PRELIMINARY SURVEY REPORT
ON
ILOCOS NORTE IRRIGATION PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES

March 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

The Government of the Republic of the Philippines formulated a plan of the Irrigation Project covering an area of 21,500 hectares in Ilocos Norte Province in the North West of the Luzon Islands for the purpose of agricultural development and requested the Government of Japan for cooperation on the feasibility study in August 1977.

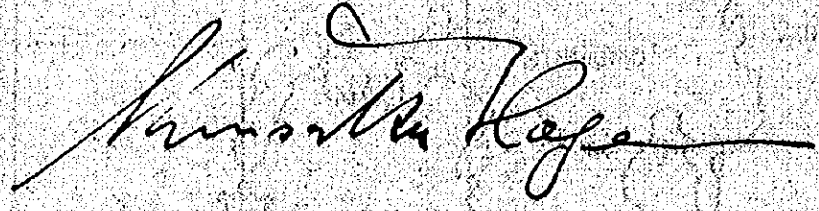
In compliance with the request, the government of Japan decided to perform a preliminary survey and dispatched the Ilocos Norte Irrigation Project preliminary survey team consisting of eight members headed by Mr. Tatsuo ASAHARA, Director of Design Division, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry from October 30 to December 2, 1977.

Prior to performing the feasibility study, the preliminary survey team identified the outline of project, benefited area and the situation of proposed project in the country, and studied the scope of works for the preparation of feasibility study through the survey and exchange of views with officials concerned.

The report presented here represents the result of the survey, and I hope it will serve for preparation of the planned feasibility study and prove to be useful as a reference material for the people concerned.

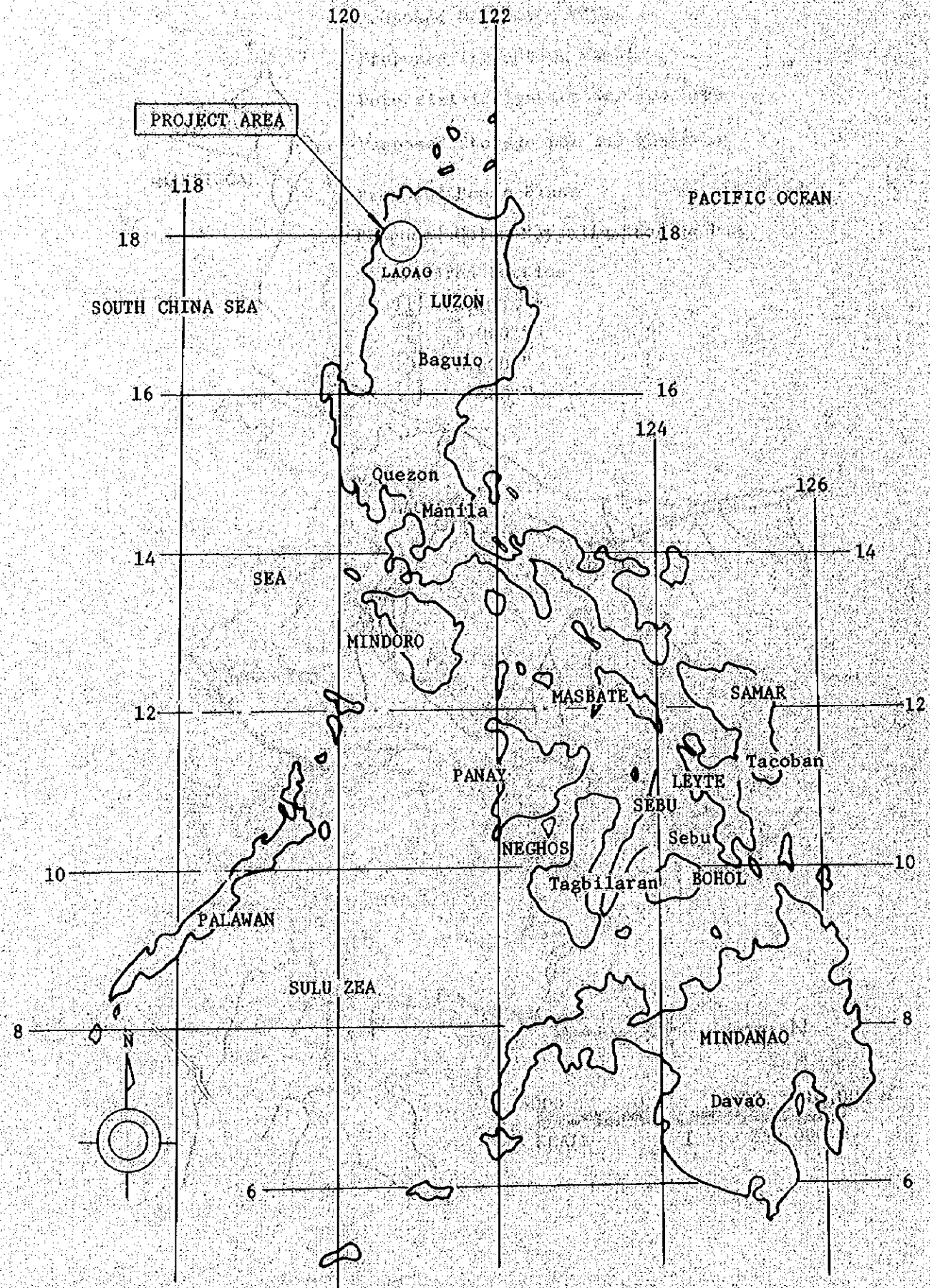
I would like to express my deep appreciation for the support and cooperation extended by the Government and officials concerned of the Philippines to the survey team.

March 1978

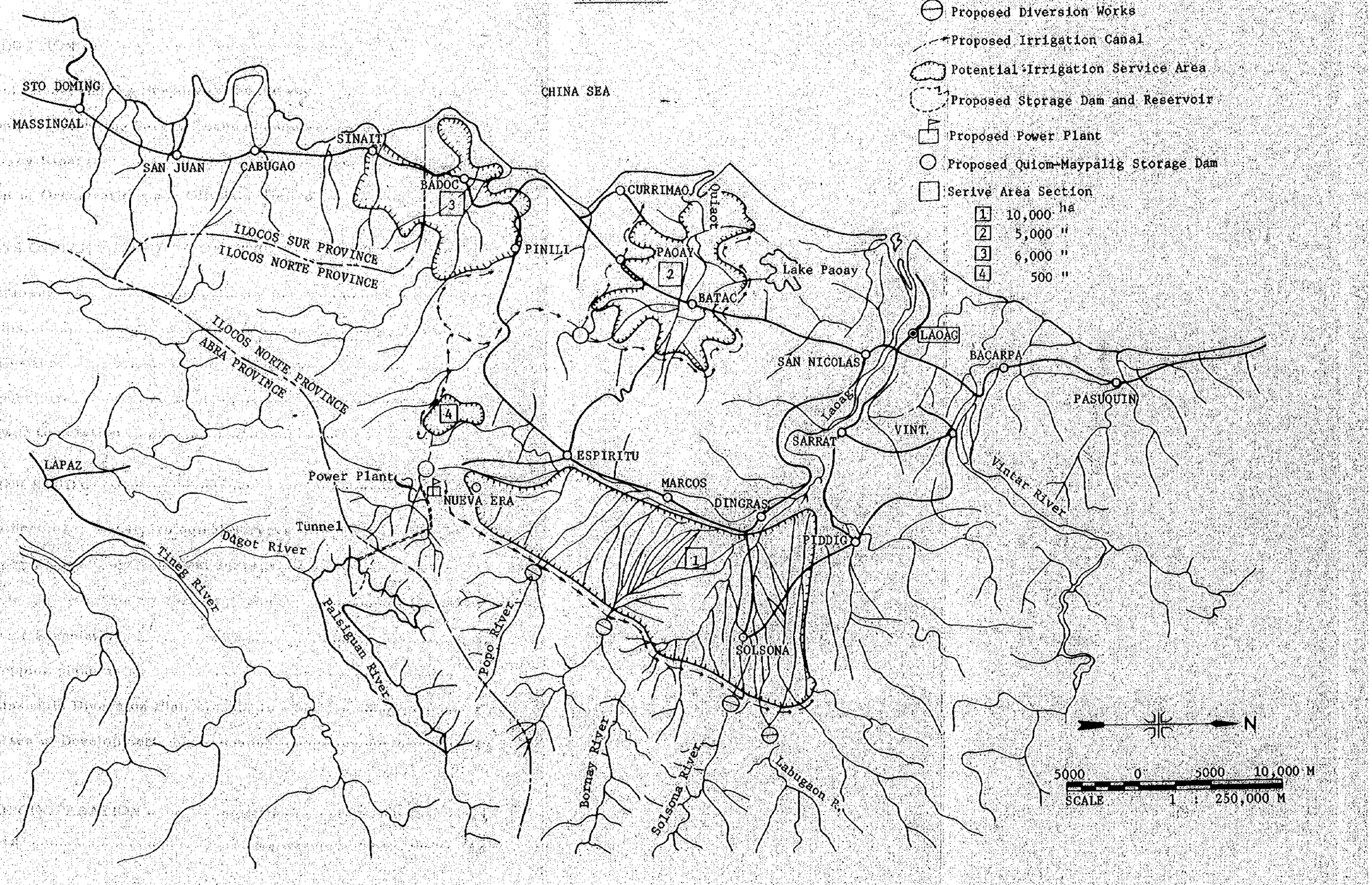


Shinsaku HOGEN
President,
Japan International Cooperation Agency

LOCATION MAP OF THE PROJECT AREA



GENERAL MAP


Proposed Diversion Works
Proposed Irrigation Canal
Potential Irrigation Service Area
Proposed Storage Dam and Reservoir
Proposed Power Plant
Proposed Quiom-Maypalig Storage Dam
Serive Area Section
1 10,000 ha
2 5,000 "
3 6,000 "
4 500 "
CHINA SEA
STO DOMING
MASSINGAL
SAN JUAN
CABUGAO
SINAIT
BADOC
ILOCOS SUR PROVINCE
ILOCOS NORTE PROVINCE
ABRA PROVINCE
PINILI
CURRIMAO
Quiaot
PAOAY
Lake Paoay
BATAC
LAOAG
SAN NICOLAS
BACARPA
PASUQUIN
Laoag
SARRAT
VINT
Vintar River
LAPAZ
Power Plant
NUEVA ERA
ESPIRITU
MARCOS
DINGRAS
PIDDIG
Tunnel
Dagot River
Tineg River
Palsiguan River
Popo River
SOLSONA
Bornay River
Solsona River
Labugaon R.
N
5000 0 5000 10,000 M
SCALE 1 : 250,000 M

CONTENTS

I. INTRODUCTION

1. Background and the purpose of the survey

Ilocos Norte Province situated in the north-western part of Luzon Island, depends largely on agriculture for its economic basis, and is one of the depressed areas in the Republic of the Philippines. The Government of the Republic of the Philippines formulated the irrigation project for the area of approximately 21,500 ha. to the south of Laoag, the capital of Ilocos Norte Province to utilize the arable land and water resources for agricultural development in order that the area would emerge from the present backward situation.

