest and waste lands (see Table 3-1).

All of the farm land is used as paddy fields, 33 percent (4,250 ha) of which is commanded by communal irrigation systems, but most of these fields can be irrigated only in the wet season, since the dry season irrigation cannot be secured due to drying up of the water sources. The irrigated area by communal irrigation systems in the dry season is estimated at 680 ha, which are equivalent to the acreage of the fields cropped with dry season paddy. The rainfed paddy fields account about 8,580 ha, occupying 67 percent of the total acreage of the paddy fields.

The area of about 6,480 ha, accounting for 61 percent of the farm lands except for sub-project areas of Cura and Nueva Era, has been grown with upland crops in the dry season by groundwater irrigation after harvesting wet season paddy. The rest of about 39 percent of the paddy fields in the area is mostly left fallowed in the dry season, although only partly cropped with the dry season paddy.

The said groundwater irrigation, however, has several problems as follows;

i) The irrigable areas by groundwater is very limited to the extent that aquifers can cover, and yet the suppliable water is liable to be short in its amount.

ii) A considerably large amount of operation and maintenance cost of the groundwater irrigation system has been a heavy burden of the farmers in their farm management, and the said cost is estimated at 750 pesos per hectare.

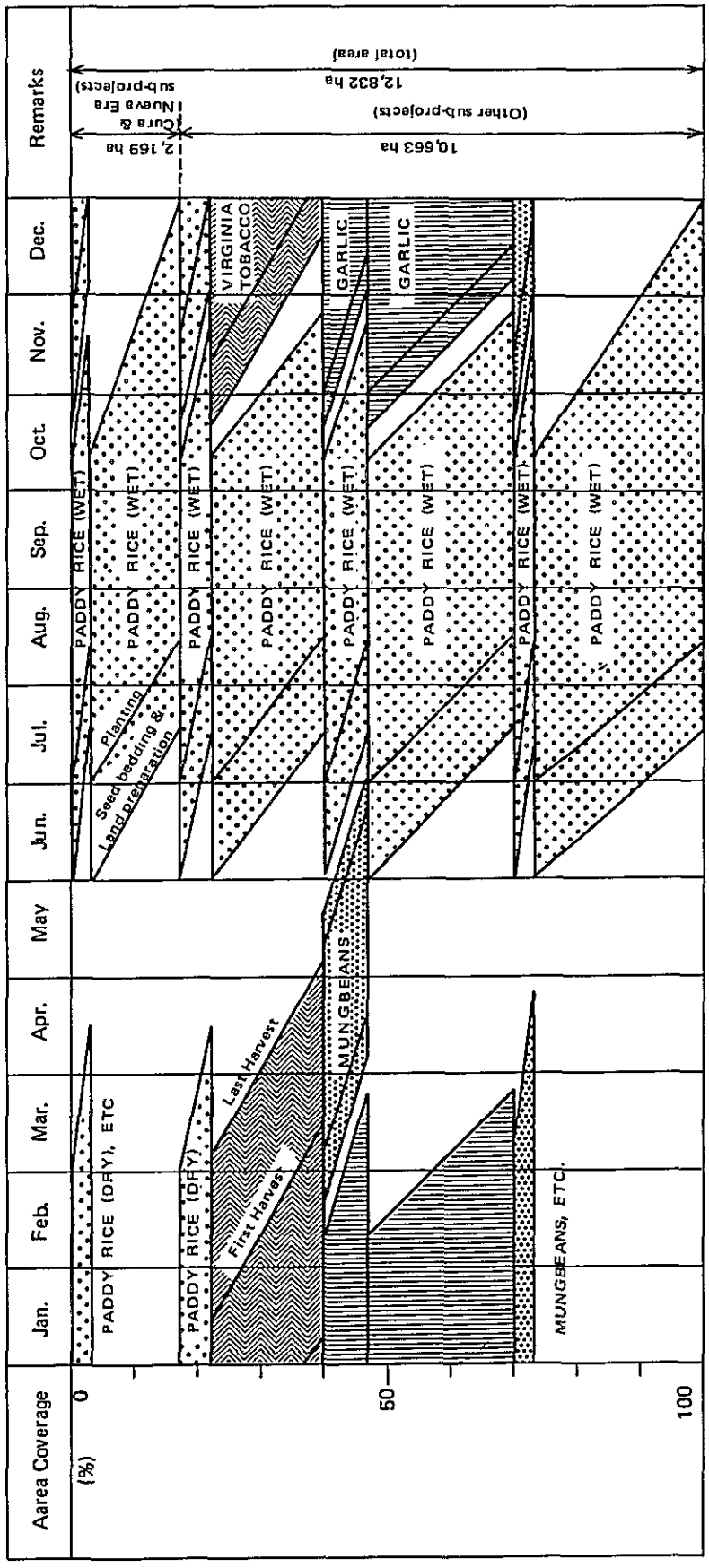
Table 3-1 Present Land Use

Land Category	Cura	Nueva Era	Sub-total	Madupayas	Batac-Paoay	Pinili	Badoc-Sinait	Sub-total	Total
1. Cultivated Land									
(1) Rice Land									
- Irrigated[1/]	447	3	450	53	1,439	411	1,899	3,802	4,252
- Rainfed	1,025	694	1,719	115	3,895	1,042	1,809	6,861	8,580
Sub-total	1,472	697	2,169	168	5,334	1,453	3,708	10,663	12,832
(2) Others	–	–	–	–	–	–	–	–	–
Total	1,472	697	2,169	168	5,334	1,453	3,708	10,663	12,832
2. Non-cultivated Land									
(1) Marsh Land	–	–	–	–	58	–	–	58	58
(2) Brush Land	–	–	–	–	–	–	10	10	10
(3) Residential	75	15	90	15	565	85	175	840	930
(4) Rights of ways	58	28	86	7	213	57	147	424	510
(5) Others	65	1,390	1,455	330	2,130	1,175	2,470	6,105	7,560
Total	198	1,433	1,631	352	2,966	1,317	2,802	7,437	9,068
Grand Total	1,670	2,130	3,800	520	8,300	2,770	6,510	18,100	21,900

Source: Soil Survey, NIA, LRED, 1980

Note: 1/ Irrigated area by communal irrigation systems

FIGURE 3 - 1. PRESENT CROPPING PATTERN



Due to the reasons given in (i) above, availability of irrigation water has limited the expansion of the acreage grown with the dry season upland crops, and in (ii) above, the recent price hike of gasoline has been increasing in number of farmers who wish to convert the pumping irrigation system to the gravity irrigation system.

No groundwater irrigation has been carried out in the sub-project areas of Cura and Nueva Era. The dry season cropping, therefore, has been carried out only in the very limited area which the communal irrigation system can cover, and the paddy fields out of the range of communal irrigation have been left fallowed after harvesting the wet season paddy.

