

Japan International Cooperation Agency (JICA)

No. 11

The Republic of the Philippines
National Irrigation Administration

**BASIC DESIGN STUDY REPORT
ON
THE REHABILITATION PROJECT
FOR
THE DIPALO RIVER AND PRINCIPAL COMMUNAL IRRIGATION SYSTEM
IN
PANGASINAN PROVINCE
IN THE REPUBLIC OF THE PHILIPPINES**

MARCH, 1994

NIPPON GIKEN INC.

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study on the Rehabilitation Project for the Dipalo River and Principal Communal Irrigation System in Pangasinan Province and entrusted the study to the Japan International Cooperation Agency (JICA).

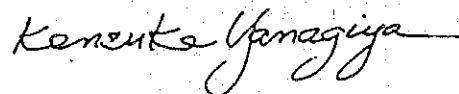
JICA sent to the Philippines a study team headed by Mr. Katsuhiko Oshima, Director of Study Review and Coordination Division, Grant Aid Study and Design Department, JICA and constituted by members of Nippon Giken Inc., from November 1 to 30, 1993.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted a field study in the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft report, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

March 1994



Kensuke Yanagiya

President

Japan International Cooperation Agency

March 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

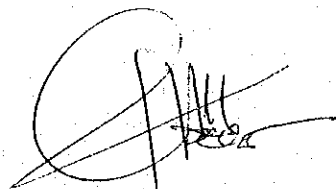
We are pleased to submit to you the basic design study report on the Rehabilitation Project for the Dipalo River and Principal Communal Irrigation System in Pangasinan Province in the Republic of the Philippines.

This study was conducted by Nippon Giken Inc., under a contract to JICA, during the period from October 25, 1993 to March 25, 1994. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Philippines and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

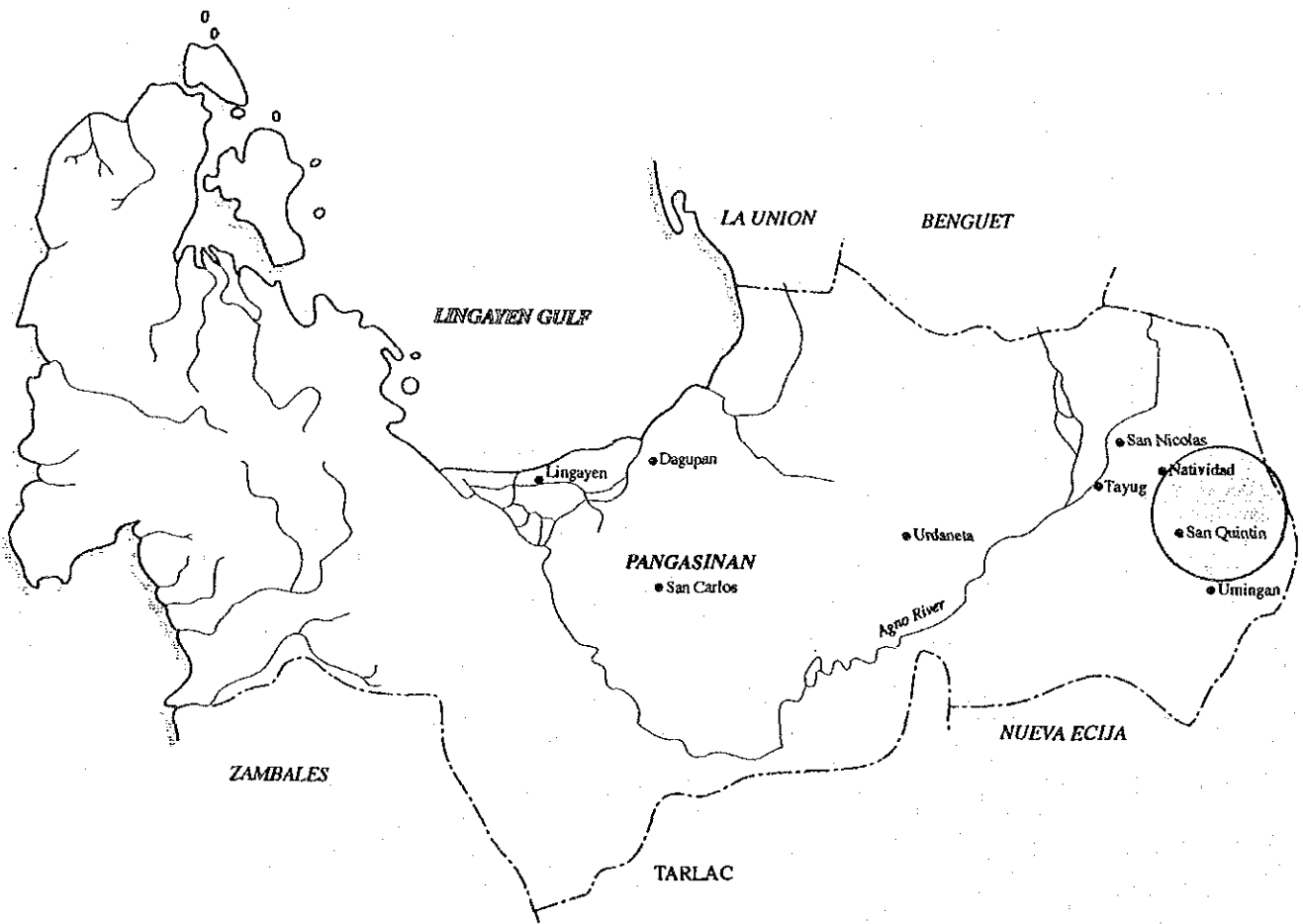
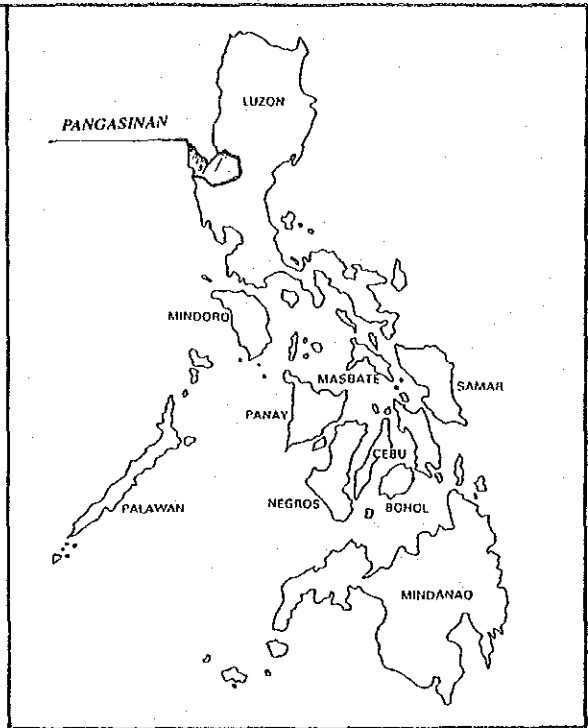
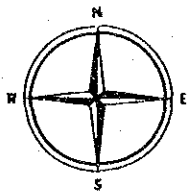
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fisheries. We would also like to express our gratitude to the officials concerned of National Irrigation Administration, the JICA Philippine Office and the Embassy of Japan in the Philippines for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