In May, 1977, the Government of the Republic of the Philippines made a request for Japan's cooperation through the Japanese Technical Cooperation Survey Team; headed Mr. Iijima, Director of Second Technical Cooperation Division, Ministry of Foregn Affairs. This was followed by a formal request made in August by the Government of the Republic of the Philippines to the Japanese Government through the Embassy of Japan in Manila.

In responce to the request, the Government of Japan dicided to perform the preliminary survey and dispatched a team consisted eight members headed by Mr. Tastuo ASAHARA, Director of Design Division, Bureau of Agricultural Infrastructure Improvement, Ministry of Agriculture & Forestry from October 30 to December 2, 1977, aiming to facilitate the smooth and effective performance of the comming study.

The Preliminary Survey Team was assigned the following terms of refferences.

1) to identify the contents of the request
2) to collect the material relating to the Projects
3) to confirm the position of the Project in relation to both the policy of Central and Local Governments.
4) to formurate the outline of the Project
5) to study the optimal scale of the Project and components to be included
6) to study the plan of cooperation
7) to study the scope of works (s/w) for the Feasibility Study
8) Necessary recommendation to the Government
9) and other necessary items.

2. Composition of the Survey Team

Assignment	Name	Present Status
Leader	Mr. Tatsuo ASAHARA	Director, Design Division, Construction Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry
Development Planning (Sub Leader)	Mr. Tadashi YOSHIMISTU	Technical Advisor, Design Division, Construction Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry
Agronomy	Mr. Fumio KIKUCHI	Chief, 6th Laboratory, Division of Genetics, National Institute of Agricultural Sciences, Ministry of Agriculture and Forestry
Cooperation Planning	Mr. Yasumi YAMAGUCHI	Senior Officer, International Cooperation Division, International Affairs Department, Economic Affairs Bureau, Ministry of Agriculture and Forestry
Irrigation	Mr. Yusuke MURAMATSU	Section Chief, Land Development Division, Construction Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry
Dam Planning	Mr. Tadao INABA	Senior Engineer, Agricultural Development Consulting Association
Electric Power Planning	Mr. Taira SUETSUGU	Senior Engineer, Agricultural Development Consulting Association
Coordination	Mr. Takumi OHASHI	Officer, Planning and Survey Department for Agriculture & Forestry, Japan International Cooperation Agency

	10/20	11/1	11/10	11/20	12/1	12/10	Remarks
Leader	10/30	11/6					
Sub Leader	10/30				12/2		
Agronomy	10/30				12/2		
Cooperation Planning	10/30		11/10				
Irrigation	10/30				12/2		
Dam Planning	10/30				12/2		
Electric Power Planning	10/30			11/19			
Coordination	10/30				12/2		

3. Survey Itinerary

Days	Date	Descriptions	Place of Stay
1	Oct. 30 (Sun)	Tokyo-Manila (JL 767)	Manila
2	Oct. 31 (Mon)	Visits to Japanese Embassy, JICA Office. Arrangements on itinerary and scope of survey.	Manila
3	Nov. 1 (Tue)	Visit to ADB. Meeting with Japanese Experts.	Manila
4	Nov. 2 (Wed)	Visit to NIA. Meeting with Mr. Del Rosario, Director of Planning Division. Visit to NEDA., Meeting with Mr. Corpuz; Assistant Undersecretary.	Manila
5	Nov. 3 (Thu)	Team Leader Asahara, Members Yoshimitsu and Yamaguchi, Secretary of the Embassy of Japan Iwamoto go to Laoag. Visit to NIA Regional Office. Inspection of beneficiary area. Courtesy call at Governor of Ilocos Norte Province.	Laoag
		Other members have a meeting with NIA and collect material.	Manila
6	Nov. 4 (Fri)	Asahara group inspects dam sites and tunnel routes	Laoag
		Other members have arrangements with NIA and collect data	Manila
7	Nov. 5 (Sat)	Asahara group returns to Manila Team meets in the afternoon.	Manila
8	Nov. 6 (Sun)	Leader; Asahara returns to Japan	
9	Nov. 7 (Mon)	Meeting with Mr. Del Rosario on the results of field observation of project area	Manila

Days	Date	Descriptions	Place of Stay
10	Nov. 8 (Tue)	Team goes to Laoag via air and surface routes	Laoag
		Member Yamaguchi has a meeting with NIA and collects data.	Manila
11	Nov. 9 (Wed)	Visit to NIA Regional Office	Laoag
		Member Yamaguchi visits Japanese Embassy and JICA Office	Manila
12	Nov. 10 (Thu)	Survey of beneficiary area	Laoag
		Member Yamaguchi visits NEDA, NIA. Returns to Japan in the afternoon.	Manila
13	Nov. 11 (Fri)	Survey of Palsiguan Dam site by helicopter	Laoag
14	Nov. 12 (Sat)	Survey of the beneficiary area by helicopter	
15	Nov. 13 (Sun)	Team Meeting	
16	Nov. 14 (Mon)	Members Yoshimitsu, Inaba and Ohashi survey the dam site by land. Members Kikuchi and Muramatsu survey the beneficiary area.	
17	Nov. 15 (Tue)	Visit to Bureau of Soils (Laoag City) Visit to Batac Soils Laboratory	
18	Nov. 16 (Wed)	Visit to Bureau of Soils Visit to Bureau of Agricultural Extension Visit to Bureau of Agricultural Economics	
19	Nov. 17 (Thu)	Survey of irrigation facilities in the beneficiary area Members Suetsugu and Ohashi return to Manila	Manila
20	Nov. 18 (Fri)	Sub-Leader Yoshimitsu and others survey the beneficiary area Members Suetsugu and Ohashi have meeting with NIA, and collect material	Manila
21	Nov. 19 (Sat)	Member Suetsugu returns to Japan Sub-Leader Yoshimitsu and others survey the beneficiary area	
22	Nov. 20 (Sun)	Member Ohashi returns to Laoag Survey of the dam site by helicopter	
23	Nov. 21 (Mon)	Meeting with NIA Regional Office Collection of Material	
24	Nov. 22 (Tue)	Team returns to Manila	Manila
25	Nov. 23 (Wed)	Team meeting	Manila
26	Nov. 24 (Thu)	Meeting with Japanese Embassy and JICA Office	Manila

27	Nov. 25 (Fri)	Meeting with Mr. Del Rosario and others,	Manila
28	Nov. 26 (Sat)	Compilation of field report and collection of material	Manila
32	Nov. 30 (Wed)		Manila
33	Dec. 1 (Thu)	Submit field report to NEDA & NIA, Report to Japanese Embassy and JICA Office on the results of the survey.	Manila
34	Dec. 2 (Fri)	Team returns to Tokyo.	Manila

4. List of the Officials directly connected with the Survey Team

Nov. 2, 1977	1.	Mr. Conrado G. Mercado Asst. Administrator for Engineering and Operations NIA
"	2.	Mr. Eduardo G. Corpuz Assistant Director General NEDA
"	3.	Mr. Jose B. del Rosario, Jr. Project Development Director PDD-NIA
"	4.	Mr. Clemente T. Alanano Head, Dams & Reservoir Section Planning Division PDD-NIA
"	5.	Mr. Mariano P. Lezarda Agricultural Specialist NEDA
"	6.	Mrs. Ligaya Mercado Secretary to the Assistant Director General NEDA
Nov. 3, 1977	1.	Hon. Elizabeth Marcos Keon Governor of Ilocos Norte
"	2.	Mr. Romeo F. Potenciano Head, Geology Section Investigation Division PDD-NIA
"	3.	Mr. Lolito Miguel, Sr. Head, Geology Section Investigation Division PDD-NIA
"	4.	Mr. Orlando Villalon Geologist, Investigation Division PDD-NIA
Nov. 3, 1977	5.	Mr. Bonifacio Alburo Chief, Land Resources & Economics Division PDD-NIA
"	6.	Mr. Epifanio C. Gacusan Agricultural Economist PDD-NIA
"	7.	Mr. Bernardo Valenzuela Supvg. Soil Technologist PDD-NIA

Nov. 4, 1977	1.	Mr. Emigdio Q. Bigornia Sr. Hydrologist, Investigation Division PDD-NIA
"	2.	Mr. Edilberto B. Punzal Supvg. Irrigation Engineer Planning Division PDD-NIA
"	3.	Mr. Erdolfo B. Domingo (Dam) Sr. Planning Engineer Planning Division PDD-NIA
"	4.	Mr. Orlando F. Gascon (Dam) Sr. Electrical Engineer, Planning Division PDD-NIA
"	5.	Mr. Alberto Baluyot (Power) Mechanical Engineer, Planning Division PDD-NIA
"	6.	Mr. Eustaquio T. Jaramillo Sr. Cartographic Engineer, Investigation Division PDD-NIA
"	7.	Dr. Adolfo C. Necesito Assistant Professor (Tabacco) Dept. of Agronomy University of the Philippines Los Banos, Laguna
Nov. 5, 1977	1.	Mr. Meliton H. Macasieb, Jr. Sr. Design Engineer, Planning Division PDD-NIA
"	2.	Mr. Manuel A. Garvida Chief, Provincial Irrigation Office NIA-Ilocos Norte
Nov. 9, 1977	1.	Mr. William Reodica (Irrigation) Sr. Planning Engineer, Planning Division PDD-NIA
"	2.	Mr. Alejandro Cantor Soil Technologist PDD-NIA
Nov. 9, 1977	3.	Mr. Harold Sinay Geodetic Engineer NIA, Ilocos Norte
"	4.	Mr. Elisco Pacis Assistant Irrigation Engineer NIA, Abra
"	5.	Mr. Franklin Cocoy Regional Officer (Region I)