The points at issue in the present land use are summarized as follows.

i) No further expansion of the farm land is expected because all of the arable land in the Project Area has already been in full use as paddy fields. An intensive land use by yield increase and multiple cropping will be a major approach to production increase in the Project Area.

ii) About 40 percent of the farm land in the Project Area is compelled to be left fallowed in the dry season due mainly to paucity of irrigation water.

A powerful measure to solve the above problems in the present land use is to execute an irrigation project.

2. Agricultural Production

a) Cropping System

The following six cropping patterns are prevailing in the Project Area, and the cropping calendar for the respective patterns is illustrated in Figure 3-1.

Present Cropping System

(Unit: ha)

	Cropping Pattern		Cura and Nueva Era	Others[1/]	Total	Percentage (%)
	Wet Season	Dry Season				
1.	Paddy	+ Paddy	129	553	682	5.3
2.	Paddy	+ Upland Crops				
(1)	Paddy	+ Tobacco	18	2,304	2,322	18.1
(2)	Paddy	+ Garlic + Mungbeans	–	782	782	6.1
(3)	Paddy	+ Garlic	–	3,129	3,129	24.4
(4)	Paddy	+ Mungbeans and/or others	47	262	309	2.4
		Sub-total	65	6,477	6,542	51.0
3.	Single paddy cropping		1,975	3,633	5,608	43.7
		Total	2,169	10,663	12,832	100.0
	Annual total cropping acreage		2,363	18,475	20,838	
	Cropping intensity (%)		109	173	162	

Note: 1/ Consisting of Madupayas, Batac-Paoay and Badoc-Sinait sub-project areas. Regarding sub-project-wise details, refer to Table 3-2.

The cropping intensity of about 162 percent in the area has been derived from the total cropping acreage in the Project Area, 12,832 ha and the total cropping acreage per annum, 20,838 ha. The details on the respective sub-projects are shown in Table 3-2. There are some differences observed as follows between the sub-projects of Cura/Nueva Era and other sub-projects.

The cropping intensity of the former areas are as low as 109 percent, and the typical cropping pattern is "Single paddy cropping a year" or "Double paddy cropping a year", the respective cropping acreages of which are 91 percent and 5 percent to the total irrigated farm land in the area. The cropping intensity of the latter areas is 173 percent, and the single paddy cropping a year occupies only 34 percent, while "the paddy + upland crops" occupies 60 percent of the total farm land in the areas. The main upland crops grown in the areas is garlic and tobacco. When garlic, having a short maturing period, is grown as the second crop after harvesting the wet season paddy, the third cropping of mungbean or other crops with shorter maturing period has been grown in rather large acreages in the areas. For references, the paddy double cropping a year occupies only 5 percent to the total cropping acreage. The reasons why the differences in cropping pattern emerge between these acreages can be assumed as follows:

Table 3-2 Present Cropping System by Sub-Project

(Unit: ha)