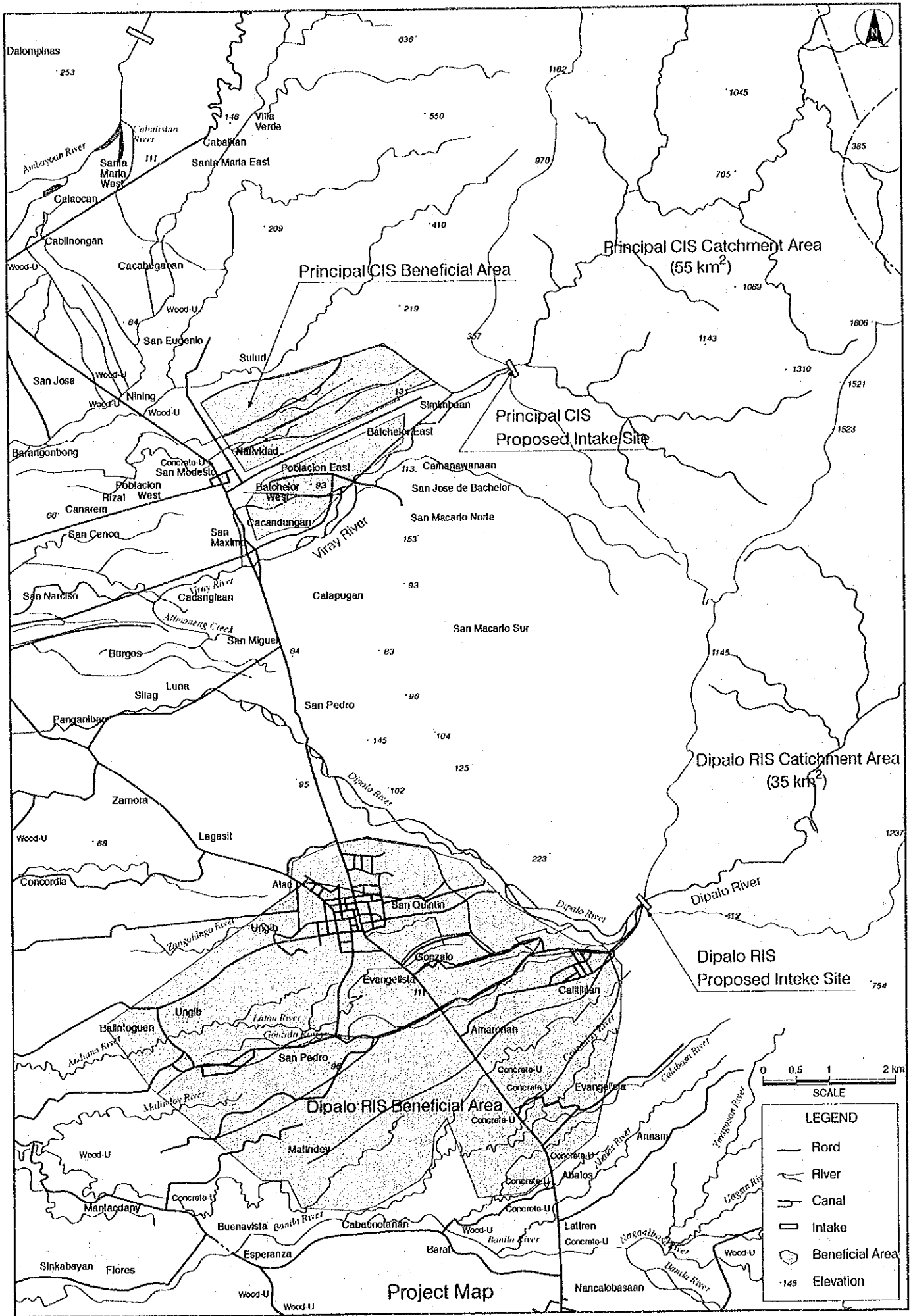
very truly yours,

A handwritten signature in black ink, appearing to read 'Yukawa', with a large circular flourish to the left.

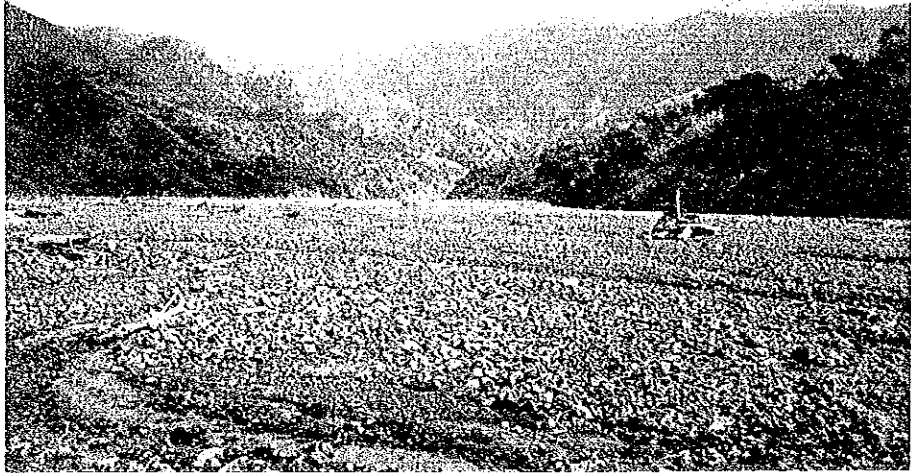
Yoshimitsu Yukawa
Project Manager,
Basic design study team on
the Rehabilitation Project
for the Dipalo River
and Principal Communal Irrigation System
Nippon Giken Inc.



LOCATION MAP

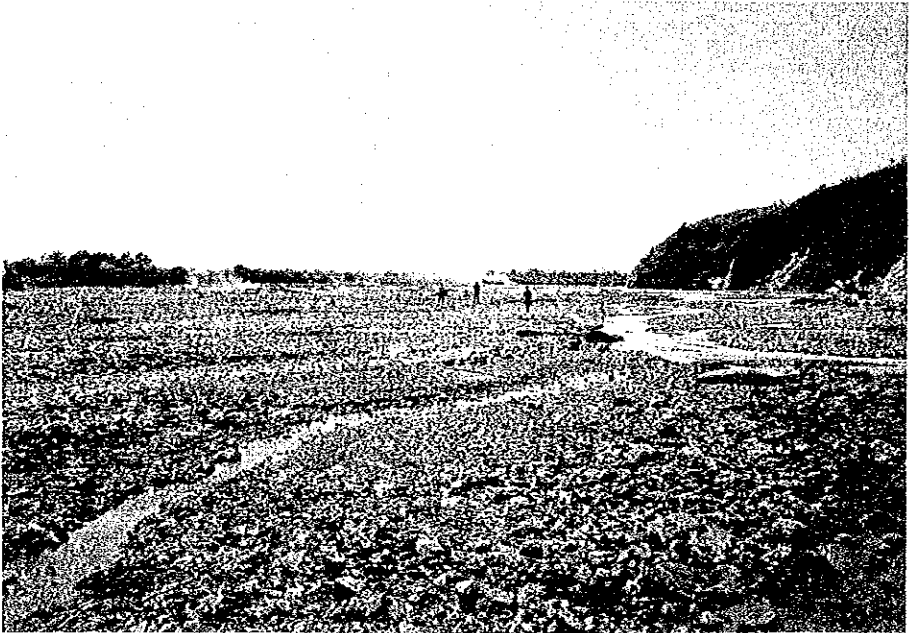


PHOTOGRAPHS



Dipalo RIS

View of upstream from proposed intake site.



Dipalo RIS

View of downstream from proposed intake site.



Dipalo RIS

View from right bank of the Dipalo river. (River flow, Damaged river bank, and Irrigation service area.)



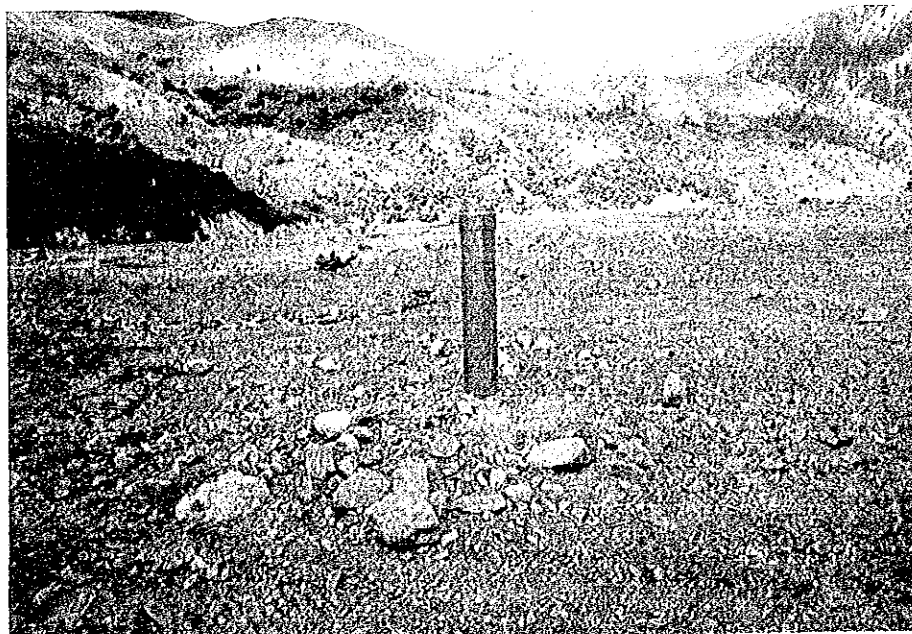
Dipalo RIS

Site of damaged river bank. River water flows over the bank into main canal.



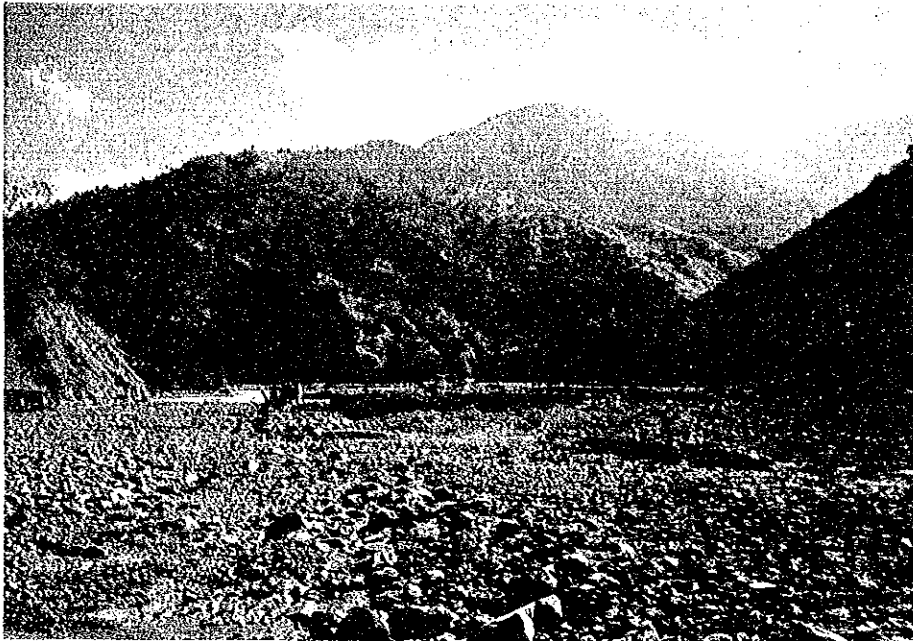
Dipalo RIS

Upper site of the main canal, that was damaged by debris inflow.



Dipalo RIS

Installation of observation well for groundwater level.



Principal CIS

View of upstream from proposed intake site.



Principal CIS

View of downstream from proposed intake site.