Nov. 10, 1977	1.	Mr. Benjamin P. Reyes Executive Vice President Technotest, Inc.
"	2.	Mr. Isidro R. Digal Head, Reports and Feasibility Studies Planning Division PDD-NIA
Nov. 11, 1977	1.	Mr. Cornelio G. Batangan Assistant Provincial Irrigation Engineer
"	2.	Mr. Luciano Felipe Provincial Irrigation Technician NIA-Ilocos Norte
Nov. 13, 1977	1.	Mr. Glicerio C. Nelmida Provincial Irrigation Engineer Abra
Nov. 14, 1977	1.	Mr. Arturo Valera Barbero Provincial Governor, Abra
Nov. 15, 1977	1.	Mrs. Anastacia N. Domingo Jr. Soil Technologist Bureau of Soil (Laoag City)
	2.	Mr. Arofe V. Finaris Sr. Soil Technologist Batac, Soils Laboratory
"	3.	Mr. Vicente U. Aguinaldo District Officer Bureau of Soils, (Ilocos Norte)
"	4.	Mr. Francisco A. Rilar Agricultural Extension Specialist II Bureau of Agricultural Extension (Ilocos Norte)
"	5.	Mrs. Gloria S. Mangosing Economist Bureau of Agricultural Economics Laoag City, Ilocos Norte
Nov. 16, 1977	1.	Mr. Vicente U. Aguina, CDD Bureau of Soils (Laoag City)
Nov. 16, 1977	2.	Mr. German D. Lucas Bureau of Soils (Laoag City)
"	3.	Mr. Pacifico P. Mariano Provincial Agriculturist Bureau of Agricultural Extension
"	4.	Mrs. Pauline E. Andres Statistical Aide II Bureau of Agricultural Extension
"	5.	Mrs. Aurea P. Bautista Officer Bureau of Plant Industry (Laoag City)

Nov. 24, 1977	1.	Mrs. Socorro Raquepo Agricultural Economist PDD-NIA
Nov. 25, 1977	1.	Mr. Serafin A. Palteng Chief, Planning Division PDD-NIA
Nov. 28, 1977	1.	Romulo G. Paculan Sr. Meteorologist PAGASA
	2.	Heradio Borja, Jr. Sr. Meteorologist PAGASA
	3.	Jovito A. Navarro Supvg. Hydrologist PDD-NIA
	4.	Mario R. Lara Chief, Construction Engineer, NIA

II. RESULTS OF THE SURVEY

1. Summary

1) In view of the fact that Ilocos Norte Province has a high potential for agricultural development, the Survey Team confirmed the importance of the irrigation project. From the view point of effective utilization of water resources, the power generation Project relating to the dam is both meaningful and significant.

2) At present there is not sufficient basic data relating to hydrology to proceed with such a large-scale regional development plan. Therefore, it is necessary to start collecting data at once. Though it is important to procure good quality survey equipment, it is even more important to work out a plan for the installation of equipment.

3) With regard to the planning of a dam, a geological survey is being conducted by the NIA. As a result of the present survey, the dam site was found to be appropriate in general. However, it is anticipated that the capacity of reservoir may not be sufficient. Therefore, it is necessary to give consideration to a supplementary water source and the farming system.

4) With regard to the power generating plan, it is estimated that the generating capacity of 60,000 kw initially planned by the Philippines will be difficult to attain. The question of the generating capacity should be studied in

connection with the water utilization scheme.

5) With regard to the aqueduct tunnel plan, the most serious technical difficulties are anticipated. At present a boring survey is being conducted, and the alighment of tunnel may seriously affect the necessary project cost.

6) Since the benefited area for irrigation is extensive and is scattered, the total length of the irrigation canal will be extremely long, it is important to study carefully the operation and maintenance at the stage of planning.

7) With the completion of irrigation facilities, it will be possible to introduce high-yielding varieties, and, with the introduction of double cropping, the total yield will increase drastically. It will then be necessary to provide the so-called supporting services such as a seed center, a extension service center, the establishment of a extension service network, the expansion and strengthen of the Agricultural College, the land improvement district, agricultural cooperatives, etc. The Government of the Philippines already takes keen interest in this aspect, and the efforts being made by NEDA to study the aspect should be highly valued.

8) The Survey Team felt the enthusiasm with which the officials of the Government of the Philippines and those of the Provincial Government of Ilocos Norte were executing the plan. With the solution of technical problems, therefore, the administrative set-up will be ready to proceed with the execution of the project.

2. Dams

1) Water sources

According to the plan prepared by the NIA, the following have been proposed as the water sources for the project named Palsiguan River Multi-purpose Development Project:-

Name	River	Catchment Area
Dabugaon head works	Labugaon	100.5 km^2
Solsona "	Gasgas	79.0
Madongan "	Madongan	153.8
Papa "	Papa	51.4
Nueva Era "	Bonga	57.0
Quiom Maipari Dam[1)]	Quiaoit	-
Palsiguan Dam	Palsiguan	153.0

*1) With regard to the Quiom Maipari Dam, because of the geological; runoff, and submersion, the plan was still at the stage where even the location of the dam could not be fixed, and it sounded as if the plan would be absorbed by the overall plan.

The Survey Team surveyed all the proposed water sources except Quiom Maipari, and inspected most areas by helicopter.

In terms of size, the Palsiguan Dam seems to be the main water source and others can be regarded as supplementary sources. However, in terms of water balance, the relationship is reversed. The Palsiguan Dam was planned primarily to supplement the supply capacity of the above-mentioned head works for the proposed benefited areas.

2) Location of the Palsiguan Dam

With regard to the dam site, it is assumed that the site was proposed from the following view points:-

a) Distance to the benefited areas, elevation, and the water head required for the power generation.

b) Demand for the river basin as large as possible.

c) To avoid the limestone layers scattered downstream.

The proposed site seems to be the only point of contact where the various demands can be met. Needless to say, however, the conclusion should be reached only after detailed topographical and geological surveys have been carried out.

3) Geological conditions at the Palsiguan Dam site

The only datum available on the dam site is a 1/5,000 geological map prepared by the NIA. An order has been placed in July, 1977, with the Technotest, Inc., to carry out drilling exploration at 7 points with a total length of 540m (this is part of the drilling at 15 points with a total length of 1,450m covering the tunnel and power plant sites); but as of November it has not commenced.

According to the geological map, massive formation of quartz andesite cover the entire left bank, and the same rock forms the small ridge on the right bank, which is to become a dam abutment. The remaining area of the right bank is basalt. Thus, general geological conditions seem to be very favorable, though

further investigations should be made into the fractured zone along the dyke of basalt seen in the lower parts of both banks and the swamp seems to be a weak line along the proposed spillway route.

The limestone formation which the Survey Team observed on both banks while going upstream the Palsiguan River did not seem to exist near the dam site. However, it is necessary to confirm on this point for the entire area proposed as the reservoir.

4) Topography of the dam site

As far as the section of the topography along the proposed dam axis, the shape is nearly symmetrical with the form factor below 3 and is suitable for not only a fill-type dam but also a concrete dam. Further, as long as favorable geological conditions exist in the entire abutment area on both banks, the crest elevation of EL375^{m} initially planned by the NIA can be accepted, provided that it is the maximum elevation.

However, tributaries of considerable widths flow into the Palsiguan River near the dam site, particularly up and down the right bank and down the left bank, resulting in the relatively slim dam abutment. Consequently, for a fairly tall construction such as a rock fill dam, it is necessary to study the structure of the dam.

Further, enough attention should be paid to the slim section of the abutment on the right bank as there is a possibility of leaking after the reservoir has been filled.

5) Construction material

Since there is an ample supply of hard rock material and river bed gravel, there seems to be no difficulty of obtaining the so-called permeable material. However, accurate information was not obtainable as to the existence of impermeable material which is indispensable for a fill dam, nor could the Survey Team make any positive discovery within the range of its on-the-spot survey. Therefore, further survey should be made to find out about the availability of the material. Since this concerns the selection of a dam type, it may become necessary to consider other types depending on the availability of the material.

6) Size of the Palsiguan Reservoir

The Survey Team recognizes that the most serious problem in the Palsiguan River Multi-purpose Development Project is that the amount of water supply will be considerably less than the amount expected initially in the Project.

For instance, if the average annual rainfall is about 2,600 mm/year in this catchment area, if the average annual runoff is 50% assuming that the amount of downstream river maintenance flow has already been deducted, then the average annual capacity of reservoir (effective water supply) will be about 200,000,000 m^3. This amounts to only two-thirds of the effective capacity planned in the Project.

On the other hand, if the average annual sediment rates is assumed to be about 2,000 m^3/km^2/year, in hundred years the total will amount to about 30,000,000 m^3. This is only two-fifth of the planned amount of dead water. Since the cost of Palsiguan Dam construction is expected to account for the greater part of the total costs of the Project, it would not be advisable to make the height of the dam unnecessarily large because of the wasteful amount of dead water, though the problem of lower effective water head for generating electric power remains.

With regard to the surcharge capacity, it is given the depth of 3m in the plan. However, after grasping the characteristics of climatic conditions in the region, if the controlled water level is set in connection with the careful execution of the flood control plan, it will be possible to include the surcharge capacity in the effective capacity of reservoir.

The elevations which is taken into consideration all the factors above to reduce the size of reservoir may be compared with those in the NIA plan as follows:-

Items	NIA	Smallest
River bed at the site	approx. EL. 225 m	EL. 225 m
Low water level	" 300	" 280
High water level	" 369	" 345
Crest width	" 375	" 350
EL from river bed	" 150	" 125

According to arough estimate, the difference in height will result in the difference in volume content of dam between about 9,000,000 m^3 and 6,000,000m^3. Though this is a mere rough estimate, if a larger dam is built at the present site, it will produce fairly difficult problems in terms of water balance, not to speak of the costs.

7) Vested interests in the lower basin of the river

The Palsiguan River flows down through Abra Province, and already has a service area of about 300 ha between the dam site and the confluence with the Tineg River. This fact should be given enough consideration in the Project, and an agreement among the authorities concerned is desirable prior to the feasibility study.

8) Power-tunnel

With regard to the power-tunnel alignment, eight drilling explorations with a total length of 910 m are in progress in the area including the power plant and the afterbay sites. It should be discussed, therefore, on the completion of the survey report. In any case, since it is a long tunnel with the length of about 10 km running under a high mountain of over 700 m in elevation, unexpected geological matters should be anticipated.

Information regarding other power-tunnels in the Philippines supplied by the NIA is given in Table 1.

Further, every possible combination of the power plant site and the hydraulic conditions of the tunnel, taking into consideration the cost of construction including electric power facilities, the relative difficulty of the construction work and the operation and maintenance system, should be studied thoroughly.

9) Head works

A few geological surveys have already been carried out on the head works or proposed dam sites on the Madongan, Labugaon, Solsona, Bonga, Papa and Quiom Maipari, and it has been reported that no serious technical problems are anticipated at each head works.

As has been described, the capacity of reservoir at the Palsiguan Dam may be smaller than is expected under the present plan. Therefore, further survey will be necessary with the view that the head works sites may be turned into reservoirs.

3. Irrigation

1) General features of the project area

a) Proposed area

The area proposed as the irrigation service area in the Philippine request for a preliminary survey is located mainly in the southern part of the Ilocos Norte Province and partly in the northern part of Ilocos Sur Province. It can be divided roughly into the following four areas:-

i) About 10,000 ha extending in a fan-shape on the right bank of the Bonga River

ii) About 5,000 ha located on both banks of the Lawa River centering around Batac.

iii) About 6,000 ha located on both banks of the Badoc River centering around Badoc.

iv) About 600 ha scattered in a small basin to the west of the Nueva Era.