Cropping Pattern (Wet Season) (Dry Season)	Cura & Nueva Era Sub-Projects			Other Sub-Projects					Total
	Cura	Nueva Era	Sub-total	Madupayas	Batac-Paoay	Pinili	Badoc-Sinait	Sub-total	
1. Paddy Rice + Paddy Rice	128	1	129	10	282	76	185	553	682
2. Paddy Rice + Upland Crops									
- Paddy Rice + V.T	–	18	18	–	1,337	327	640	2,304	2,322
- Paddy Rice + G + M	–	–	–	–	245	175	362	782	782
- Paddy Rice + G	–	–	–	–	982	701	1,446	3,129	3,129
- Paddy Rice + M or Others	29	18	47	12	100	62	88	262	309
(Sub-total)	(29)	(36)	(65)	(12)	(2,664)	(1,265)	(2,536)	(6,477)	(6,542)
3. Paddy Rice (One Crop)	1,315	660	1,975	146	2,388	112	987	3,633	5,608
Total	1,472	697	2,169	168	5,334	1,453	3,708	10,663	12,832
(Annual Cropping Acreage)	1,692	734	2,363	190	8,525	2,969	6,791	18,475	20,838
(Cropping Intensity)	111%	105%	109%	113%	160%	204%	183%	173%	162%

Note: V.T.: Virginia Tobacco, G: Garlic, M: Mungbean

Source: Land use survey conducted by NIA, LRED in 1980.

i) Soils in the Cura sub-project area, which are suited to upland cropping, have a high groundwater table up to the end of October, except a certain high-elevation part of the area, and this high groundwater table hamper the upland cropping to be successful.

ii) Soils of the Nueva Era sub-project area are not suited to upland cropping.

iii) Other areas than the above two are in most part blessed with favorable soil conditions to upland cropping with quick drawdown of the groundwater table after the wet season.

iv) An extensive method is applied to the Cura and Nueva Era area where the relatively large-scaled farming is carried out, whereas an intensive method to the other areas where the small-scaled farming is carried out.

The following two items are listed up as bottlenecks which are the currently prevailing cropping system in the Project Area.

i) Paucity of irrigation water in the dry season has compelled the farmers to carry out "Single paddy cropping" in the extensive method, although increase in multiple cropping acreage is badly needed due to no further expansion available in farm land.

ii) The cropping pattern of "Paddy + Upland Crops" has some problems with the short planting time and concentration of cropping season to the period from October to December. Under the situation, there are difficulties that the fields remain too moistened to grow upland crops and the labor conflict takes place between paddy harvesting and upland crops sowing.

These are the common problems that the cropping pattern of "Paddy + Upland Crop" encounters in practice, and well-arranged irrigation/drainage system as a countermeasure should be established to provide a favorable u?land cropping environment to have timely cropping available every year.

b) Farming Practices and Agricultural Inputs

1) Paddy

The following table shows the diffusion rate of HYV (High Yielding Varieties), which prevails generally in irrigated paddy cropping, and mixed cropping of HYV and LV (Local Varieties).

Number of Farms by Paddy Varieties

Item	Number of Farms (%)			
	H.Y.V.	L.V.	Mixed	Total
Irrigated (Wet season)	74	7	19	100
Irrigated (Dry season)	55	29	16	100
Rainfed (Wet season)	43	28	29	100

Source. Farm Management Survey by NIA, LRED in 1978.

About 30 percent of the farms surveyed has adopted only the L.V. for growing the rainfed wet season paddy and the irrigated dry season paddy. That is because the local varieties is expected to adapt itself to the poor irrigation and drainage conditions of the fields.

In the Project Area, the transplanting method is practised by most of the farmers and the wet seed beds are used for growing seedlings. About 1.3 cavans of paddy are shown for covering one hectare of the field (see Table 3D-1, Appendix 3D-1).

Input amount of chemical fertilizers vary slightly with kinds and types of the paddy growing. Almost all of farmers dose the nitrogen fertilizer at the rate of 40 - 50 kg/ha in its element on an average (see Table 3D-1, Appendix 3D-1). Phosphorus and potash fertilizers are applied by about a quarter of the nitrogen fertilizer. Pesticide application rate in acreage ranges from 40 to 70 percent depending on types of the paddy growing. and the dosing amount is small. Furthermore, an extreme little herbicides are applied as compared with pesticides applied.

Paddy harvesting in the Project Area is practised in a manner that the farmers reap paddy with sickles in cutting the plants around 10 cm above the ground surface, and use pedal-threshers or bamboo baskets and wooden board for striking paddy panicles to the board for threshing, and after threshing the paddy is sun-dried on the concrete floors. Paddy straws after threshing are preciously used for mulching for upland crops.

2) Upland Crops

Virginian strains are the main tobacco plants grown in the Project Area. Application rate of chemical fertilizers and pesticides in acreage is about 90 percent, and the application amount of these chemicals, except for potash fertilizers, has reached a comparatively high level of input (see Table 3D-1, Appendix 3D-1). A full-scale irrigation has been carried out for the tobacco fields by portable sumps, with which groundwater is lifted up to irrigate the tobacco plants on the hills through hose immediately after planting and several times before harvesting. No topping nor picking off lateral

shoots are practised in the Area, because the lateral shoots do not grow big when no topping is practised. After harvesting the tobacco leaves, the fire-curing of the leaves is carried out burning fire-woods in the earth-wall or plywood-wall curring barn by individuals or groups of farmers.