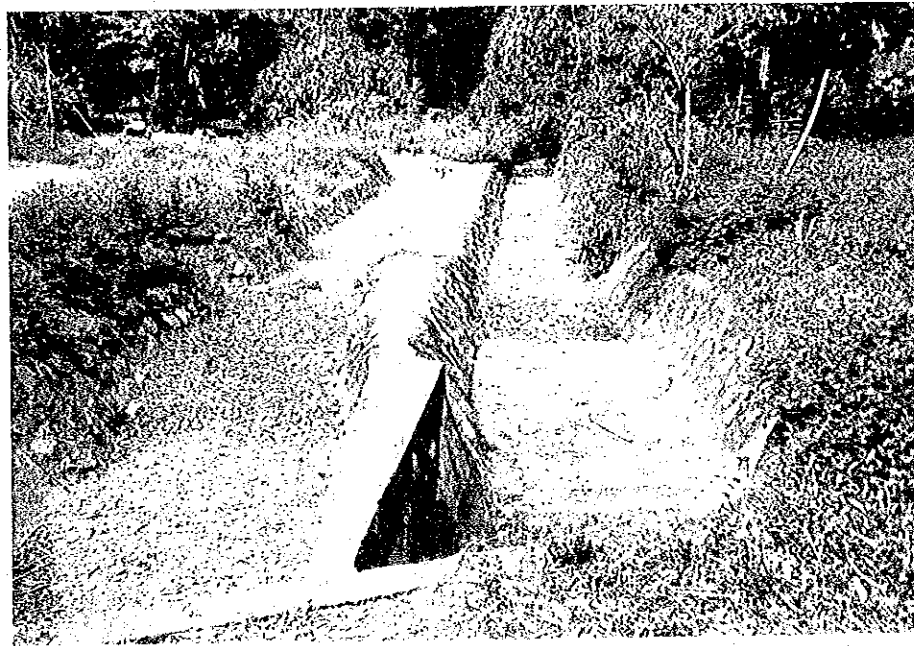
Principal CIS

View of irrigation service area.



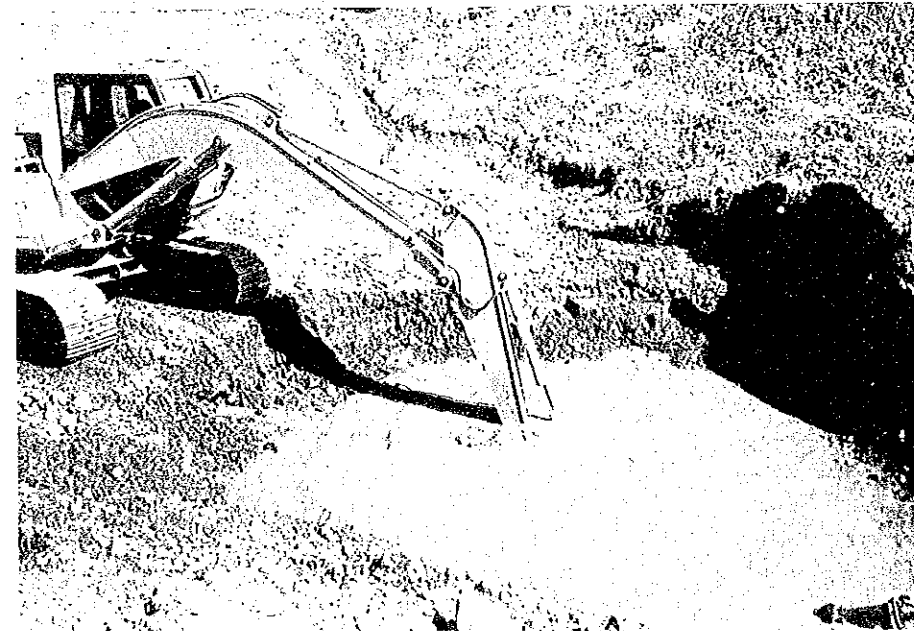
Principal CIS

Upper site of main canal.



Principal CIS

Existing diversion site of canal system.



Principal CIS

Excavation of test pit on debris deposit. Subsurface water flows in the pit.

SUMMARY

Pangasinan Province is located in the rice producing zone of central Luzon and the Dipalo River Irrigation System (Dipalo RIS) and the Principal Communal Irrigation System (Principal CIS) are situated on the most important systems conducted by the provincial government in line with the provincial development plan for the agricultural development and have been well operated. But the gigantic scale earthquake occurred in central Luzon in July of 1990, and caused heavy damage to these irrigation systems due to large-scale land slides in the catchment areas of the rivers continuing debris flows. As a result, the intake facilities of both irrigation systems have been thoroughly buried by debris deposit and are unable to function.

National Irrigation Administration (NIA) has carried out a feasibility study on Dipalo RIS and Principal CIS in February 1992 for recognition of damaged present conditions and groping a possibility of recovering functions of the systems.

Taking account of the result of the Feasibility Study, the Government of the Philippines composed a rehabilitation plan and requested the Government of Japan to assist the Project to be implemented under Japan's Grant Aid Program.

In response to the request, the Government of Japan decided to conduct a Basic Design Study (the Study) on the Project. Japan International Cooperation Agency (JICA) sent a expert team from November 1 to 30, 1993 for the Study under Japan's Grant Aid Program.

Depending on the result of the Field Survey and succeeding Home Works on the Basic Design Study, necessity and effectiveness of rehabilitation of the Project have been recognized, and proper facilities for irrigation have been designed by the Team. The Draft Final Report of the Basic Design Study is prepared by the Team, and JICA sent the mission for explanation of the Report from March 3 to 10, 1994, and the contents of the Report were acknowledged by NIA.

Present condition of the Project area recognized by the Study Team is as follows.

The existing intake weirs of the Dipalo RIS and Principal CIS have been completely buried under debris, and have lost their irrigation function. The depth of the debris deposit from the present river surface to the base rock is estimated at about 18 m at the proposed intake sites of the Dipalo RIS and 12 m at the Principal CIS. The inflow of debris from slopes along the catchment area is considered to have ended at the time of the Study. It was clarified by the Study Team that the debris deposit was not appeared at both 2 km upstream from the proposed intake site at the time. The debris in the river is moving from that sites to the downstream. It is a result of the field survey that the debris is not supplied newly but moving in the rivers.

On the agricultural aspects, paddy was planted in all fields during the wet season before the earthquake. Paddy, corn, legume, peanut and onion were cultivated in 29 % of the area in the Dipalo RIS and 88 % in the Principal CIS during the dry season. After the earthquake almost all fields have been forced to lie fallow during the dry season, while the cultivated area during the wet season has been considerably reduced due to lack of irrigation water. During the wet season, paddy cultivation is narrowly made possible by in sufficient water from river surface for irrigation through temporary intakes. During the dry season, only subsurface water flow exists in the rivers and so only a few areas can be cultivated using spring water. In addition to the decrease of cultivated areas, the cost for works on temporary intakes by floods are a heavy burden on the farmers. Further, the average yield of crops has dropped because of the dependence on rainfed or unstable irrigation.

Though the intake facilities are no functioning under the present conditions, they have still usable main canals by easy rehabilitation and active irrigator's associations in the Project area. Therefore, early attainment of effectiveness and smooth operation of the Project are promissible.

The Project will directly contribute to recovering the cropping area and cropping intensity to the pre-earthquake level.

Cropping Areas and Cropping Intensity at Before and After Earthquake

Cropping		Dipalo RIS		Principal CIS	
		Wet Season	Dry Season	Wet Season	Dry Season
Before	Area (ha)	1,548	447	770	676
Earthquake	Intensity (%)	(100)	(29)	(100)	(88)
After	Area (ha)	387	10	208	9
Earthquake	Intensity (%)	(25)	(1)	(27)	(1)

The original request by the Government of the Philippines consisted only of construction of the intake facilities of the systems. However, heavy damages were found on the main canals in both systems and the protection dike in the Dipalo RIS through field reconnaissance by the Team. Because reconstruction works of these facilities were deemed essential in order to rehabilitate the irrigation systems completely, it was decided between the JICA Team and NIA to include them into the Project.

The components of the Project agreed upon by both parties are summarized as follows.

Item	Dipalo RIS	Principal CIS
A. Intake Facility		
(1) Impervious Wall		
Type	Reinforced concrete	Reinforced concrete
Location	250 m upstream from original weir site	150 m upstream from original weir site
Length	188 m	207 m
Depth	18 m	12 m
Thickness	800 mm	800 mm
Appurtenant Facility	Waterway: 80 m width Inlet: 1 unit River bed protection: 3 sites	Waterway: 120 m width Inlet: 1 unit River bed protection: 2 sites
(2) Collecting Conduit		
Collecting Conduit		
Material	F.R.P pipe with hole	F.R.P pipe with hole
Diameter	600 mm	800 mm
Total length	700 m (20 m * 35 lines)	840 m (24 m * 35 lines)
Connecting Pipe		
Material	F.R.P pipe without hole	F.R.P pipe without hole
Diameter	800 mm	1,000 mm
Total length	150 m	150 m
Appurtenant Facility	Filter: 3 layers Pressure control box: 1 unit	Filter: 3 layers Pressure control box: 1 unit
(3) Transmission Conduit		
Material	RC pipe covered by reinforced concrete	RC pipe covered by reinforced concrete
Diameter	700 mm	900 mm
Total length	950 m	950 m
Appurtenant Facility	Maintenance box: 2 units Outlet box: 1 unit	Maintenance box: 2 units Outlet box: 1 unit
B. Main Canal (Rehabilitation of the existing main canals)		
- Rehabilitation of Upper Portion of Main Canal	Length: 950 m Reinforced concrete flume type	Length: 950 m Reinforced concrete flume type
- Concrete Lining of Main Canal	Total length: 3.0 km Reconstruction: 400 m of the 3 km	None
- Dredging	Length: 400 m	None
C. Protection Dike (Rehabilitation of the existing protection dike)		
Type	Gabion	None
Length	1 km	
Height	3.25 m	

D. Equipment Supply (To intake of surface water and O & M on irrigation facilities)

Bulldozer (6.5 t)	1 unit	1 unit
Backhoe Shovel (0.25 m ³)	1 unit	1 unit
Pick-up (4-wheel-drive)	1 unit	1 unit
Motorcycles (125 cc)	1 unit	1 unit

The main facilities of the Project are the intake facilities to secure the original irrigation level. Several alternatives were considered for this purpose. Based on several alternative studies, installation of collecting conduits is selected as the most suitable method for the area. The method is considered to be appropriate both technically and economically. The structure is stable against movement of debris, and the operation cost is free. The impervious wall is to be constructed on the downstream side of the collecting conduits to secure a more stable water supply during the dry season. Furthermore, inlet for a surface-water is installed on the impervious wall to collect additional surface water during the wet season.