The total area is about 22,000 ha. (Hereafter the individual service area will be referred to as First, Second... Fourth area.)

b) Present irrigation systems

The irrigation systems adopted at present in the Republic of the Philippines may be divided roughly into the following three types: 1) National Irrigation System;
2) Communal Irrigation System; and 3) Other types.

The National Irrigation System is normally adopted for a large area of more

PRESSURE TUNNEL

Name of Project	Number of Unit	Length (m)	Diameter (m)	Capacity (M.W)	Rated Head (m)
1. Pantabangan Dam	2	600	6.00	100	94
2. Caliraya Hydro Plant	1	1,440	2.50	32	288
3. Magat Multi-Purposed	6	112	5.00	300	76.5
4. Casecnan Trans Basic					
Tunnel No. 1	1	22,300	6.00	160	311
Tunnel No. 2	1	26,400	6.00	106	232
5. Chico No. 2	2	6,000	5.50		
6. Kalayaan Pamped Storage Plant	1	970	6.00	300	289.00

than 1,000 ha. It is constructed and maintained by the NIA Central Office entirely at national expense.

With regard to the Communal Irrigation System, its construction is either carried out or assisted by the NIA Provincial Office, and this system originates from the Spanish colonial days. After completion, the operation and maintenance is carried out by the Irrigators Association. Association members either offer labour or bear the corresponding amount of cost for operation and maintenance work.

Irrigation within the proposed area is being carried out by the Communal Irrigation System. However, its facilities are very simple, and many head works are made of bamboo and masonry. Consequently, stable irrigation is not being carried out. For instance, the irrigated area adopting the Communal Irrigation System in the First area is about 5,800 ha during the rainy season; but it is reduced to 800 ha during the dry season.

However, the Irrigators Association in the area is well-organized as an organization, and communal work is being carried out orderly, though the problem of technical standard is a different matter.

c) Irrigation projects in the adjacent area

Table 2 shows those areas around the proposed area in the Ilocos Norte Province where the National Irrigation Improvement System Project (NISIS) is being carried out.

Table 2 National Irrigation System

Project Name	Service area	Town	Remarks
Dingras Irrigation System	1,100 ha	Dingras	Natural Intake from Bonga River
Pump No. 1	500 ha	San Nicolas	Pumping from Laoag River
Pump No. 283	1,246 ha	"	"
Laoag Vintar	2,279 ha	Laoag	Natural Intake from Vintar River
Cura River	814 ha	Piddig	—
Pasuquin Extension	670 ha	Pasuquin	—

Source: Information obtained verbally from NIA Provincial Office.

Each system has its control system for operation and maintenance staffed by Superintendent, Watermaster, Gatekeeper and Ditchtender, and major gates and pumping stations have Gatekeeper's Headquarters responsible for the control. This control system is also responsible for collection of water fees.

2) Irrigation plan

a) Irrigation area

With regard to hydrologic observation stations, the Survey Team could inspect the Pluviometric and Pan-evaporation Station and the Stream Gaging Station in Dingras; but the accuracy of measurements could not be determined. The Team was also unable to collect data on percolation. However, according to a rough estimate based on the amount of usable water supply and other existing data concerned, so long as the Palsiguan Dam is the only water source, the amount of irrigation water during the dry season should be estimated at 20 t/s. Accordingly, as it will be described later, it is necessary to study: 1) relocation of the proposed service area; 2) supplementary water sources; and 3) cropping pattern for the dry season.

Further, since the First area is a developed fan-shaped area, it will be necessary to collect enough data relating to repeating use of water and percolation.

b) Irrigation canals

Two main irrigation canals are planned for the proposed service areas: one of 30 km in length for the First area and the other of over 50 km to serve the Second, Third and Fourth areas (hereafter they will be referred to as First and Second main canals).

The first main canal will be constructed to run north-east from Nueva Era and across the head of the vast alluvial fan created by the River&Papa, Madongan, Solsona and Labugaon. Consequently, it involves many river crossing works and thus requires considerations for determination of the line and cost of additional construction works such as canal lining.

The first main canal is planned to run through the skirts of Ilocos mountain range, and will have to function unavoidably as a catch drain. Therefore, it will be necessary to study appropriate counter-measures.

The second main canal is planned from Nueva Era to the west, then from Badoc northward to the Second service area, connecting the Fourth, Third and Second areas. The Fourth and Second areas are basin-type service areas, and

there are hills between them. Therefore, there may be difficulties with the location of the main and secondary canals. However, it is not necessarily a good design to raise the elevation of the canal for the purpose of extending the service area. In that case sufficent economic evaluation should be made.

At present there is virtually no land consolidation being carried out, and the density of farm road is low. Therefore, the layout of canals should be planned in connection with the future development of these facilities.

c) Regulating reservoirs

Since the Second main canal is expected to be over 50 km, it will be necessary to provide one or two regulating reservoirs. Then it will be possible to reduce the maximum canal discharge and carry out smoothly the distribution of irrigation water to the large service areas. With regard to the possible sites, the upper-reaches of the Quiait River and the approach to the Third area seem to be suitable from the view point of effective water utilization. However, the latter may need further study on topographical and geological conditions, and land acquisition.

d) Supplementary water sources

As has been mentioned in Section a) of this capter, so long as the water source for this project is limited to the Palsiguan River, it will be difficult to supply sufficient irrigation water to the proposed service areas. Additional water sources are, therefore, necessary to increase the irrigable area during the dry season. Fortunately, there are additional water sources in the vicinity which are given in Table 3.

Table 3

River	Catchment area	Service area
Labugaon	100 km	First
Madongan	150	"
Papa	50	"
Solsona	80	"
Nueva Era	60	"
Quiaoit	10	Fourth

Source: Palsiguan River Multi-purpose Project, p. 26, and others.

3) Construction plan

The First service area is an isolated area, enclosed by the Cura River in the north, the Bonga in the west, and in the east and the south by the Ilocos mountain range. The area is connected with the National Highway No. 3 with only two bridges, one which is being constructed at Nueva Era and the other one at Dingras. There is no road which runs across the fan-shaped area. Therefore, one has to cross the river bed at Labbana to go to the central part during the dry season, and during the rainy season only human beings manage to cross the river by boat. Further, the roads in the First area are mostly not surfaced except for approaches to villages. Therefore, for the construction of the First main canal, it will be indispensable to 1) construct a bridge on the Bonga River halfway between Dingras and Nueva Era and 2) construct a work road which runs vertically across the area along the main canal. The work road will play an important role not only in the construction of the canal but also in future regional development and the operation and maintenance of the irrigation systems.

For the construction of the Second main canal, the Road 300 which connects the National Highway No. 3 and Banna, the middle point between Dingras and Nueva Era will serve as a major work road. However, this road is passable only by jeep even during the dry season. Consequently, much improvement and a road connection with the canal will be required.

4) Operation and Maintenance

The operation and maintenance of the irrigation system after completion of the construction, the previous system of control will be inadequate because of the following factors:-

i. The service area is extremely large and is divided into four independent sections
ii. Coordination with power generation is required.
iii. The irrigation system extends to three provinces.
iv. The size of the facilities is extremely large.

Therefore, a new system of operation and maintenance will have to be devised. Especially the coordination with power generation will affect irrigated agriculture and, therefore, will need cooperation between the authorities concerned.

4. Agriculture

1) Climate and agriculture in Ilocos Norte

The Philippines can be divided into four climatic regions according to the distribution of annual rainfall. Ilocos Norte, where the proposed service area is located, belongs to the first type with two distinct seasons, the rainy season from May to November and the dry season from December to April. The months of June, July and August have much rainfall, whereas it seldom rains from January to March. The mean temperature ranges between 25°C and 30°C, and the yearly mean temperature is 27.5°C. According to the new climatic classification based on the yearly raining pattern, the length of the period of maximum rainfall and the length of dry season, the country is divided into seven types from A to G, and Ilocos Norte belongs to the A type.

The total area of the Province is 339,934 ha, and agriculture accounts for 42,280.6 ha or 12.4% of the total. As Table 4 shows, the planted area for short term crops such as rice, corns, tobacco and garlic is extremely large. Particularly, rice is the most important crop and occupies over 89% of the total planted area for short term crops (Table 5). Ilocos Norte Province is a special production locality of tobacco and garlic which are important cash crops. In addition, corns, green beans (mongo), peanuts, sugar cane, onions, egg plants, and coconut are grown.

The number of farms is 31,047 as of 1971, and the size of the farm is small. For instance, those of under 1.0 ha account for 45.4%, and those between 1.0 and 3.0 ha account for 46.7% of the total.

2) Cropping pattern

The cropping pattern of rice and upland field crops depends largely on the climatic conditions with distinct dry and rainy seasons. During the rainy season rice is planted in the almost entire service area except for a small section with inadequate irrigation. There is a Communal Irrigation System in the area to which the river water is drawn by natural intake. However, because of the inadequate irrigation facilities and the uneven rainfall, actual irrigation depends entirely on the river water level. Consequently, in some sections paddy fields are sometimes washed away by a flood, whereas there is a shortage of water in hilly areas and in those parts far from the river even during the rainy season. In the service area 60% of the paddy fields are rain feds due to

lack of irrigation water. The Survey Team observed in Batac, Badoc and West Nueva Era areas that there were many paddy fields with no hope of crops, showing cracks in the fields.

At the time of survey (second half of November), harvesting of the high-yielding varieties (HYV) had been almost completed, and tall and late-maturing traditional varieties with high photo-sensitivity had attained maturity. These traditional varieties bear a small number of tillers though panicles themselves are large, and, therefore, the yield level seemed to be fairly low. The traditional varieties are planted partly because they are better than the improved varieties in quality and taste, but mainly because they are comparatively more adaptable to unfavorable environment such as deep flooding and drought or to extensive cultivation without fertilization, weeding and insecticide.

In a section of the area where irrigation water is available during the dry season second crop rice is grown, and in other sections, particularly in Batac and Badoc, tobacco and garlic are cultivated fairly extensively in those paddy fields where harvesting is over.

As Table 6 shows, because of the shortage of irrigation water, those sections where paddy rice cultivation is possible account for about 15% of the total service area during the dry season. Cultivation of garlic and tobacco occupies 10% of the total area. The remaining part is either cultivated for various field crops or laid as a fallow land.

The marked maldistribution of annual rainfall in the service area has profound effects on sowing, aplanting and harvesting seasons of paddy rice. With regard to the cropping pattern in the service area, there are three types: paddy-rice + paddy-rice, paddy-rice + garlic, and paddy-rice + tobacco combinations for the rainy and the dry seasons. Fig. 1 gives the cultivation calender for these cropping patterns. Sowing and planting seasons of paddy-rice extend to about three months depending on the beginning of the rainy season, supply of irrigation water and allocation of labour. Accordingly the harvesting season has a considerable range. Generally traditional varieties need longer growing periods than improved varieties, and have late harvesting. As for paddy-rice cultivation during the dry season, the tendency is to plant non-seasonal and early maturing improved varieties because of the shortage of irrigation water.