The so-called "Ilocos White" is the main garlic variety grown in the Area. No ploughing is made in common for garlic sowing because no sufficient time can be spared for land preparation immediately after paddy harvesting; consequently weeds tend to grow thick. A great deal of paddy straws are used for mulching and the pumping irrigation is carried out in the same manner as in the tobacco irrigation. Application rate of chemical fertilizers in acreage is considerably high particularly, nitrogen fertilizer has been dosed by about 49 kg per hectare in its element, while potash and phosphorous fertilizers by only less than one third of nitrogen fertilizers. Application rate of pesticides in acreage is quite small.

Mungbeans are grown with local varieties in the extensive farming with little agricultural inputs like fertilizers, etc.

Estimation on the total agricultural inputs used in the Project Area is tabulated as follows and further details are referred to in Table 3D-2, Appendix 3D-1.

Annual Application Amount of Agricultural Input

Seeds	
Paddy	870 ton
Tobacco	70 kg
Garlic	860 ton
Mungbeans	15 ton
Chemical Fertilizers	3,664 ton
Pesticides	
Liquid	11,424 quart
Granule	16 ton
Herbicides	
Liquid	808 quart
Granule	17 ton

c) Agricultural Production

The crop-wise total cropping acreage, average yield and total production in the Project Area are estimated in the following table :

Present Agricultural Production

Crops	Cropping Acreage (ha)		Yield (tons/ha)		Production (tons)
	Phase II	Phase I[3/]	Phase II	Phase I[3/]	
1. Paddy	13,514	2,451	1.75	1.53	27,513
- Irrigated, Wet season	4,252	1,465	2.38[1/]	1.77(1.56)[4/]	12,603
- Irrigated, Dry season	682	515	2.25[2/]	1.61(1.23)	2,243
- Rainfed, Wet season	8,580	471	1.41[1/]	1.27(1.10)	12,667
2. Tobacco	2,322	–	1.01[1/]	–	2,345
3. Garlic	3,911	–	1.37[1/]	–	5,358
4. Mungbeans & others	1,091	–	0.38[2/]	–	415
5. Corn	–	275	–	0.50	138
Total	20,838	2,726			35,769

Note: 1/ Farm Management Survey NIA, LRED, 1978 (see Appendix 3D-3)

2/ BAEcon, average yield of respective crops in the Project municipalities (1972 - 1979)

3/ Phase I remaining area

4/ The figures in parenthesis show the yield in Madongan sub-project area.

The following case shows an example of high yielding accomplished in the Project Area or in its vicinity; the Masagana 99 program in the related municipalities have annual paddy yield of 3.6 ton/ha on an average (yield between 8th and 13th terms, mainly wet season paddy; Ref. to Table 3D-16, Appendix 3D-1), while the fertilizer trials for determining the fertilizer application standards by FAO/NFAC/JICA have revealed the yields of the wet season paddy and the dry season paddy are 4.4 ton/ha and 3.6 ton/ha, respectively (Average of the yields in 1978 and 1979, Ref. to Table 3D-17, Appencix 3D-1). The application tests by FAO/NFAC/JICA were conducted in the selected fields with favorable local conditions of irrigation and drainage to get a fairly high yield, although the irrigation/drainage system is improperly provided. Therefore, the Project will allow to establish the target yields as high as the above test results to cope with the consolidation level of the irrigation/drainage facilities in the Area.

In the Project Area, a Virginian tobacco compact farm organized by PVTA marked a yield of about 1.6 ton/ha of the tobacco leaves (dry) in 1977/78[1/]. The

1/ Adolf C. Necesito, "The Philippine Virginia Tobacco Industry; In search for effective technology for development and transfer in the farmland, 1979".

yields of garlic and mungbeans which are researched in the Dingras experimental station, are 3.0 ton/ha and more than 2.0 ton/ha, respectively.

The paddy production by all the municipalities concerned with the Project considerably fluctuates year by year as clearly learned from Table 3D-3, Appendix 3D-1 illustrating annual paddy production trend from 1972 to 1979 in the Project Area. The paddy production in the Project Area was marked very low in 1973, 1975, and 1976 (*in* cropping year), when a considerably small rainfall was observed in the middle or the end of wet season. The fact proves that the paddy cultivation in the Area has been compelled to depend largely on the natural conditions of rainfall due to low level in consolidation of irrigation facilities. The rainfall pattern changes largely year by year, and the low yield of paddy has frequently occurred. In the recent ten years, increase in yield and cropping acreage has contributed to paddy production increase at the respective rates of 50 percent, and the annual rate of yield increase has been estimated at 30 kg/ha (see Table 3D-19, Appencix 3D-1).

Production of Virginian tobacco, garlic and mungbeans has been an increasing tendency; however, since no remarkable increase in yield has been observed for crops but tobacco, the recent production increase in garlic and mungbeans has resulted from an increase in cropping acreages (see Table 3D-19, Appendix 3D-1).

Considerations of the statistic on production of various crops (see Table 3D-3 to 3D-15, Appendix 3D-1) have enabled to estimate the increasing rates of yield of the major crops in the Project Area and the results are shown as follows.