This subsurface water collecting conduit system is newly proposed in the Philippines, and is adopted based on the examination of engineering and economic feasibility, ease of construction and ease of O & M. However there are many other irrigation systems damaged by the thick river sand deposit, the proposed subsurface water intake system is expected to apply to the recovering of intake function of the irrigation systems in the Philippines.

The construction work should be carried out intensively during the dry season, because most construction will take place in rivers. The parallel construction of both sites during one dry season is difficult to be undertaken considering the volume of earth work and concrete work, increased transportation time for concrete, and so on. Therefore, the Project shall be executed in two phases.

As each site is independent, the effects of the Project will immediately appear after completion of construction at one site. And the construction will require 12 months for each phase. The construction of the Dipalo RIS shall be started prior to that of the Principal CIS because of the possibility of further flood damage to the Dipalo RIS.

The components of operation and maintenance of the proposed facilities in the Project are maintenance of the river and main canal, and dredging to remove packed debris at the inlet of the impervious wall for surface water. For these works, bulldozer and backhoe shovel shall be used. Maintenance of the main canal is required during the wet season and at the beginning of second cropping, which requires about 90 days a year. The dredging works at inlet should be done after each flood, requiring a total of 60 days a year. The annual O & M costs are estimated at 90,000 Pesos (340,000 Yen) at each site.

The direct effect of the Project is an increase in agricultural production in the Project area through rehabilitation of intake facilities for irrigation. The production value, which is very low at present due to water shortage, will recover to the pre-earthquake level by the rehabilitation works of the Project.

The direct beneficiaries of the Project are the farmers in the irrigation area, and the number of which is estimated at 8,877 in the Dipalo RIS and 3,624 in the Principal CIS totaling 12,501.

This Project can not extend the irrigation service area beyond the pre-earthquake area due to limitation of water resources. Because of the effective use of surface and subsurface water in the Project, unit crop yields in the area will increase and stabilize at a higher level. Improved cropping areas and better yield rates will result in increased total crop production. The total increase in net farm income in the area is estimated at 39.61 million Pesos (151 million Yen) per annum between with and without-project conditions. The annual net income of each farm household in the beneficial area is expected to increase of 17,000 Pesos (65,000 Yen).

In addition to the above crop production effects, the Project will provide the effect of flood control. The protection dike in the Dipalo river, which will be reconstructed to protect the main canal and farm lands, will prevent flood damages such as accumulating of debris in the canals and breakage of the canals and canal structures.

After the original intake facilities were buried, farmers have been obtaining irrigation water from temporary intakes and canals built at each cropping season. This work cost is a heavy burden on the farmers. The Project will contribute to eliminate this burden.

As described above, the Project is expected to create direct and indirect effects in recovering or upgrading the agricultural outputs and contribute in various ways to enhance the lives of inhabitants in the Project area. The Project is considered as a pilot project for groundwater intake method in rivers, and the NIA intends to extend this type of irrigation to the many irrigation systems that suffer from siltation in the rivers. The executing agency of the Project, NIA, is capable organizationally, technically and financially to execute the Project. Also, respective offices of the NIA and the Irrigators Associations in the Project Area which responsible for operating and maintaining the facilities have already been established.

In conclusion, it is recommendable that the Project shall be executed under the Grant Aid Program by the Government of Japan in an expedient manner.

In order to facilitate the implementation, operation and maintenance of the Project, it is recommended that the Government of the Philippines undertake the followings.

- To secure land for construction, temporary roads and stock yard.
- To hold meetings with the farmers in advance to explain possible effects on their irrigation works and farming activities caused by the construction works.
- To maintain the downstream portion of the main canals and whole lateral canals by Irrigators Associations.

Furthermore, achieving effective operation after construction will depend considerably upon the self-help efforts of farmers as well as the efforts of the Philippine officials. It is, therefore, recommended that the concerned Philippine personnel conduct their activities with due attention to the following points.

- Regarding the Dipalo RIS, Ambayoan Dipalo RIS shall be responsible to the Operation and Maintenance of the main facilities of the RIS such as gate operation, intake facilities and main canals, and shall control the IAs, which shall conduct the Operation and Maintenance of the terminal facilities including secondary canals.
- Regarding the Principal CIS, Provincial Irrigation Office Pangasinan shall control the IAs, and the IAs shall be responsible to the entire system.
- The NIA shall work to strengthen relationships with IAs for successful operation and maintenance of this irrigation systems. For this purpose, NIA shall provide regulations regarding operation and maintenance of intake facilities and canals, collection of irrigation service fees, etc. and execute them with guiding IAs.
- The respective Irrigation Offices should properly manage the furnished O & M equipment, giving priority to O & M activities in the Project area, and also allowing the use in other daily concerned activities as well.

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APPENDIX

1. Appendix on Basic Design Study
2. Appendix on Explanation of Draft Final Report

TECHNICAL DATA

DRAWINGS

ABBREVIATIONS AND TERMS

ADB	Asian Development Bank
ADRS	Ambayoan-Dipalo River Irrigation System
CIS	Communal Irrigation System
IA(s)	Irrigators Association(s)
JICA	Japan International Cooperation Agency
MTPDP	Medium-Term Philippine Development Plan
NIA	National Irrigation Administration
NIS	National Irrigation System
PIO	Provincial Irrigation Office
RIO	Regional Irrigation Office
RIS	River Irrigation System
cm	centimeter
ha	hectare
kg	kilogram
km ² , sq.km	square kilometer
m	meter
mm	millimeter
m ² , sq.m	square meter
m ³ , cu.m	cubic meter
sec, s	second
t	ton
%	per cent
P	Philippine Peso
\$, U.S. \$	U.S. Dollar
Y	Japanese Yen

CHAPTER 1 INTRODUCTION

The Rehabilitation Project for the Dipalo River and Principal Communal Irrigation System in Pangasinan Province (hereinafter referred to as "the Project") is planned to rehabilitate the intake facilities of the Dipalo River Irrigation System (Dipalo RIS) and the Principal Communal Irrigation System (Principal CIS) in the eastern part of Pangasinan province, which lost irrigation function completely by the heavy earthquake in July, 1990. The Project aims to restore a large output of agricultural production in both irrigation areas, and to motivate inhabitants to work on the Project works.

National Irrigation Administration (NIA), the Government of the Philippines confirmed the high priority of the Project and urgent need of its implementation through Feasibility Study on the Project by NIA itself in 1992. The Government of the Philippines requested the Government of Japan to consider the Project under Japan's Grant Aid Program in the year of 1992. In response to the request, the Government of Japan decided to conduct the Basic Design Study (the Study) on the Project. The Japan International Cooperation Agency (JICA) sent the Study Team (the Team) headed by Mr. Katsuhiko Oshima, Director of Study Review and Coordination Division, Grant Aid Study and Design Department, JICA, to study the Project under Japan's Grant Aid Program, for 30 days from November 1 to 30, 1993. Member list of the Team, survey schedule, member list of persons concerned, and Minutes of Discussions are attached in Appendix.

Through the Field Survey and succeeding Home Works, necessity and effectiveness of rehabilitation of the Dipalo RIS and Principal CIS in Pangasinan province have been recognized, and proper facilities for irrigation have been designed by the Team. The Project is deemed to be suitable for the Japan's Grant Aid Program, and this Basic Design Study Report on the Project is prepared by the Team as a result of the whole Study.

JICA sent the mission headed by Mr. Yuto Hara, staff of 1st Basic Design Study Division, Grant Aid Study and Design Department, JICA, for explanation of the Draft Final Report from March 3 to 10, 1994. As a result of discussion, the contents of the report were acknowledged by NIA.

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Outline of Agriculture and Irrigation in the Philippines

In the Republic of the Philippines that is one of agricultural countries, self-sufficiency of staple foods is one of important national policies toward economic development. The irrigation development at national level is a strategy to achieve self sufficiency of staple foods. The National Irrigation Administration (NIA) conducts a number of irrigation projects in 1,488,000 ha of paddy field out of total 3,170,000 ha paddy field in the Philippines. The irrigated paddy field consists of 627,000 ha or 42 % of National Irrigation System, 709,000 ha or 48 % of Communal Irrigation System and 152,000 ha or 10 % of Pump Irrigation System in the country.

National Irrigation Systems, which have larger service areas, are constructed by NIA directly and the irrigation facilities are also operated by NIA after completion of the construction. On the other hand, Communal Irrigation Systems, which have smaller service areas, are principally under administrative and technical control of NIA, and constructed and operated by irrigators' associations which consist of beneficiaries.

Some of these irrigation systems are damaged and lessen their function due to natural calamities, superannuation and inadequate design and management. A number of beneficial farmers in such irrigation systems are forced to low and unstable farm production because of shortage of irrigation water.