For garlic cultivation in paddy fields, straws from the previous harvest are used to cover the surface after plowing for the prevention of drying during the germination and elongation periods, and for weed control effects. In some sections where the supply of surface water is not adequate, pumping facilities are installed to utilize groundwater for irrigation. Because of its flowering characteristics, planting after December will result in low yield, and this limits the suitable work period.

Tobacco needs drying on harvesting, and the cultivation in the service area during the dry season provides a suitable environment for the production of good quality leaves.

Other planting patterns include cultivation of pulse crops such as mongo and peanut, vegetables such as tomato and eggplant, crops like corn, or upland crops in both rainy and dry seasons.

With the sufficient supply of irrigation water, the service area favoured with suitable air temperature and sunshine will have a technical possibility of altering freely the present cropping pattern. It will, for instance, increase the production area of second crop rice to a great extent.

Planting of upland crops which require less water compared with paddy rice seems to be necessary for economy in irrigation water and for efficient utilization of water. The cropping patterns such as paddy rice ⊕ garlic or rice ⊕ tobacco combinations seen in a section of the service area will continue to be used as long as they produce high yields.

3) Irrigation and yield

For ideal rice cultivation in the tropics the following three conditions have to be satisfied: 1) appropriate water management; 2) application of ideal varieties with desease resisting and short growing periods; and 3) proper cultivation control such as right season for cultivation, planting intensity, correct fertilization and insecticide (Tanaka, 1965). The supply of water is the most basic of these three, and there is a close relationship between the proportion of irrigated paddy fields and the average paddy yield in the countries of South-East Asia. In those countries where irrigation facilities are not adequate and the propotion of irrigated paddy field is low, paddy yield is also low. (Okita, Takase, 1976).

Table 7 give per ha. paddy yield for irrigated paddy fields, rain-fed paddy

fields, rain-fed paddy fields and upland cropping area during the last ten years, and shows clearly that irrigated fields had higher yield. With regard to the service area, as Table 6 shows, yield from rain-fed fields, which occupy most of the area, is extremely low. Though yield from irrigated fields during the rainy season is also low, this is due to the extensive cultivation using traditional varieties and with little or no fertilization, and also to insufficient supply of water caused by inadequate irrigation facilities.

Table 8 shows per ha. yield obtained in eight districts of Ilocos Norte, where systematic irrigation has been carried out under the National Irrigation System. For instance, in paddy fields in Dingras, IR30 and IR38 whose growth period is from 110 to 120 days were planted, and the paddy yield of 75 cavans per ha. (= 3.75 ton/ha) has been recorded. It should be mentioned that growth period of traditional varieties is normally 15 days.

If sufficient irrigation water is supplied by the proposed Project, and with the introduction of modern agricultural techniques based on the use of improved varieties and improved fertilization, the yield including that from the present rain-fed fields during the rainy season is expected to increase considerably.

If the proposed Project could supply sufficient water during the dry season, it will not only make it possible to expand the paddy rice area within the service area greatly but also raise yield beyond the level of crops of the rainy season by utilizing effectively the abundant sunshine. This is clearly seen in the results of IRRI experiments and the records of other Province with adequate irrigation facilities (Fig. 2, Table 9). According to the results shown in Fig. 2, yield increasing effects by intensive fertilization are greater in the dry season and with high-yielding improved varieties (HYV).

With adequate irrigation facilities it will be possible to expand the paddy rice area both in wet and dry seasons and increase per ha. yield, and help maintain stable production without large yearly fluctuations. Further, with the consolidation of irrigation facilities to the terminals, water-saving culture will become possible and economy in irrigation water may be expected. Water requirements of a crop varies with each of its growth stage, and, for instance, rice requires a small amount of water during its non-productive tillering stage. Upland crops such as garlic and tobacco require a smaller amount of water than rice. With the provision of adequate irrigation facilities, however, it will be

possible to obtain higher yield with appropriate supply of water during the growth period.

Table 4 Land use in Ilocos Narte (1971)

Land Use	Area	Proportion
Total	42,280.6 ha	100.0 %
Short term crops	31,203.1	73.8
Perennial crops	2,682.6	6.3
Grass land	4,164.7	9.9
Forest	2,035.3	4.8
Miscellaneous	1,132.6	2.7
Others	1,062.3	2.5

1971 Ilocos Norte Prepared upon census of agriculture Vol. 1 Final Report (NEDA)

Table 5 Effective crop areas and yields of main agricultural products in Ilocos Norte (1970.7 - 1971.6)

Crops	Effective crop area	Yield
Rice	31,526.5 ha	47,323 t
Corns	2,894.3	2,586
Tobacco	3,052.7	2,240
Garlic	1,915.5	2,365
Green beans	1,679.9	503

1971 Ilocos Norte Prepared upon census of agriculture Vol. 1 Final Report (NEDA)

Table 6 Areas of cultivation and paddy yields of rice, tabacco and garlic in the service area

	area	Yield (t)
Total	21,500	
Paddy rice, 1st crop	8,400	2.3 (46)
2nd crop	3,360	2.4 (48)
Rain-fed paddy field	12,600	1.6 (32)
Tobacco	1,400	0.98
Garlic	700	2.20

Figures in parentheses represent the Cavan conversion values.

Prepared upon Palsiguan River Multi-Purpose Project, Province of Ilocos Norte (NIA, 1977)

Table 7 Rice yields on irrigated paddy field, rain-fed paddy field and dry field in Philippines

	1966-1971 Years	1972-1976 Years
Irrigated field	41.42 cavan	46.9
Rain-fed field	29.91	31.1
Dry field	19.44	19.5

From BAE con and 1966-77 NEDA statistical yearbook

Table 8 Mean and maximum yields of rice in 8 National Irrigation Systems in Ilocos Norte Province

Name of system	Mean yield per ha	Maximum yield per ha
1. Laoag-Vintar R.I.S.	65 cavans	85 cavans
2. Dingras R.I.S.	70	75
3. NMC and Pasquin Exf.	60	80
4. Cura R.I.S.	35	45
5. Bolo R.I.S.	70	80
6. Bonga Pump # 1	70	80
7. Bonga Pump # 11	75	85
8. Bonga Pump # III	75	85

NIA survey result

Table 9 Yields under 5 cultivation systems on farmers fields in 3 areas in Philippines

Year	Area	Season and locations	Yield (t/ha)				
		Rainy season					
1974	Nueva Ecija	10	1.7	1.9	2.1	2.4	2.2
1974	Laguna	10	3.7	3.8	4.2	5.0	5.2
1975	Nueva Ecija	11	3.2	3.4	3.7	3.8	4.4
1975	Laguna	5	4.0	3.0	2.7	4.6	5.3
1975	Camarines Sur	2	3.5	3.9	4.7	4.3	4.1
		Dry season					
1975	Nueva Ecija	3	4.5	3.6	4.2	5.5	6.6
1975	Laguna	9	4.2	3.5	4.1	5.5	5.7
1975	Camarines Sur	3	4.0	3.5	4.8	5.5	6.0
1976	Nueva Ecija	9	4.2	-	4.6	6.3	6.5
1976	Laguna	7	4.3	-	4.8	5.2	6.4
1976	Camarines Sur	5	3.3	-	3.7	4.3	4.8

M1 represent the level of farmer, and M5 a cultivation method of a high level of investment of fertilizes, etc.

From Constraints to high yields on Asian rice farms: an interim report, IRRI 1977.

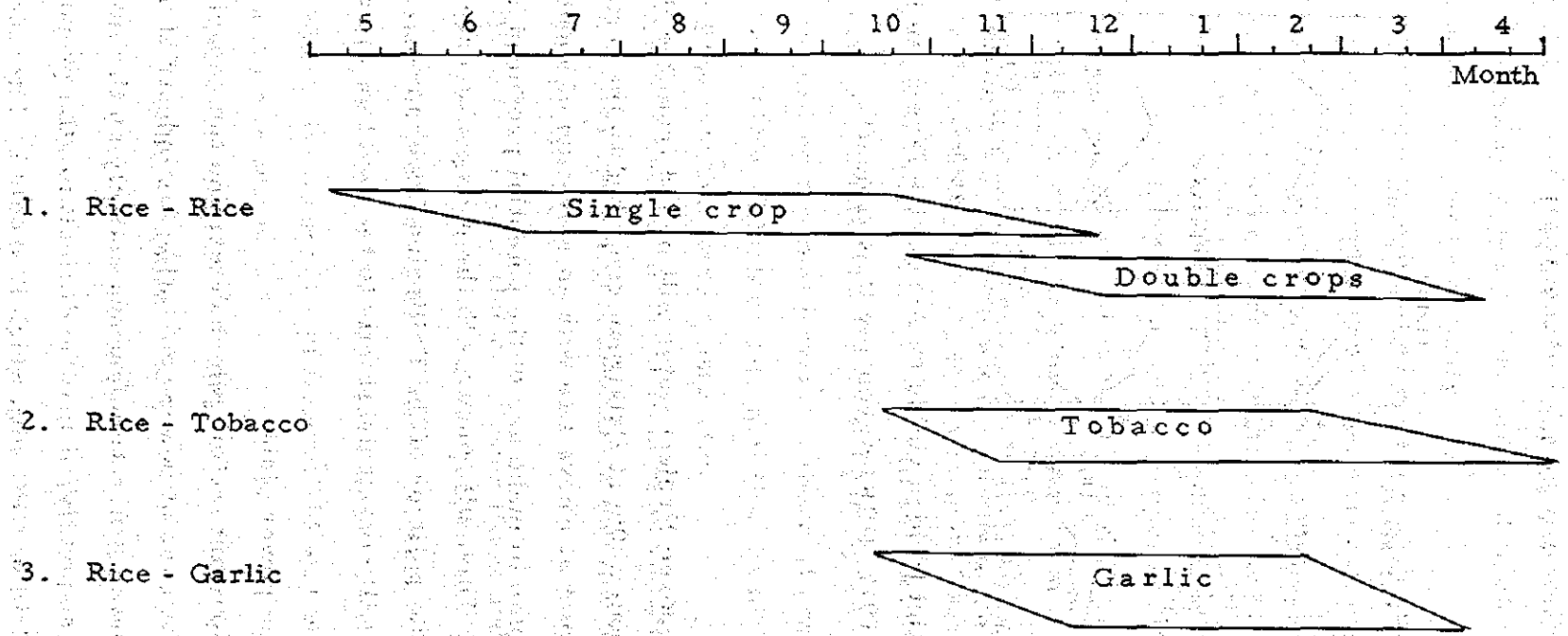
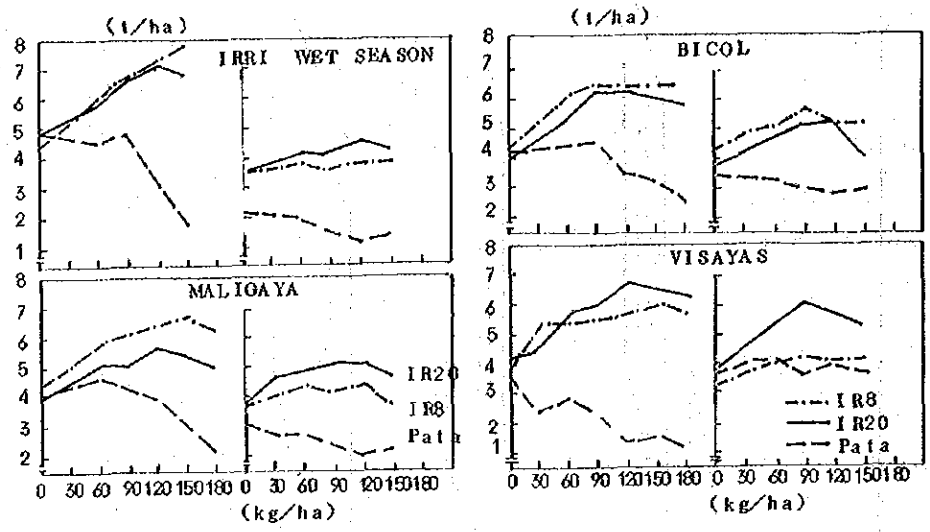