Crops	Increasing Rate (percent/year)
Paddy, Irrigated (Wet season)	0.8
Paddy, Irrigated (Dry season)	1.3
Paddy, Rainfed (Wet season)	0.9
Virginian Tobacco	1.4
Garlic	1.1
Mungbeans	1.3
Cotton	1.3

d) Animal Husbandry

According to Table 3D-20, Appendix 3D-1 showing number of animal raising farmers and population of animals in the Project Area, carabao, cattle, swine, chicken are the major animals being raised. Carabao and cattle are bred as draft animals at the rate of 1.3 heads/farmer and 2.2 heads/farmer, respectively. The agricultural census

in 1971, however, resulted in showing the numbers of serviceable carabao or cattle per farmer by 1.2 heads and the rate of carabao and cattle involved is 2:1 (see Table 3D-21 and 3D-22, Appendix 3D-1). Recently the carabaos have been decreased in number to be raised, whereas the cattle increased by almost double in the Project Area.

Swine and chicken have been raised, as shown in Table 3D-20, Appendix 3D-1, by about 60 percent of the total farmers in the Project Area at the rate of 7.8 heads of swine and 31 heads of chicken on an average. These animals are bred in small scale mainly for home consumption of pork, chicken and egg, but recently, some people have had an attempt to run a large-scaled breeding of swine and/or chicken for the local market and Manila, a large consumer. Such large-scaled breeding, which cannot be run by farmers due to large capital requirement for its management, has been operated on the commercial basis, but in Paoay, the Government supporting multipurpose cooperative has tried to carry out a large-scaled breeding of swine, chicken and broiler by member farmers so as to meet the demands of the local markets nearby and Manila.

3. Farm Management

a) Farm Households and Farm Labor

There are a total of 106 barangays included in the Project Area, on the basis of which the survey was made in 1975 to find the total population, numbers of households and farm households by 72,845 persons, 13,850 households and 10,621 households, respectively (see Table 3D-23, Appendix 3D-1). The rates of the population, number of households and farm households belonging to the rural area specified in the population census are 84 percent, 90 percent and 96 percent, respectively. The total farm households occupy about 77 percent of the total households in the Area, and the farm households in one barangay count 100 households on an average, and the farm land acreage in one barangay is 117 ha on an average.

The total farm labor in the Project Area has been estimated as follows;

Full-time farmers:	13,800 persons
Part-time farmers:	10,300 persons

b) Farm Size and Land Tenure

The farm size per household in the Project Area is 1.2 ha on an average, which is less than half of the national average of 2.7 ha (see Table 3D-24, Appendix 3D-2). A large difference in the farm sizes exists between the sub-projects of Cura/Nueva Era and the other subjects areas; the farm sizes per household in the latter are much smaller than those in the former.

As learned from the distribution of numbers of farmers by their farm sizes, few farmers are found in the Project Area to cultivate the lands with more than 3.0 ha, while about 41 percent of the total farmers to cultivate the lands with less than 1.0 ha. The farmers belonging to the latter class actually cultivate the lands of about only 0.5 ha on the average (see Table 3D-25, Appencix 3D-2).

On the other hand, survey on numbers of the farmers by land tenure shows that full owners, part owners and tenants occupy 33 percent, 42 percent and 25 percent of the total farmers in the Project Area, respectively (see Table 3D-27, Appendix 3D-2). And the respective classes cultivate 31 percent, 45 percent and 24 percent of the total farm lands in the Project Area (see Table 3D-28, Appendix 3D-2). In most cases of land tenancy in the Project Area, the share-cropping system is dominant in payment of the land rent on the half-share basis (see Table 3D-29, Appendix 3D-2).

In eight municipalities of the Project Area, the MAR has promoted the agrarian reform, in which the Land Transfer Operation covers 1,079 ha while Lease Holder Operatoin covers 11,568 ha (see Table 3D-30, Appendix 3D-2).

The acreage of the former occupies about 6 percent and the latter 57 percent of the total farm land in the Project Area. Accomplishment rate of the agrarian reform in the Area is about 40 percent in Land Transfer Operation, and about 15 percent in Lease Holder Operation, respectively, as of 1979. The Government aims at completing the both operations within the period of the five-year development plan, 1978 - 1982.

c) Farm Management Types

In the Cura and the Nueva Era areas, the farm management is conducted mainly in the paddy mono-culture type, while in the other areas of the Project Area rarely in the paddy mono-culture type but in the "paddy + upland crops" type by more than 90 percent of the farmers, according to the sample survey for the selected farmers in the areas (ref. to Appencix 4C-3). The upland crops play an important role as cash crops in this type of farmer management; however, paucity of irrigation water (a major constraint) has hindered the cropping acreage from its expansion.

d) Farm Mechanization and Farm Labor Balance

Farm mechanization in the Project Area is assumed to be developed to the extent that the cultivators or 4-wheel tractor are used for ploughing harrowing works in land preparation for about 5 percent of the total farm lands and the pedal-thresher for threshing works for about 75 percent of the total farm land. The details are shown in Table 3D-31, Appendix 3D-2. Works other than the above have been carried out by

man-power and/or animal (ref. to Chapter 6 Economic Analysis). The pumps for irrigation for upland cropping have been introduced by one unit for about two hectares.