2.2 Outline of Relevant Development Plan

(1) Medium-Term Philippine Development Plan (1993-1998)

The Medium-Term Philippine Development Plan (MTPDP, 1993-1998) started within the circumstances of the present Philippine economy. The MTPDP stated basic vision for development, sectoral development framework of 1) agro-industry development, 2) human development, and 3) infrastructure development, and area development strategies of 1) Luzon, 2) Visayas and 3) Mindanao.

The MTPDP aims poverty alleviation, achievement of social justice and sustainable development. These objectives shall be attained by human empowerment, and strategies for them are as follows.

- Human development, which will address the spiritual, political, socio-cultural and physical aspects of people empowerment.
- International competitiveness that will be necessary for the attainment of people empowerment in the economic sense.

The specific strategies that shall be adopted in support of this overall objective are the following.

- Generate investments in capital, technology and people.
- Improve domestic resource mobilization
- Maintain macro-economic discipline

The MTPDP puts stress upon decrease regional imbalance of economy through development of the growth centers in the outer regions, concerning to excessive centralization of population and capital into the Metro Manila. Therefore, development plan is programmed by region for Luzon, Visayas, Mindanao and other regions. In the agriculture sector of Luzon development plan, massive agricultural productivity improvement, agricultural support services in terms of irrigation development, commercialization of appropriate technologies, easy access to credit, effective extension services and post-harvest facilities development will be necessary requirements.

(2) Philippine Agricultural Development Plan (1991-1995)

Corresponding to the basic policy of the MTPDP, the Philippine Agricultural Development Plan for 1991-1995 was declared by the Department of Agriculture (DA) in 1990. The plan is mentioning targets and strategies of the agricultural development during the five (5) years, on the idea that the improvement of agriculture sector is to be the base of national economic development. The principle of the policy is as follows.

- a) To provide the public goods and services that will support and facilitate the efforts of small farming families to attain sustainable productivity and increase their real incomes.
- b) To advocate an economic environment that will increase incentives for agricultural enterprises to a level at least commensurate with the level of incentives for the rest of the economy, and to promote the efficient allocation and optimum utilization of scarce resources, consistent with the principle of equitable and sustainable development.
- c) To help direct more public investments to, and hasten the provision of, badly needed infrastructure and services supportive of agro-industrial development in the rural areas.

To achieve its policies, following strategies are addressed in consideration of priority.

- a) Empowering of small farmers through 1) extension of full support for the speedy achievement of the equity objectives of agrarian reform and provide agrarian reform beneficiaries with the support services they require, 2) assistance for small farmers in the establishment of self-help organizations that can sustain agribusiness enterprises, and 3) institution for full participation of small farmers in the decision-making and in planning, implementation, and monitoring of DA programs and projects.
- b) Improvement of the Department's capability to deliver the services needed by farmers through 1) upgraded quality and broad reach of its extension services, 2) improvement of its policy, planning and management capabilities, 3) acceleration of the devolution of planning, programming, and implementation authorities and responsibilities to the provincial and municipal levels, and 4) foreign assistance to support agricultural and rural development.

- c) Creation of an economic environment conducive to increase agricultural productivity and incomes through 1) reforms in trade, taxation, transport, natural resource pricing, credit, and micro-economic policies that stifle the growth of agriculture, 2) work to ensure that farm prices keep pace with inflation, and 3) more government expenditure on rural infrastructure and research and extension.
- d) Development and dissemination of appropriate location-specific and cost-reducing production and post-harvest technologies.
- e) Reduction of the cost of production inputs, especially certified seeds, fertilizer, and irrigation, and increasing the availability of these inputs.
- f) Increasing the availability of credit to small farmers by implementing more credit programs which course credit resources through farmers' organizations.
- g) Facilitation of access to markets and the promotion of efficient markets and marketing systems.
- h) Special assistance to poverty-stricken rural communities and groups, specifically the provision of infrastructure, nutrition, and health assistance, alternative livelihood opportunities, and improved resources management techniques to poverty-stricken upland and coastal communities.
- i) Implementation of measures to cushion and minimize the damage to agriculture and rural economy bought about by natural calamities.

(3) Provincial Development Plan of Pangasinan

Depending on the basic strategy of the Philippine Agricultural Development Plan, individual provincial development plan is also established reflecting characteristic of each local condition.

Pangasinan provincial government prepared the Provincial Development Plan for 1992-1995. This plan consists of 1) human infrastructure or human engineering program, 2) agricultural development program, 3) infrastructure program, 4) industrialization program, and 5) other programs.

- a) To increase the present productivity of rice from an average of 3.15 ton/ha to 4.25 ton /ha.
- b) To increase agricultural production and maximize land utilization with soil suitability and area zonification.
- c) To reduce farmers dependence on chemical fertilizers and improve soil texture with organic farming.
- d) To optimize agricultural commodity production through efficient delivery of technical service.
- e) To increase the area to be planted during the second cropping by 7,735 ha and later much more.
- f) To improve the quality of rice and grains and cereals through the provision of post harvest facilities.
- g) To organize rural-based associations such as farmers, irrigators, Rural Development Clubs, cooperatives and out-of-school youths.
- h) To develop self-reliant farming communities.

2.3 Outline of the Request

(1) Outline of the Request

Both of the Dipalo River Irrigation System (Dipalo RIS) and the Principal Communal Irrigation System (Principal CIS) are located in the rice producing zone of central Luzon. The great earthquake, which occurred in central Luzon in July of 1990, caused heavy damage to these irrigation systems by large-scale land slide in the catchment areas of the rivers continuing debris flow. As a result, the intake facilities of both sites are thoroughly buried by debris deposit and have lost their function. This Project aims to reconstruction the intake facilities for irrigation and agricultural production in the two systems as the conditions before earthquake.

National Irrigation Administration (NIA) recommended immediate rehabilitation in the Dipalo RIS and Principal CIS, based on the feasibility study for the Project conducted by NIA itself. Based on the above situation, the Government of the Philippines requested the Japan's Grant Aid Program to the Government of Japan on the Rehabilitation Project for the Dipalo River and Principal Communal Irrigation System in Pangasinan Province.

(2) Components of the Request

The Project area is located in the eastern part of Pangasinan province. The service area of the Dipalo RIS covers municipalities of San Quintin and Umingan, and that of the Principal CIS covers municipality of Natividad.

The Project is to recover irrigation function in the Dipalo RIS and Principal CIS whose intake facilities were suffered by debris deposit caused by the earthquake. The most suitable intake method for rehabilitation is to catch the underground water effectively by new installation of collecting conduit and impervious wall in the debris deposit. This method has an advantage that the intake capacity is not affected by continuing debris movement on the rivers. This underground intake method, which is the first experience in the Philippines, is adopted in deep considerations with technical and economical soundness, construction method, and simple operation and maintenance works after construction.

The implementing agency of the Philippines side is the National Irrigation Administration (NIA).

(3) Fixation of Components of the Request

The original request by the Government of the Philippines consisted only of construction of the intake facilities of the systems. However, heavy damages were found to exist on the main canals in both systems and the protection dike in the Dipalo RIS through field reconnaissance by the Team. Because reconstruction of these facilities were deemed essential in order to rehabilitate the irrigation systems completely, it was decided between the JICA Team and NIA to include this into the Project.

The components of the Project agreed upon by both parties are summarized as follows.

1. Intake Facilities
 - 1) Components of the intake facility in the Dipalo RIS
 - a. Impervious wall
 - b. Subsurface collecting conduit
 - c. Transmission conduit to the existing main canal
 - 2) Components of the intake facility in the Principal CIS
 - a. Impervious wall
 - b. Subsurface collecting conduit
 - c. Transmission conduit to the existing main canal
2. Main Canals
Rehabilitation of the existing main canals in both systems.
3. Protection Dike
Rehabilitation of the existing protection dike in the Dipalo RIS.

CHAPTER 3 OUTLINE OF THE PROJECT AREA

3.1 Location and Socio-economic Conditions of the Project Area

(1) Location

The Project areas are located in the Municipalities of San Quintin and Natividad in the eastern part of the Province of Pangasinan, situated within an area between 15° 57' to 16° 04' in the north latitude and 120° 45' to 120° 51' in the east longitude. It is approximately 200 km north of Metro Manila and 30 km east of Urdaneta, where NIA Regional Office and Provincial Office are located. Access to the project area is through Urdaneta to Natividad, San Quintin provincial road. Location of the Project area is shown in Location Map.

(2) Socio-economic Conditions

The Project areas of the Dipalo RIS and Principal CIS are located in 17 barangays and 5 barangays, respectively. Population of those barangays is 21,565 and 5,838, and numbers of households are 3,998 and 1,104, respectively. The numbers of beneficial households are 1,647 and 685, respectively. The population growth rate of the related three (3) municipalities is 1.35 % in average. The population, number of households and service area of the Project are shown in Table 3.1.1.

Table 3.1.1 Population, Household and Project Area of the Project

Irrigation System	Municipality	Number of Barangays	Population	Number of Households	Project Area (ha)
Dipalo RIS	San Quintin	15	20,266	3,741	1,815.7
	Umingan	2	1,299	257	147.3
	Sub-total	17	21,565	3,998	1,963.0
Principal CIS	Natividad	5	5,838	1,104	920.0
Total		18	27,403	5,102	2,883.0

The income level of the farm households in the Project area before the earthquake is estimated at the lower than poverty line as shown in the following table. The farm economy would fall down from the level these years because of the impossibility of irrigation.