Fig. 1 Cropping pattern and cultivation calendar in the service area

Fig. 2 Yields per ha of 3 species cultivated under 3 different nitrogen levels at 4 locations in rainy and dry seasons (1968-1973)



Conventional

From constraint to high yields on Asian rice farms: an interim report, IRRI 1977 (IRRI Agronomy Department).

5. Power generation

1) Planning

Under the proposed Project water will be led from the Palsiguan Dam with an elevation of about 220m at Palsiguan river bed to the irrigation cannal system which has an inlet at Nueva Era with an elevation of about 110 m. It is, therefore, natural to plan to make use of the potential produced by the water head for generating power. This will concur with the policy of energy self-supply, which is one of the basic policies of the Philippine Government. It is also clear that the Project will contribute greatly to the development of northern Luzon.

2) Capacity of the power plant

One of the important factors which determine the capacity of the generator is, unlike the case of power generation for industrial use, that the amount of water for power generation depends entirely on the amount of irrigation water. Consequently, it may be difficult for the proposed plant to participate in Luzon Grid of NPC with which it should be interconnected.

Bearing that in mind, and on the assumption that an afterbay with sufficient regulating capacity will be built at Nueva Era, the estimated effective capacity of the Palsiguan Dam and the amount of the necessary irrigation water lead to an estimated generating capacity of not larger than 30mw, which is less than 50% of the proposed generating capacity.

For determination of the installed capacity of the proposed power plant, its effects on the invested capital cannot be disregarded. However, the quantitative analysis has to be left for further study. The determination of generating capacity should be made with the following factors in mind:-

i. Water discharge for irrigation and its fluctuations.

ii. The regulating capacity of the proposed afterbay at Nueva Era.

iii. The peak demand in Luzon Grid of NPC and the generation mix between thermal and hydraulic power at peak periods.

3) Development of power resources by NPC and estimated load

The total installed capacity of power plants interconnected with Luzon Grid at present is 744 mw. They include Bataan Thermal No. 2 (150 mw) which has recently been constructed and Panta Bangan Hydraulic (100 mw). Under the policy of NPC regarding thermal power, no thermal power plants will be constructed after 1987 with Malaya Thermal No. 2 which is under construction by MECO being the last one to be constructed.

NPC takes keen interest in the utilization of the subterranean heat for power, and has a development plan to produce 660 mw by 1987-- part of the plan is under construction at present.

* Additionally, there is a Bataan Nuclear Power Plant under construction presently for completion in 1982. *Also in response to such a plan, a pumping-type power plant (300 mw) is being planned to be constructed in 1981.

When the proposed hydraulic plants at Magat, Abulog, Chico and Tab are constructed, the total capacity of Luzon Grid will be 5,370 mw by 1987, and the generation mix will be:-

Hydraulic	20%
Subterranean	18%
Atomic	17%
Thermal	45%

The estimated load on Luzon Grid for 1977 is 1,722 mw; but the load is expected to reach 3,735 mw in 1987, an increase of over 100% in the next ten years.

4) Position of the proposed power plant in Luzon Grid

The position of the power plant proposed by the Project in relation to the Luzon Grid development program provides an important subject for further study. It should also be considered that the position of the plant will have a profound effect on invested capital. Of course, there is no doubt that the power generated at the proposed plant will contribute to a reduction in imports of fuel for thermal power as long as the plant is interconnected with Luzon Grid.

5) Alternative site of the plant

With regard to a suitable site for the plant, an alternative site may be directly under the proposed Palsiguan Dam. It will be a dam-type plant, and the discharge will be led to a suitable point on the upper reaches of the Bonga River through a driving channel of a gentle slope with a free flow. Whether the driving channel should be a pressure tunnel or a free flow type depends on further investigation.

III. FURTHER STUDY

1. Meteorologic and hydrologic surveys

With regard to the proposed Palsiguan Dam, it seems to be difficult to obtain the capacity of reservoir planned by the Philippines which amounts to 380 million m^3. It will not be wise to plan the construction of the dam judging only from the material and data relating to meteorologic and hydrologic conditions which are available at present. In terms of quantity and quality the available data is not sufficient. Figures estimated from the existing material are smaller than those suggested in the original idea. It should be mentioned that a large-scale development program requires accurate basic data. For that purpose it is advisable to set up observation facilities for Meteorologic and hydrologic studies at the dam site, intake area and necessary positions within the service area, so that these conditions may be studied continuously for at least two or three years. In that case it will be advisable to obtain Japanese cooperation.

2. Topographical and geological surveys

Under the proposed Project, large-scale constructions such as a large dam, a long pressure tunnel and a power plant, are to be constructed. Selection of sites and types plays an important role in maintaining safety and economy of the facilities. Therefore, it is important to obtain accurate information necessary for planning and designing by means of careful topographical and geological surveys. Survey should be carried out by a proper method and on a proper scale according to the stage of progress made in the survey, thus increasing accuracy which is vital for obtaining the necessary information and data.

According to a geological map of the Philippines, a geological difference is discernible near the proposed dam site, and the proposed tunnel running through Mount Dagot is expected to meet considerable geostatic pressure and may have to run through faults. In view of these factors, it is most necessary to carry out detailed survey systematically in future. As for geological survey it will be necessary to obtain Japanese cooperation.

3. Study of the contents of the development

In case there is a shortage of water resources for the proposed Palsiguan Dam, the following measures should be studied;

1) Reassessment of the proposed service area which corresponds to the amount of available water supply
2) Assessment of supplementary water sources. For instance, it is possible to select a site from those planned for intake facilities at Labugaon, Madongan and Papa which can be utilized effectively for a dam.
3) Study of the cropping pattern in the dry season

4. Power planning

As a result of the change in the capacity of the Palsiguan Dam, the generating capacity of 60,000 kw planned by the Philippines will have to be reduced. In that case it will be necessary to study the appropriate scale, position, type of tunnel and the scale of afterbay.

5. Cropping planning

1) In order to estimate the amount of irrigation water required in the service area, it is necessary to obtain data on percolation for the entire area. Percolation figures depend on soil conditions and the state of groundwater. With regard to soil analysis, survey results of Ilocos Norte Province are taken, present the Batac Soils Laboratory which belongs to the Bureau of Soils is compiling 1) soil map; 2) soil suitability map; 3) land capability map; and 4) fertilizer recommendation map for rice, all of Batac and Paoay. It is desirable to compile these maps for other service areas.

2) It is necessary to find out about the effects of the irrigation development in technical and socio-economic aspects on the present cropping patterns and agricultural method which are restricted by the shortage of irrigation water.

3) In order to avoid friction regarding the intake of irrigation water, cultivation period should be given a reasonable range both in dry and we seasons. For this purpose it is necessary that further technical study such as selection of varieties, fluctuations in yield caused by shifting of sowing or transplanting period, other changes in the form of agriculture and insect damage.

4) At present there is an expansion program in the Philippines for the production of Masagana 99 and Masaganang maisan for rice and upland crops respectively. It is necessary to know how the Ilocos Norte Province is proceeding with this program, particularly with upland crops.

5) As for garlic and tobacco, results of experiments on irrigation and effects of fertilization should be obtained.

6) The NIA is carrying out surveys on the size of farm management cropping patterns, cultivation methods and yield in the service area by sampling method. Results of the surveys should be examined and the characteristics of sections in the service area should be obtained.

6. Transbasin diversion plan

Though the Palsiguan Dam will be constructed in Abra Province, the service area will be outside the Province. However, the Province will directly benefit from the following two factors: secondary effects of flood control with the completion of the dam; and improved power supply for the State. On the other hand, there are demerits such as submerged land and a transfer of water

resources to other districts. Therefore, cooperation from the Abra Province is necessary for the achievement of the Project, and coordination between the Central and Local Governments concerned is desirable.

7. Phases of development

The present Project will require many more months for various basic surveys for the various reasons given above as it is a large-scale development program. However, in view of the fact that the Philippine Government and the local authorities are eager to embark on the project, those necessary surveys may be divided into two groups depending on the urgency: 1) those which require early feasibility surveys; and 2) those which will continue to be carried out until the time when field surveys should succeed them.

(1) To estimate the amount of water supply from other water sources than the Palsiguan Dam and set a planned area. A feasibility study is carried out for this area.

(2) With regard to other service areas, they are to be incorporated when the feasibility of Palsiguan Dam project is confirmed.

The first phase of development survey will consist of the feasibility study for(1) and the basic survey(2). As for the second phase, the Detailed Design for (1) and a feasibility study for(2) are to be carried out. However, under Plan(1), in case Plan(2) is set up, the construction of intake facilities and main irrigation channels whose suitability have been recognized will preceed.

IV FUTURE COOPERATION

1. As a point of contact between the technical problems discovered by this preliminary survey and the strong intention on the part of the Philippine Government to embark on the Project, the following survey program should be evoluated:-

Collection of hydrological and geological data concerning the dam and the power tunnel should commence at once. Since this will take at least two to three years, it should be found out if temporary supplying of water to the service area will affect the project adversely. Further, whether such a method is feasible and, as a partial program economically pays within the frame work of the entire project should be studied. Phase I of the survey program consists

of the collection of basic data and a feasibility study of a staged irrigation development system aiming at the realization of partial effects. Based on the results of Phase I, Phase II may be carried out to study feasibility of the entire project including the dam and the power plant.