The current labor inputs per hectare for the major crops in the Project Area are illustrated in Figure 3D-1, Appendix 3D-2, and based on the above data, the relationship between demand and supply of labor has been studied as follows. Overlapping of the paddy harvesting and dry season crop planting has resulted in peak of the labor demand in November, but considerably large labor surplus has merged in other season than November. Therefore, it is deemed necessary to create further farm labor opportunity by providing new jobs during the slack time so as to utilize such surplus labor.

4. Farm Economy

The farm economy in the Phase II area depends largely on the profitability of paddy, tobacco, garlic and mungbean croppings. The farm economy in Batac, Paoay, Badoc, Pinili and Sinait in the above area is mainly influenced by market trend of tobacco and garlic. The farmers in the Cura and the Nueva Era areas, cropping mungbean and corn besides paddy, earn their income mainly from paddy.

The Land Resources and Economics Division, NIA, conducted a farm management survey in 1977 for the areas of Batac, Paoay, Badoc, Pinili and Sinait, and another supplemental survey was made in January, 1980 for the areas of Cura and Nueva Era.

The farm economic analysis for the Phase II area was made according to the above results and is illustrated as follows.

Cropping Pattern of Sample Farmers
- Farm Management Survey -

			Badoc, Pinili, Sinait			
	Batac	Paoay	Irrigated	Non-Irrigated	Cura	Nueva Era
Survey Year	1977	1977	1977	1977	1980	1980
No. of Sample	33	26	20	54	3	2
Average Size (ha)	0.91	1.36	1.20	1.12	1.17	2.25
Cropped Area (ha)						
Irrigated Paddy	–	–	0.92	–	1.75	–
Wet Season	–	–	0.92	–	1.17	–
Dry Season	–	–	–	–	0.58	–
Rainfed Paddy	0.91	1.36	0.28	1.12	–	2.25
Tobacco	0.40	–	0.33	0.19	–	–
Garlic	0.14	0.48	0.45	0.39	–	–
Corn	0.02	–	–	–	0.28	0.50
Mungbean	–	–	–	0.01	0.58	0.38

The paddy fields in Batac and Paoay, although the rainfed fields, have been cropped to garlic or tobacco in the dry season; the former mainly in Paoay and the latter in Batac. The Batac area has marked higher dry season cropping ratio by 61 percent than the Paoay area by 35 percent. The farmers is Badoc, Pinili and Sinait have grown tobacco or garlic in the dry season at the cropping ratio of 64 percent with some irrigated fields, while some farmers have grown tobacco and garlic in the rainfed fields at the cropping ratio of 53 percent.

The sample farmers surveyed in Cura have grown crops in the irrigated fields. The present land use in the dry season seems to be relatively intensive with cropping of paddy and mungbean corn in rotation. In the Nueva Era area, non-irrigated fields have been found due to unfavourable soil conditions and inability to secure the irrigation water sources. The cropping in the dry season has reached only 39 percent with growing corn on mungbean.

The differences among cropping patterns mentioned above reflect on the different scales of the farm economy in the areas.

The following table shows comparisons of farm incomes from various cropping pattern on the ground of 1.0 hectare unit cropping acreage. The values specified to those areas other than the Cura and the Nueva Era have been converted to the 1980 prices from the prices surveyed in 1977. The table indicates that the income of the growers of tobacco/garlic is four or five times as much as that of the exclusive paddy growers.

The market price of fertilizers and agri-chemicals have been increased by 20 to 30 percent from 1977 to 1980, while the farm gate prices of the products have been raised by 18 percent from 55 to ₱ 65 per cavan of paddy, 45 percent from ₱4.7 to ₱6.8 per kilogram of tobacco and 67 percent from ₱5.5 to ₱9.2 per kilogram of garlic. In particular, the garlic produced in 1980 seems to be sold at higher price than that in the usual years. Such upward tendency in prices of tobacco and garlic has favored the growers with high profit to the farm economy.

These upland crop growers can earn much income even with bearing a considerably high water cost for pumping irrigation.

Farm Income of 1.0 Hectare Farmer at Present

- Farm Management Survey -

	Badoc, Pinili, Sinait					
	Batac	Paoay	Irrigated	Non-Irrigated	Cura	Nueva Era
No. of Sample	33	26	20	54	3	2
Farm Income in Hectare (₱)	3,905	3,365	4,815	4,119	870	841
			– Percent by crop –			
Irrigated Paddy	–	–	11.7	–	75.0	–
Rainfed Paddy	18.4	21.4	3.5	17.5	–	85.4
Tobacco	52.0	–	26.4	19.0	–	–
Garlic	29.6	78.6	58.4	63.4	–	–
Corn	0.0	–	–	–	1.6	2.3
Mungbean	–	–	–	0.1	23.4	12.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Note. Refer to Appendix 3D-3.