Table 3.1.2 Farm Income in the Area before the Earthquake

Irrigation System	Income Per Household (Pesos/household/year)	Income Per Capita (Pesos/person/year)
Dipalo RIS	21,434	3,944
Principal CIS	29,482	5,565

3.2 Natural Conditions

(1) Topography

The Dipalo RIS and Principal CIS are located in the alluvial fans of the Dipalo river and the Viray river. The northeast of the area is mountainous area with elevation of about 1,500 m. Many steep rivers flow from the ridge to the west-southwest and formulate alluvial fans. These rivers afterward join the Agno river, the large river in Central Luzon, and reach to the gulf of Lingayen.

(2) Geology

The major geological characteristic of the area is that the Philippine Fault runs on the foot of the steep mountain from the north-northwest to the south-southeast. The fault was the epicenter of the earthquake of 1990. The eastern mountain area of the fault upheaved after the earthquake.

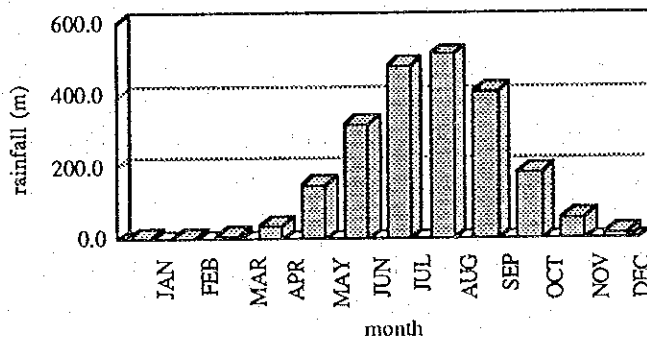
The slope area of the mountain consists of igneous rock such as basaltic or andesitic tuff, which is easy to slide. Therefore, the land slide of the slope occurred heavily and widely. The irrigation area is located in the alluvial fan and continuing alluvial plain.

(3) Climate and Hydrology

Meteorologically, the Project area falls under Type I that is characterized by two pronounced seasons. One is the dry season affected by the northern monsoon from November to April and the other is the wet season affected by the southwest monsoon from May to October. Mean annual rainfall on the area reaches 2,263 mm on an average. The mean temperature at Dagupan City is 27.9 °C. The relative humidity at Dagupan City varies from 72.4 percent to 84.9 percent.

However the rainfall data at San Roque station from 1982 to 1992 is collected, the data is deficient with a lot of observation missing and is not adopted to the hydrological analysis.

Rainfall data at San Roque Station, which is located in the 10 km north of the area, are shown in Figure 3.2.1.



Figutr 3.2.1 Monthly Rainfall (San Roque station)

(4) Soils, Vegetation and Land Use

The soils of the beneficial areas are mostly classified into Annan Series and Umingan Series. Soil of Annan Series is generally extended steep area. Cultivated area with this soil has been planted to rice, corn, vegetable, root crops and some fruit trees. Soil of Umingan series is good for cultivation using easily applied conservation practices. Both of the soils are well drained.

The land slide in the catchment area caused by the earthquake turned the original forest of the area into waste land. As a result, some problems occurred, such as decrease of water retention capacity of soils, erosion of surface soils, increase of peak discharge of river flows, and so on.

3.3 Social Conditions

The access road is conditioned well from Urdaneta, the location of NIA-RIO and NIA-PIO, to the center of the Municipalities of Natividad and San Quintin. The route is a paved road through Tayug, the location of NIA-ADRIS. The municipality centers of Natividad, San Quintin and Umingan are connected by provincial road paved by concrete partially. There were three (3) major bridges on the provincial roads in the section. The bridge over the Dipalo river was broken by a series of floods, but 4-wheel-drive cars can pass across the river bed. The bridges over the Viray river and Vanilla river are passable now. The access roads from the provincial road to the proposed intake sites are gravel roads, and construction equipment can pass through them.

In the municipal centers of Natividad and San Quintin, there are public markets and rice mills for trade of farm products.

The domestic water is supplied from public and private wells in the area. During the dry season the wells often dried up in upper areas.

The electric power is supplied to the most barangays in the area, but electrification of individual households is still at a low level. There is a telecommunication office in San Quintin for local, interlocal and international calls.

3.4 Outline of Agriculture and Irrigation

(1) Outline of Agriculture and Irrigation

The irrigation areas, 1,548 ha in the Dipalo RIS and 770 ha in the Principal CIS, were all paddy fields. Table 3.4.1 shows the cropping areas in the area before and after the earthquake, by crops and by cropping seasons.

Table 3.4.1 Cropping Areas in the Project Area before/after the Earthquake

Irrigation System	Crop	Before Earthquake (- 1990)		After Earthquake (1991 - 92)	
		Wet Season	Dry Season	Wet Season	Dry Season
Dipalo RIS	Paddy	1,548 ha	237 ha	387 ha	5 ha
	Legume	- ha	98 ha	- ha	2 ha
	Onion	- ha	112 ha	- ha	3 ha
	Total Area	1,548 ha	447 ha	387 ha	10 ha
	Crop. Intensity	100 %	29 %	25 %	1 %
Principal CIS	Paddy	770 ha	370 ha	208 ha	5 ha
	Corn	- ha	167 ha	- ha	2 ha
	Onion	- ha	139 ha	- ha	2 ha
	Total Area	770 ha	676 ha	208 ha	9 ha
	Crop. Intensity	100 %	88 %	27 %	1 %

Before the earthquake, paddy was planted in all fields during the wet season. During the dry season, crops of paddy, corn, legume, peanut and onion were cultivated in 29 % of the area in the Dipalo RIS and 88 % in the Principal CIS. After the earthquake almost all fields have been forced to lie fallow during the dry season, while the cultivated area during the wet season has been considerably reduced due to lack of irrigation water. During the wet season, paddy cultivation is made possible by using surface water from rivers for irrigation through temporary intakes. During the dry season, only subsurface water flow exists and so only a few areas can be cultivated using spring water.

The temporary intake works necessary for wet season irrigation are made to be a training dike with about 0.5 m height by bulldozer gathering river bed material. The intake function is only about 0.5 m³/sec in wet season. This temporary intake works are easily flushed away by small flood, and farmers are obliged to work out it by flood more than 10 times in one rainy season.

In addition to the decrease of cultivated areas, the costs for constructing temporary intakes yearly are a large burden on the farmers. Further, the average yield of crops has dropped because of having to rely on unstable irrigation water supply and unpredictable rainfall.

(2) Irrigators Association

There already exist Irrigators Associations (IAs) in the Dipalo RIS and Principal CIS, as shown in Table 3.4.2. The IAs have effectively operated and maintained the irrigation facilities before the earthquake. They are still active even for temporary irrigation works after the earthquake. The proposed irrigation facilities of the Project are expected to be operated and maintained by the existing IAs as well as before the earthquake.

Table 3.4.2 Irrigators Associations in the Project Area

Irrigation System	No. of IA	No. of member
Dipalo RIS	3	1,647
Principal CIS	1	685

(3) Outline of Dipalo RIS and Principal CIS

The Dipalo RIS is part of the Ambayoan-Dipalo RIS (ADRIS), which was constructed in the left bank area of the Agno river more than 15 years ago. The irrigation service area of the Dipalo RIS is 1,963 ha, out of 6,013 ha of ADRIS. The actual irrigation area of the Dipalo RIS is 1,548 ha of paddy fields.

The Principal CIS is one of the Communal Irrigation Systems implemented by the NIA Provincial Irrigation Office of Pangasinan. The current Principal CIS is a combination of three (3) CISs along the Viray river, i.e., Principal, Anglat and Cacandongan CIS. They were unified by improvements carried out on an intake weir and the canals in 1988. The improved Principal CIS had functioned effectively for only two (2) years until the earthquake occurred. At present, the farmers there are forced to take a little surface water through temporary intakes from the original intake sites. The actual irrigation area of the Principal CIS is 770 ha of paddy fields.

The features of the Dipalo RIS and Principal CIS before the earthquake are shown in Table 3.4.3.

Table 3.4.3 Original Features of Dipalo RIS and Principal CIS before Earthquake

Facility	Item	Unit	Dipalo RIS	Principal CIS
Water Source			Dipalo River	Viray River
Intake Weir	Catchment Area	km ²	35	55
	Length	m	25.6	34.0
	Intake Discharge	m ³ /sec	3.75	3.25
	Flood Discharge	m ³ /sec	110	158
Main Canal	Total Length	km	10.58	5.00
	Design Discharge	m ³ /sec	3.75	3.25
Lateral Canal	Total Length	km	24.34	12.00
	Design Discharge	m ³ /sec	0.13 - 1.19	2.58
Outlet		sites	65	30

The existing intake weirs of the Dipalo RIS and Principal CIS have been completely buried under debris, and have lost their irrigation function. The total volumes of the debris on their catchment areas which was slid by the earthquake are estimated as shown in the following table.

Table 3.4.4 Estimation of the Volume of the Debris Production

Irrigation System	Average Depth of	Area Ratio of	Total Catchment	Volume of Debris
	Land Slide (m)	Land Slide (%)	Area (sq.m)	Production (cu.m)
Dipalo RIS	1	15	35	5,250,000
Principal CIS	1	15	55	8,250,000

The inflow of debris from slopes along the catchment area is considered to have ended at the time of the Study. It was clarified by the Study Team that the debris deposit was not appeared at both 2 km upstream from the proposed intake site at the time. The debris in the river is moving from that sites to the downstream. It is a result of the field survey that the debris is not supplied newly but moving in the rivers.

The present depth of the debris deposit from the present surface to the base rock is estimated at about 18 m at the proposed intake sites of the Dipalo RIS and 12 m at the Principal CIS. This may further increase due to movement of the debris from upstream for a time, but then should gradually decrease due to the erosive action of the river.