2. Assuming that such surveys will be conducted, further survey may be carried out as follows:-

1) Development survey

For Phase II survey it is necessary to have long-term survey workers and specialits stationed in the area concerned for technical guidance on deplopment of hydrologic and observation, and for a transfer of know-how for planning geological surveys. At the same time, the staged irrigation system for the realization of partical effects should be given a direction by a team of specialists in advance. After these preparations have been made, collection of long-term data will be continued, and a feasibility study under Phase I may be carried out.

Then, with the collection of sufficent data for a feasibility study of the entire Project, a feasibility study of Phase II can commence.

2) Technical cooperation in agriculture

Then feasibility has been established under Phase I and II, contruction may commence with an international loan at an appropriate time. For the realization of effects of such construction work, the following condition should be provided:-

a) A new seedling center
b) Extension service center and its network regarding water management, fertilization and introduction of technology.
c) A farmers' organization for the establishment of a water management system and of circulation mechanism.
d) For improvement of mechanized agriculture, a mechanization center should be formed
e) Expansion of the Agricultural College

To satisfy these conditions, it will be effective to plan a technical transfer in project cooperation, and this should begin two years prior to the commencement partial supply of water by irrigation facilities.

3) Senior adviser

In the case of an integraled project such as this, it is necessary to coordinate the efforts made by the various authorities concerned. Therefore, it will be most effective to have a senior adviser specialist in Manila who can be responsible for coordination between NEDA, NIA and other bodies from the stage of project formation. And it is desirable and effective that he remains in his position until the completion of the project.

It is understood that there will be a another request for the Ilocos Norte road construction program. It is the idea on the part of the Philippine Government to develop this project to an integraled agricultural development program, if the feasibility can be established regarding the irrigation, the dam and the power plant. This will be effective for the provision of the above conditions. Therefore, prompt exchange of corespondence is necessary.

Appendix

I. Collected Data Lists

II. INTERIM Report

I. Collected Data Lists

Information of the Project

1. Project Identification Report
   Palsiguan River Multi-purpose Project
   Province of Ilocos Norte Republic of the Philippines
   National Irrigation Administration
   March 1977
2. Ilocos Norte Area Development Project
   Accomplishment Report
   for the mont of June 1977
   " July 1977
   " August 1977
   " September 1977
   " October 1977
3. Five-Year Philippine Development Plan 1978 - 1982
   incl. Ten-Year D.P. 1978 - 1987
4. Ilocos Norte Rural Development Project
   Road Component
   Planning & Project Development (DPH)

Agronomy

1. Philippine Virginia Tobacco .....
   Publication No. 1 1974
2. Three years of cooperative research on Philippine
   Virginia Tobacco ....
   UPCA. PVTA 1975
3. National Irrigation Systems Improvement Study
   (Feasibility report) .....
   Package I Appendix B
   Agriculture and project economy
   NIA and Sanyu Consultants Incorporated
4. Terminal Report on Agronomy for NISIS
   by Dr. I.C. Cagampang 1976

5. Present land use

by NIA

(Ilocos Norte Area Development Project Province of Ilocos Norte)

6. Land Classification Map

by NIA

(Ilocos Norte Area Development Project Province of Ilocos Norte)

7. Soil Map

by NIA

(Ilocos Norte Area Development Project Province of Ilocos Norte)

8. Soil Map

by NIA

(Ilocos Norte Area Development Project Province of Ilocos Norte)

9. Percolation Test Results

Ilocos Norte Area Development Project July 1976

10. Soil Survey of Ilocos Norte Province

Philippines Soil Report 39

11. Ilocos Norte 1971 Census of Agriculture

Vol. 1 Final Report

12. Fertilizer Recommendations

by Batac Soils Laboratory

13. Estimated Area Harvested, Production and Yield of Palay, Corn, Tobacco, Garlic and Mungo, with Market Price

by Bureau of Agriculture Economics

Data Collection Center

Laoag City

Topography

1. Topographical Base Map S = 1/250,000

2. " 1/50,000

Irrigation, Hydrology

1. National Irrigation Systems Improvement Study

Feasibility report Package I. Appendix C

by NIA and Sanyu ..... Copy

2. Appraisal of the National Irrigation Systems

Improvement Project I (April 12, 1977)

Report No. 1488a - PH ..... Copy

3. Philippine Weather Bureau Scientific Papers

Annual Climatological Review 1960, 1961

4. Hydrometeorologic Map (Ilocos Norte)

5. Historic Rainfall and Streamflow Records

6. Zanjeras (Communal Irrigation System) within the irrigable area of Labugaon-Madongan Irrigation Project Solsona, Ilocos Norte

7. Irrigated areas as of December 31, 1976 (NIA)

8. Project Identification Report

Ilocos Norte Rural Development Project

Irrigation Component February 1977

Soil & Geology

1. Ilocos Norte Area Development Project

Accomplishment Report

June '77 - October '77

2. Preliminary geologic report on the proposed Solsona Irrigation Project

Lolito E. Miguel, Sr.

Chief Geologist, Project Development Department NIA

Sept. 22, 1976

3. Geologic log of core-drill hole

Quiom/Maypalig Reservoir Project

Oct. 9, '76 - Dec. 27, '76

4. Geologic log of core-drill hole

Madongan Dam/Reservoir

Feb. 1, '77 - Aug. 15, '77 continued

5. A geologic report on the proposed Madongan Damsite (Reservoir)

Lolito E. Miguel, Sr.

NIA Jan. 1977

6. Gologic log of core-drill hole

Power tunnel alignment Aug. 26, '77 - Oct. 13, '77 continued

After bay dam Sept. 6, '77 - Sept. 15, '77

With "Regional geology of the proposed Power horse and after bay dam".

Electrification

1. Power Expansion Program

with DWGS of Luzon 115 KV, 230 KV & 345 KV Transmission Line Interconnections and Luzon 69 KV, 34.5 KV, 23 KV, 13.8 KV & 2.4 KV Transmission Lines.

National Power Corporation System Development Div.

(February 1977)

Others

1. Asian Agricultural Survey 1976 A.D.B.
2. Water Management in Philippine Irrigation Systems : Research & Operations (IRRI)
3. An agro climatic classification for evaluating cropping systems potentials in Southeast Asian rice growing regions. (IRRI)

II INTERIM REPORT

INTERIM REPORT
of
Preliminary Survey
on
Ilocos Norte Irrigation Project

December, 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

December 1, 1977

Mr. Alfredo L. Juinio
Administrator
National Irrigation Administration
Diliman, Quezon City

Dear Sir:

On behalf of the Preliminary Survey Team for Ilocos Norte Irrigation Project, I would like to submit herewith a report on the results of the survey made by the Team.

The Team carried out the survey of said Project thoroughly and sufficiently and had a series of discussions every now and then with officials concerned.

I am deeply grateful for the generous cooperation and well-planned arrangement extended by your staff and other authorities concerned.

In this connection, I expect the friendship and cooperation existing between the Republic of the Philippines and Japan will further be strengthened, we remain

Yours faithfully,

TADASHI YOSHIMITUS

Sub-Leader
Preliminary Survey Team
for Ilocos Norte Irrigation Project

JAPAN INTERNATIONAL COOPERATION AGENCY

Encl.: As stated.

cc.: Mr. Eduardo Corpus
Assistant Director General
NEDA

TABLE OF CONTENTS

INTRODUCTION

In response to the request of the Government of the Republic of the Philippines, the Government of Japan dispatched the Survey Team in order to conduct a preliminary study on the possibility of Ilocos Norte Irrigation Project. The Team, through Japan International Cooperation Agency is headed by Mr. T. Asahara consisting of eight (8) members starting from October 30th ending December 2nd, 1977. (List of members are shown in Annex I)

The terms of reference of the Survey Team are shown in Annex II and Annex III indicating survey activities.

Due to the results of the all out and positive cooperation extended by the Philippine central and local government offices, the survey was carried out satisfactorily obtaining the following survey results (Philippine staff members related to the survey are shown in Annex IV).

I. GENERAL REMARKS

1. Agriculture is the major industry for the area in the economic, social and all the other aspects. However, Ilocos region has been relatively lagging behind in agricultural infrastructure improvement. In order to remedy it, this irrigation project including power generation has a high potentiality, which our survey team also recognized, well.

2. The Team visited all sites of the proposed water resources as well as investigated and discussed the project sheme from specialized points of view such as dam, irrigation, agronomy and power.

3. As a result of these investigation, the water resources at Palsiguan damsite might be insufficient to supply the water for the irrigable area of about 22,000 ha. For making the solution of this problem, the following further studies will be recommended:

(a) Assessment of the service area based on potential water source,

(b) Evaluation of water source for additional reservoir and

(c) The cropping pattern in the combination with upland crops in dry season.

4. The proposed Palsiguan damsite seems suitable for dam construction from the technical point of view, taking into account the situation to the service area, topographic and geological conditions.

5. The capacity of the power plant shall be less than the proposed one because of insufficient water of the Palsiguan river. Nevertheless, much effect of the power supply not only to the area but also, to the Luzon Grid can be expected.

6. The proposed dam, tunnel and power plant are so large in scale that further investigation and study technical and systematical will be necessary.

7. This irrigation project will make it possible to introduce HYV of rice and modernized agricultural techniques such as proper fertilizer application, weed and pest control and so forth, thereby dry season rice will be planted in a wider area, and production yield will increase.

8. The proposed service areas are large and scattered. Therefore, diversion canals will be very long. In this connection, study on operation and maintenance for canals will be necessary.

9. The project is technically possible. There are, however, several alternative studies needed to obtain sufficient water supply and minimize the length of canal and project cost. The study of the project would be suggested to continue the investigation and data collection, as well as additional items mentioned in Par. 3 & 6. Further study is recommended to ascertain whether the project is feasible in both technical and economical points of view.

II. SPECIFIC ISSUES

1. Dam and Irrigation

(1) Water Resources (Dam, Tunnel and Diversion Dams)

(a) We, the Japanese Preliminary Survey Team for Ilocos Norte Irrigation Project, have concluded that Palsiguan Dan has been proposed as the main water source for Palsiguan River Multi-purpose Project, and Labugaon, Gasgas (Solsona), Madongan, Papa, Bonga (Nueva Era) and Quiaoit Diversion Dams as supplemental water sources. The Team visited all damsites mentioned above except Quiaoit and made ocular inspection of all damsites and reservoir areas by helicopters.

(b) The proposed Palsiguan Damsite seems justifiable from the following view points:

- o Potential situation necessary for irrigation and power generation;
- o Large catchment area necessary to secure a sufficient quantity of water; and
- o Avoidance of inadequate geological conditions with limestone prevailing on the downstream reaches of the Palsiguan river up to the vicinity of the Damsite.