The farmers in Cura and Nueva Era, without growing tobacco and garlic, can earn only low. Income raise of these farmers will require expanding of cropping acreage of marketable crops, increasing in paddy yield, expanding of irrigable areas and increasing in cropping ratio in the dry season. High income earned by tobacco/garlic growers has been supported not only by favorable market prices of the products but by much labor input. The following table shows comparison of the farm income of tobacco and garlic growers by their farm sizes. The larger farm size the farmers operate, the smaller cropping ratio they are growing tobacco and garlic with. The extension of tobacco and garlic area are limited from 0.7 ha to 0.8 ha per farmer, and the comparatively large income per hectare is gained by those farmers operating in rather small farm-size.

Farm Income of Tobacco and Garlic Farmer

- Batac, Badoc, Pinili and Sinait -

	0.5 ha	1.0 ha	1.5 ha	2.0 ha
No. of Sample	17	29	19	5
Irrigated Paddy (ha)	0.12	0.08	0.08	0.25
Rainfed Paddy (ha)	0.38	0.92	1.32	1.75
Total Paddy (ha)	0.50	1.00	1.50	2.00
Cropping Ratio of Tobacco and Garlic (%)	87	55	55	42
Farm Income (₱)	2,970	4,124	6,298	6,371
Farm Income/ha (₱)	5,940	4,124	4,200	3,185

Total No. of Population	4.9	5.0	6.6	6.0
Population Engaged in Farming	2.3	2.1	2.1	3.3
Per Capita Farm Income	606	825	954	1,062

Note: Refer to Appendix 3D-3.

The income increase by the farmers possessing more than 1.0 ha of the land, tobacco and garlic having come to a limit in farming scale, will essentially require to increase cropping ratio and yield of paddy and other cash crop.

5. Processing and Marketing of Agricultural Products and Input Materials

a) Processing and Marketing of Agricultural Products

1) Paddy and Mungbeans

The NGA (National Grains Authority) has taken a policy to control the grain market through partial intervention into the market. Paddy, however, is the only item purchase from Ilocos Norte Region up to now. In 1979, the NGA procured about 6,800 ton of paddy from Ilocos Norte province, which is equivalent to 7.4 percent of the total paddy production of that province in the same year (see Table 3D-39, Appendix 3D-4). As learned from the said table, the paddy which the NGA purchases from that province has recently been increased in amount abruptly, whereas the paddy released thereto has been rapidly decreased. This suggests that the paddy production in Ilocos Norte province has almost reached to meet its demand and the NGA has been trying to stabilize the producers' paddy price through increasing procurement while having no need to release thereto.

Table 3D-40 to 3D-42 in Appendix 3D-4 show the ricemills, warehouses, transportation facilities, paddy wholesalers and retailers available in all municipalities included in the Project Area. In the Ilocos Norte province, the NGA has operated a Cono-type ricemill with capacity of 30 tons/day except the many Kiskisan type ricemills used for processing domestic consumption of paddy.

Another one ricemill with capacity of 18 ton/day is expected to be provided in the proposed grain center in Dingras. Besides private warehouses existing in the Project Area, the NGA owns three warehouses with storage capacity of 154 ton in total in paddy, and has made a plan to construct a 5,000 ton capacity warehouse in the new Grains Center.

Ilocos Norte province seems to have made a domestic export of about 30 percent of its total mungbean production in 1979. The NGA has a plan to procure 25 tons of mungbean from Ilocos Region under the five-year development plan, although having no market intervention yet in this item. The NGA's procurement plan covers only 0.5 percent of the actual production result of 5,100 tons in 1979.

2) Tobacco and Garlic

Tobacco market has been controlled by PVTA (Philippine Virginian Tobacco Administration) through the system with fixed floor price of procurement and quality grading standards. In this system, the buyers licensed by PVTA can purchase tobacco leaves only through the so-called Trading Center in following the operation rules. There are 25 tobacco Trading Centers operated throughout the Ilocos Norte province, the procurement turnover of which was about 7,200 tons in total in 1977.

No market control has been imposed on the garlic business, which is made through complicated channels with many middlemen standing between farmers and consumers. Such complicated system has much profited middlemen, pushing up the price to bring about a large difference between the farm gate price and the retail price. The MA report entitled "Garlic Production and its Market" (surveyed in 1978) reveals that the garlic produced in 1978 costed at ₱8.9/kg at the retail level, whereas the farm gate price was only ₱3.3/kg, and 86 percent of the surveyed farmers are quite unsatisfied with the garlic buyers beating down with low prices and have taken this as a critical problem to the producers. In this connection, the MA has proposed the plan to establish either a garlic producers' cooperative or a new marketing system for securing the stabilization of the garlic market.

In many cases, the farmers sell garlic in bundles at the farm gates after harvesting and drying, while some buyers or middlemen try to make a speculative purchase of garlic before harvesting.

b) Marketing of Agricultural Input Materials

1) Seeds

Paddy

The BPI (Bureau of Plant Industry) is in charge of production and distribution of quality seeds through controlling storage and marketing of the certified seeds which the Seeds Growers Associations provided by one at every province produce.

The BPI's Dingras experimental station, explained later, produces the fundation seeds, which are distributed to the above Seeds Growers Association.

About 4,520 cavans of the certified seeds were produced in 1979 in Ilocos Norte province (see Appendix 3D-4, Table 3D-44). It is estimated that this amount of the certified seeds covers about 70 percent of paddy cropping area with high yielding varieties in Ilocos Norte, and the shortage in seed supply is about 30 percent at present.