CHAPTER 4 OUTLINE OF THE PROJECT

4.1 Objectives of the Project

The main objective of the Project is contributing to restore a large output of agricultural production by rehabilitating the intake facilities damaged by the earthquake in the Dipalo RIS and Principal CIS. The living standard of the farmers shall increase through the recover of cropping activity in the irrigation area.

It is also one of the objectives of the project to provide the working opportunities in the construction works to the farmers.

4.2 Review of the Request

(1) Feasibility and Necessity of the Project

The rehabilitation works on the irrigation facilities have been an important matter in the national or provincial irrigation development plans for a long time, because the Philippines has topographical, geological and meteorological conditions which are used to be suffered by natural disasters. In addition, the Government of the Philippines can not prepare enough budget for the rehabilitation on the irrigation systems. Therefore, many damaged irrigation systems remain not to be rehabilitated, although the rehabilitation projects have a large benefit.

The Project area, the Dipalo RIS and Principal CIS, is one of the damaged irrigation systems by the debris deposit caused by the earthquake. The intake facilities lost their function because they were buried in the debris. The present temporary irrigation activity is not enough to sustain cropping in the original irrigation service area. The crop production of the Project area is significantly reduced by the lack of irrigation water, while double cropping of paddy and other crops had been carried out mostly in the paddy field before the earthquake. As a result, the living standard of the farmers has significantly fallen down in these three years.

The Project implementation will restore the farm outputs from the about 2,300 ha of paddy field and the about 12,500 farmers' income at least until the level of the pre-earthquake period. As the Irrigators Associations are still active and tertiary canals are also well maintained in the Project area, the effects of the rehabilitation of the intake facilities are deemed to appear immediately. The National Irrigation Administration (NIA), the implementing agency of the Project, has many experiences to implement the foreign assistance projects and has enough capability for management of the Project.

As mentioned above, the necessity, urgency and feasibility of the Project are clarified, then the Project is regarded that it is most suitable to be implemented under Japan's Grant Aid Program.

(2) Project Implementation and Management

The construction works of the Project shall be carried out by the NIA-Regional Irrigation Office-I (NIA-RIO-I). The Dipalo RIS is directly implemented by the NIA-Ambayoan-Dipalo River Irrigation System Office (ADRIS) located in Tayug, which is one of the eight National Irrigation System Offices under the NIA-RIO-I. The Principal CIS is implemented by the NIA-Provincial Irrigation Office-Pangasinan (NIA-PIO-Pangasinan) located in Urdaneta, which is one of seven PIOs under the NIA-RIO-I. The organization charts of those offices of the NIA are shown in Figure 4.2.1.

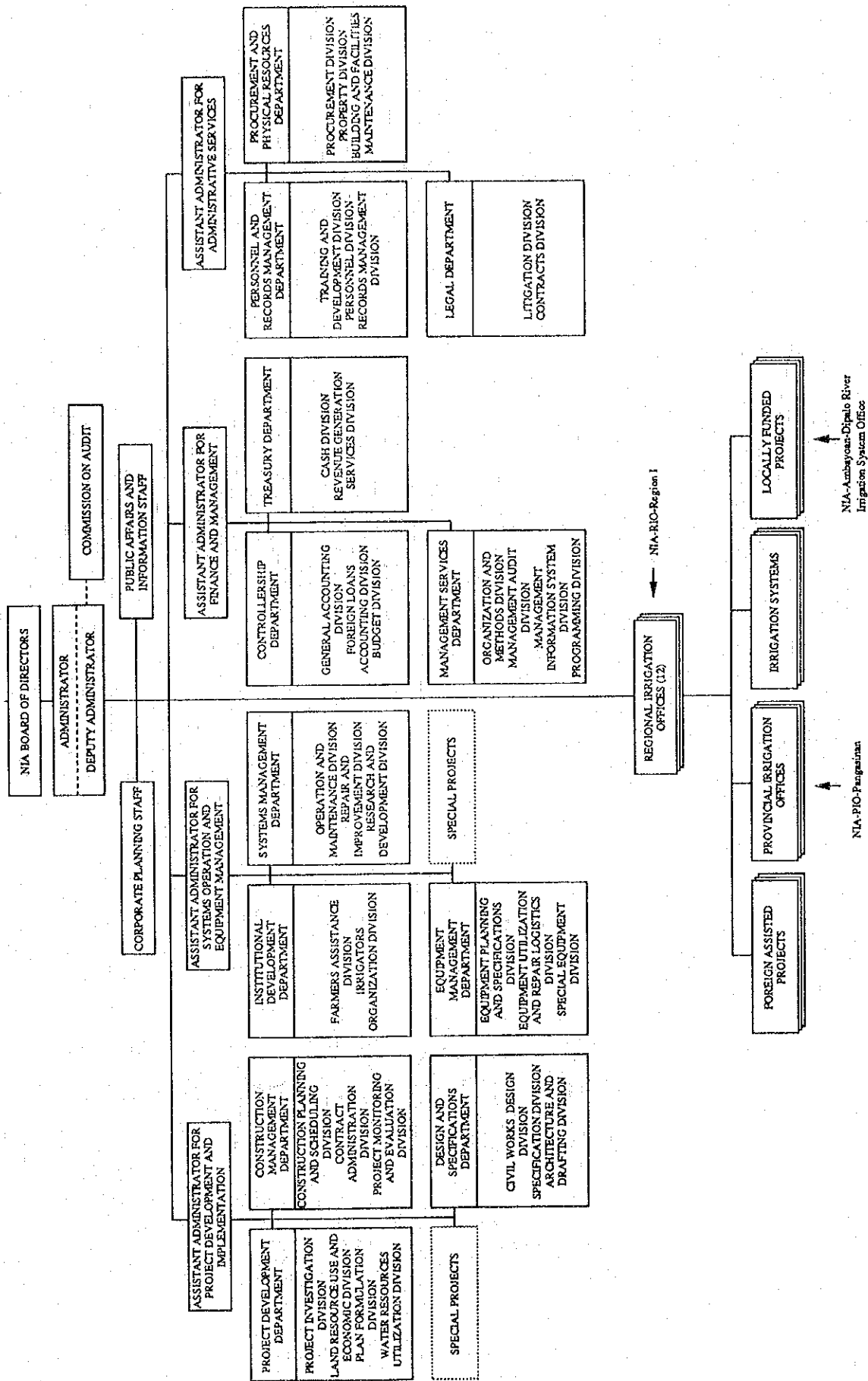


Figure 4.2.1 (1) Organization of National Irrigation Administration (NIA)