(c) The information on the geological conditions at the Dam-site actually gathered is only a 1/5,000 map of "Structural Geology of the Proposed Damsite" prepared by NIA. Further investigations, drilling exploration at 15 points with a total length of 1,450 m covering the Tunnel Alignment, Power Plant and Afterbay sites, are under way.

However, no accomplishment was observed at the Damsite up to November 20, 1977.

On the way to pass through the path, limestone is seen at the both sides of the river, while stable rock formation known as Dacite at the damsite. Accordingly, it can be presumed that geological conditions at the Damsite have no particular deficiency though further detailed investigations are necessitated.

(d) The proposed dam height (EL. 375 m at the top) is only acceptable as the maximum one with the limitation that both abutments consist of stable rock formation in all elevations. It will be difficult to fit stably a higher dam body than the above-mentioned into both abutments, rather thin ridges shaved by tributaries flowing closely to them especially at the upstream of the right abutment and the downstream of the left abutment.

(e) Pervious materials for rock-fill dam such as hard rock and boulder are obtainable near the damsite. However, any impervious material was found near the site during the field inspection. It is emphatically necessary to conduct further investigations for the impervious materials.

(f) The Team likes to suggest the fact that the water amount available at the damsite, the most important factor for the Project, is less than the proposed one. On the assumption that the average annual precipitation is about 2,600 mm/year, and that the possible storage capacity is about 50% of the above-mentioned annual rainfall, taking into account the water demand for irrigation of the existing service areas located on the lower reaches of the Palsiguan river. The water to be stored at the dam is estimated at 200,000,000 cu.m. This volume is far less than the proposed active conservation storage of 300,000,000 cu.m.

By detailed study of flood control, it may be possible to make the surcharge storage be included in the active conservation storage by means of limiting water surface at the time of anticipated flood season.

A larger dam and reservoir than the above-mentioned would bring about difficult problems in water management, such as year-round inactive pocket of the reservoir.

(g) The Palsiguan river running through Abra province has its own service area existing between the damsite and the junction with the Tineg

river. The situation of the Damsite shall be considered bilaterally.

(h) On the Power-tunnel alignment including the Power Plant and Afterbay, eight drilling explorations with a total length of 910 m are under way, so geological conditions of the Tunnel shall, consequently, be considered. In any case, unexpected geological problems are bound to arise in the course of constructing a long tunnel under high mountains. Some combinations regarding the location of the power plant and hydraulic conditions of the Tunnel shall be comparatively studied from view points of construction and maintenance.

(i) Preliminary geological investigation by NIA at Madonga, Labugaon, Solsona, Bonga, Papa and Quiaoit Diversion dam-sites indicate that there are no serious problems to be encountered. However, further investigation will be required at these sites regarding Dam and Reservoirs due to insufficient water at the Palsiguan Damsite.

(2) Irrigation

(a) Proposed Area

The proposed project area under this Preliminary Survey is estimated to about 22,000 ha. in total, such as:

1) about 10,000 ha. alluvial fan-shaped areas at the right side of the Bonga river
2) about 5,000 ha. at both sides of the Lawa river of which Batac is the center.
3) about 6,000 ha. at both sides of the Badoc river of which Badoc is the center.
4) about 600 ha. of small basin in the west of Nueva Era. Hereinafter, (1) is called as No. 1 area, (2) as No. 2 area ..... (4) as No. 4 area.

(b) Possible Irrigation Area

The Team inspected some hydraulic gaging stations such as a rainfall and pan-evaporation station at Dingras and a rainfall, pan-evaporation and stream gaging station at the upstream of the Solsona river. But, the accuracy of measurements has not clearly been confirmed.

Percolation data of the basic data for irrigation planning were not

available in the service area during the field investigation, so the percolation shall be examined thoroughly, as well as examination of repeating use of water.

According to rough estimation based on general information, if only Palsiguan Dam is a reservoir in this project, available water discharge for irrigation during dry season shall be about 20 m^3/s. Therefore, it is necessary to study additional or alternative plan such as:

- o rearrangement of the service areas
- o additional reservoirs
- o study on cropping pattern in dry season

(c) Irrigation Canal

Two main irrigation canals are planned in the proposed project area. The one No. 1 canal is planned for No. 1 area from Nueva Era to the north-east direction across many tops of alluvial fan-shaped areas made by the rivers of Papa, Madongan, Solsona and Labugaon and has about 30 km in length. Accordingly, it must entail many cross works requiring full study for canal location and canal lining in connection with construction cost.

This canal will also be used as catchdrain from Ilocos range along which the canal will be located. Therefore, it is necessary to study appropriate system of catch-drain.

The other main canal, No. 2 is planned from Nueva Era to the west, then from Badoc to the north along 50 km in length. Because of complex topography, there may be some difficulties with regards to locations of the main and branch canals.

(d) Regulating Reservoir

It is better to have one or two regulating reservoirs in No. 2 main canal because the length of the canal is too long as around 50 km. It will make the canal smaller in size and also make smooth management of water distribution to these large areas.

(e) Supplementary Reservoir

In order to keep the irrigable area during dry season, supplementary reservoirs shall be proposed. There are some water resources rather suitable for reservoir such as Madongan. These reservoirs may affect

reduction of size of No. 1 canal and for preventing the alluvial river bed from variation.

(f) Operation and Maintenance

Due to the following reason, the existing system for operation and maintenance of irrigation facilities may be unsuitable for this Project:

- o large and separated service areas
- o power generation planned in the Project
- o three provinces related to the Project
- o big scale of facilities

Therefore, a special operation and maintenance system shall be considered for this project since combination of Irrigation and Power Generation, among others, is considered indispensable.

2. Agronomy

1) Present Status of Crops Culture

(a) Ilocos Norte has two distinct seasons in a year, the rainy season from May to November and the dry season from December to April. The prevailing cropping pattern in the province, which largely depends on such climate conditions, is the combination of rice and one of upland crops such as corn, tobacco and garlic. During the rainy season most fields are devoted to rice production, while dry season rice culture is limited to some areas along rivers with communal irrigation systems. Garlic and tobacco are the major upland crops in the province during the dry season though corn and mongo are also planted as upland crops after harvesting the wet season rice crop.

(b) River waters are directly supplied to the existing irrigation systems. Consequently, the variation of river water level exerts inevitable influences upon irrigation water supply. Some areas are over-irrigated in the rainy season, while nearly 60% of the total service area, mostly elevated and hilly areas, remains as rainfed area due to the insufficiency of irrigation water even in the wet season.

(c) Rainfed paddy fields are planted to tall and late-maturing traditional varieties with high photo-sensitivity. Yield of these traditional varieties seems relatively poor since the varieties bear a small number of tillers

though panicles themselves are large. It was observed during the field inspection that no rice production could be expected at some paddy fields at Batac, Badoc and No. 4 area.

(d) It is considered that yield of the first crop rice will increase to a considerable extent, if irrigation water is supplied to the rainfed areas, and if high yielding varieties of rice and proper fertilizer application are adequately introduced.

(e) Only 15 % of the total service area is planted to second crop rice in the dry season due to the shortage of irrigation water. About 10% were utilized for garlic and tobacco production and the rest remains as idle lands. Under such circumstances, it is well anticipated that sufficient irrigation water supply will increase the production area of rice during the dry season to a great extent.

(f) Actual records of rice production at farms and in other provinces of the Philippines where farm fields are equipped with irrigation facilities proved that rice production during the dry season shows generally higher than the wet season rice production. However, yield of rice during the wet season is much higher than that of the dry season in the service area possibly due to the shortage of irrigation water supply.

(g) Some farmers who engage in garlic cultivation equipped their farm fields with pumping facilities to utilize groundwater for irrigation, in order to attain the optimum yield. Therefore, if an appropriate volume of irrigation water is supplied in accordance with the water requirement in each stage of growth, the production might increase to a considerable extent.

2) Effective Use of Irrigation Water for Crop Culture, considering from an Agronomic View Point

For effective use of irrigation water, attention should be paid to the following:

(a) The longer the growing period of crops, the more irrigation water is required. Therefore, early maturing rice varieties should be introduced. In Dingras River Irrigation System, IR 30 and IR 38 whose growth period from transplanting to harvesting is within the range of 110 to 120 days have been planted and the highest palay yield of 75 cavans per ha. (3.75 ton/ha)

was recorded. On the other hand, the growth period of traditional rice varieties is more than 15 days.

(b) For smooth and timely irrigation water supply in the service area, a proper cropping pattern and planting calendar should be adopted both in wet and dry season. To cope with it, study should be made on effect of seedling and transplanting time on yield and grain quality.

(c) Water requirement of a crop varies with each of its growth stage. For instance, rice requires a little irrigation water during its non-productive tillering stage. During this stage, much irrigation water can be conserved. Needless to say, preparation of rationalized irrigation facilities is prerequisite for such way of irrigation water saving as mentioned herein.

(d) Upland crops require a smaller quantity of irrigation water than rice during their growth period. Therefore, upland crops should be planted in some area during the dry season. The cropping patterns of rice-garlic of rice-tobacco which have been adopted in the service area are to be prefered even after the implementation of construction for irrigation facilities so far as culture of these crops is economically advantageous.

(e) In order to estimate the water requirement, percolations in the rainy and dry season should be observed. The percolation is mostly determined by soil conditions and groundwater table. The soil analysis which has been made in a part of the service areas such as Batac, Badoc and Paoay, should be continously made for the whole service area.

3. Power

(1) In this project, there is a large in elevation between Palsiguan Damsite which river bed elevation is about 220 m from the sea level and the service area which is the highest point elevation of about 110 m so, that it is naturally intended to use the water for generating power.

Advantageous effects of Power generation in this project are that it would enhance the national policy of energy self-supply, and also, it would do much for the regional development of the Northern part of Luzon.

(2) Factors for determination of the capacity of the power plant, in this Project, are available water-head and maximum discharge for irrigation from Palsiguan Dam. And it is necessary to be in good balance of water

demand for Irrigation and water amount available in the Reservoir. The maximum installed capacity of the Power Plant shall be less than 30,000 kw (30 megawatt) which is about half of that proposed.

(3) Above-mentioned assumption is only an instance of numerous cases, so that it should not be indicated persistently in the future for this Project. Maximum installed capacity of the power plant shall be determined economically and rationally concerning with the following:

: Water discharge for Irrigation and its fluctuation

: The peak power demand in Luzon Grid of NPC with which the power plant should be interconnected.

: The re-regulating capacity of the Afterbay at Bonga river, Nueva Era.

(4) There are so many alternatives with regards to the locations of facilities of the power plant so that it is necessary to examine each possible case for the best combination.

For example:

(a) Power plant

: at Palsiguan, at Nueva Era or at both

: open-air type, underground type, or buried type

: with surge tank or with spill way

(b) Power tunnel

: pressured type or free flow type

Japan International Cooperation Agency
Tokyo, Japan