Upland crops

Tobacco seeds are supplied by PVTA, while seeds of garlic, mungbean and vegetables are sold by the BPI's Dingras experimental station.

2) Fertilizers and Agri-chemicals

The market price of fertilizers and agri-chemicals have been designated by FPA (Fertilizer and Pesticide Authority) as standard prices for the respective regions.

In the Project Area, most of these input materials have been supplied through retail shops in the business line. There are 19 retail shops handling these materials found in major municipalities in the Ilocos Norte province.

6. Agricultural Supporting Services

a) Research and Extension

1) Research institutes

The BPI (Bureau of Plant Industry) and the BAI (Bureau of Animal Industry) carry-out research works, breeding, propagation of quality seeds and species, respectively, while PTRTC (Philippine Council for Agriculture and Resources Research) conduct researches on tobacco and CRDI (Cotton Research and Development Institute) on cotton, respectively. The headquarters of the latter two organizations are located in the Mariano Marcos State University in Batac.

The BPI, PVTA and BAI have provided the following facilities in the Project Area.

	Research Institutes	Major Activities
(i)	BPI Dingras Experiment Station	Research and seed breeding of paddy, garlic, mungbean and vegetables

(ii)	BPI Regional Crop Protection Center	Research works for pest control for plants
(iii)	BPI Batac Tobacco Experiment Station	Breeding and comparative study among tobacco varieties
(iv)	PVTA San Pedro (Batac) Experiment Station	Applied research on Virginia tobacco cultivation
(v)	BAI Dingras Stock Farm	Animal breeding and conservation of superior line

These facilities, functioning as a link of the national research networks of the respective authorities concerned, have not always kept close relations with local farmers. The Ilocos Norte provincial authorities do not provide any specific research organizations to meet the local requirements.

2) Extension services

The provincial office of the BAEx (Bureau of Agriculture Extension) is composed of three major departments of farm management improvement, living condition improvement and upbringing of the rural youths. The farm management technologists (FMT) have been assigned at every municipalities to give guidances to the farmers concerned.

The provincial office of BPI, providing three major department such as farming techniques department, pest control department and applying test department, has assigned production technicians (PT) at every municipality as permanent staff for guidance and education of the farmers concerned. Therefore, the education and extension services have been rendered for farm management by FMT of BAEx and for farming teqniques by PT of BPI, respectively. The staffing density of FMT and PT in Ilocos Norte is one FMT per 140 farmers and one PT per 230 farmers, respectively (see Table 3D-45, Appendix 3D-5).

The BPI is the executing body of the Masagana 99 Program (paddy production increase program), while the BAEx is the executing body of the Masagana Maisan Program (Maize production increase program).

b) Agricultural Credit

The ACA (Agricultural Credit Administration), PNB (Philippine National Bank), DBP (Development Bank of Philippines), RB (Rural Bank) and LB (Land Bank) are the agricultural financing agencies in the country. There are two PNB branches, one DBP branch and 13 RB branches established in the Ilocos Norte province. The branches of the RB are located in almost of all municipalities in the Project Area.

Financing for the Masagana 99 and the Masagana Maisan Programs has been handled by the ACA, PNB and RB, which have given the farmers credit of ₱1,600/ha for Masagana 99 and ₱900/ha for Masagana Maisan at the ceiling in condition of repayment after six months and annual interest of 12 percent.

The participating farmers and the objective acreages in the Masagana 99 Program in 1979 wet season cropping are 32,394 farmers and 24,161 ha, respectively, in Ilocos Norte province out of which 751 farmers and 730 ha are under financing by the above banks. The total amount of finance is ₱876,400 and the amount per hectare is estimated at ₱1,200. The paddy fields as objectives of financing in the Masagana 99 Program occupies only two percent of the total acreage of the paddy field in the Project Area.

c) Farmers' Organization

1) Communal Irrigation Organization

There are 105 communal irrigation organizations existing (4,252 ha in commanded areas) in the Project Area. The organizations, composed of the beneficiaries, have been operated by man-power services and free-offer of the construction materials to the rehabilitation works of the facilities such as canal, intake structures, etc. which are carried out several times a year, and without collecting water charges, while the NIA has been supervising operation and maintenance works of these communal irrigation systems.

2) Cooperative Organizations

The organization of Samahang Nayon has been established at every barangay under administration of the MLGCD, aiming at promoting a variety of cooperative activities such as production, marketing, financing, procurement, etc. 71 barangays, 62 percent of the total number of barangays in the Project Area, have been registered on Samahang Nayon as of early 1980. The total members of registered Samahang Nayon count about 2,900 farmers, occupying only 27 percent of the total farmers in the Project Area.

The four major cooperative organizations with farmers as main members are listed in Table 3D-48, Appendix 3D-5. The Paoay Lake Cooperative Inc. the multi-purpose cooperative covers a wide range of business lines of production in animal husbandry/fisheries, marketing of the products, financing and building of farmers houses, and so forth. For successful performance of this organization, many other governmental organizations than MLGCD have been concerned with through executing various projects.