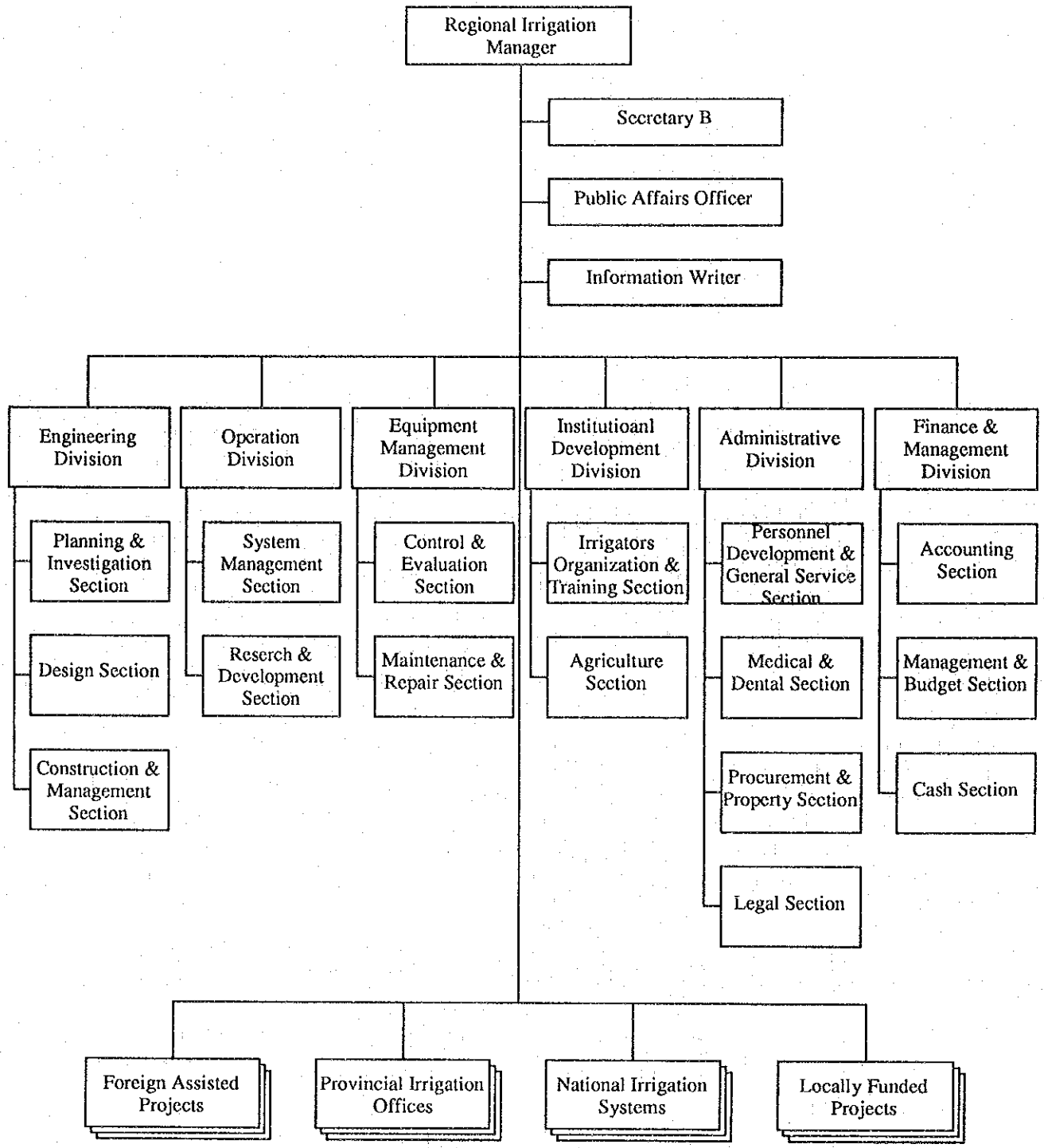


Fig. 4.2.1 (2) Organization Chart of NIA RIO-I

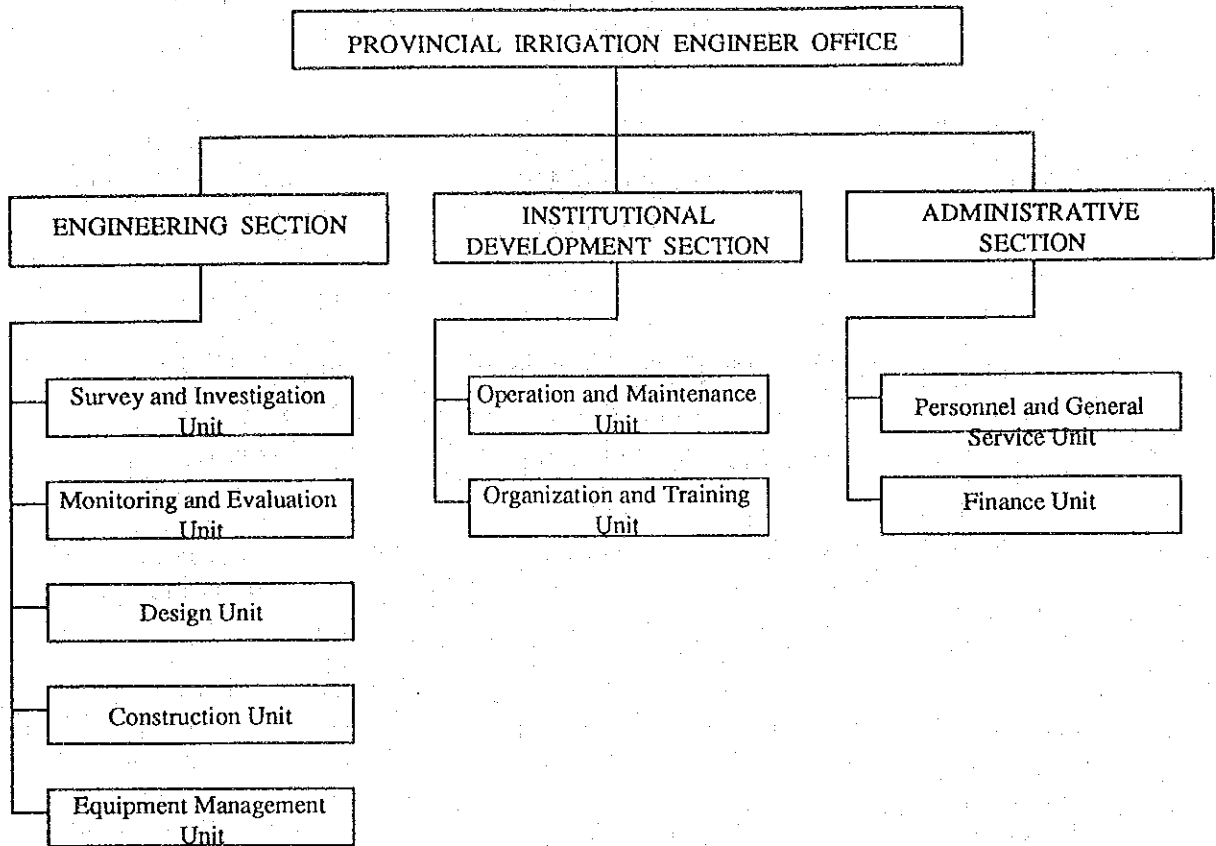


Figure 4.2.1 (3) Organization of NIA-Provincial Irrigation Office-Pangasinan

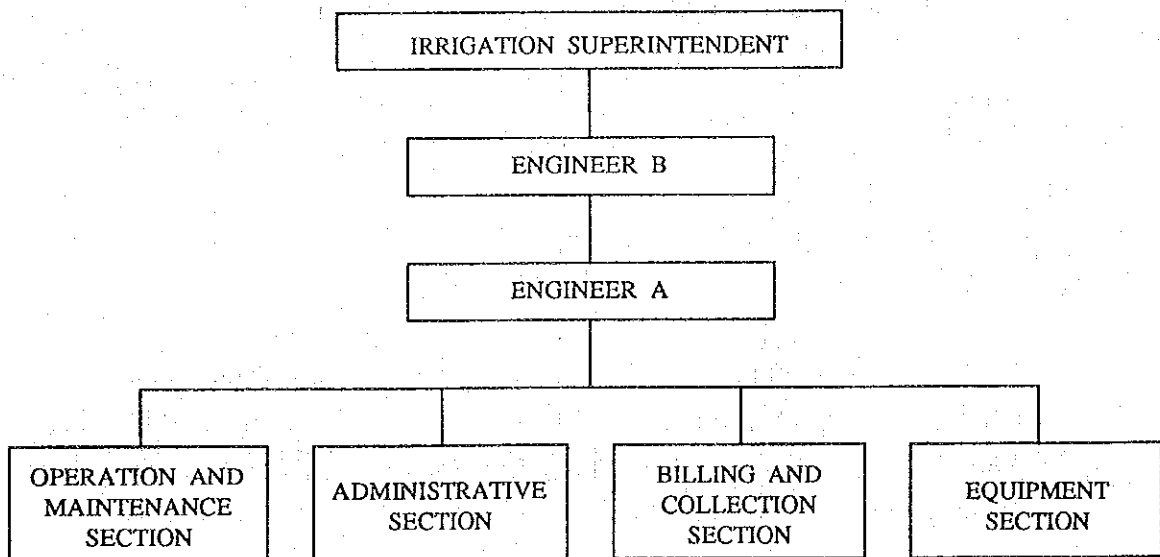


Figure 4.2.1 (4) Organization of NIA-Ambayoan-Dipalo River Irrigation System Office

(3) Relevant Rehabilitation Projects

The rehabilitation works of the damaged infrastructure by the earthquake is on going as "The Earthquake Reconstruction Project" (this Project). This Project started on August of 1990 with financial and technical assistance of the World Bank. The components of this Project are roads, bridges, buildings, medical facilities and irrigation facilities. Total project budget is 183 million dollars, of which 125 million dollars is coming from loan budget by IBRD and the rest 58 million dollars is prepared by the Government of the Philippines. This Project is planned to complete on December, 1994.

The irrigation components of the above project are implemented by the NIA. The budget of them is 16.25 million dollars in total. The progress of the irrigation rehabilitation works was about 60 % of their scope as of September, 1993.

The magnitude and range of the earthquake damages on irrigation systems can be estimated and summarized on the budget, target area and number of beneficiaries of this Project by each province as shown in Table 4.2.1. According to the Table, Pangasinan province is shown as the largest area to be rehabilitated as components of this Project.

The components of the rehabilitating irrigation facilities in this Project is shown in Table 4.2.2. The rehabilitation components consists of 117 sites of intake weirs, 167 sites of dams, 945 km of canals and so on. The construction works at level 1, which require urgent repair works, have already completed at 100 %. The constructions at level 2, which require normal rehabilitation, have completed at 94 % as of September, 1993.

This Project focuses to rehabilitate small scale irrigation systems with average unit cost of 3,300 Pesos/ha. The irrigation systems that require totally and expensive rehabilitation works such as the Dipalo RIS and Principal CIS are out of the scope of this Project.

On the other hand, Asian Development Bank (ADB) prepared the rehabilitation program of the existing irrigation systems in the Agno river basin including the Dipalo RIS and Principal CIS before the earthquake. However, the program was abandoned because the background of the program is drastically changed by the earthquake.

As mentioned above, the related projects planned by IBRD, ADB, other international cooperation organizations or the Government of the Philippines is not overlapped with the Project. Therefore, the Project on the Dipalo RIS and Principal CIS is suitable for implementation under Japan's Grant Aid program.

Table 4.2.1 Budget, Area and Beneficiary of Irrigation Sector in Earthquake Reconstruction Project by Province

Region	Province	Type	Budget (P '000)	Area (ha)	Beneficiary (nos)
CAR	Abra	CIS	30,263	4,375	9,430
	Benguet	CIS	42,573	2,870	3,365
	MT. Province	CIS	11,042	971	2,540
	Ifugao	CIS	4,418	498	552
	Kalinga-Apayao	CIS	4,594	558	635
I	Illocos Norte	CIS	12,404	4,337	5,858
	Illocos Sur	NIS	12,545	3,871	11,344
	La Union	NIS/CIS	57,678	9,918	33,128
	Pangasinan	NIS/CIS	45,564	38,874	9,790
II	Quirino	CIS	8,913	331	306
	Cagayan	CIS	3,832	228	134
	Nueva Viscaya	CIS	21,531	6,228	4,852
	Isabela	CIS	2,500	270	270
III	Nueva Ecija	NIS/CIS	69,111	35,722	19,809
	Tarlac	NIS/CIS	54,404	19,613	5,161
	Asmbales	CIS	2,876	265	175
TOTAL			427,532	128,929	149,748

Table 4.2.2 Component of Irrigation Sector of the Earthquake Reconstruction Project
(Revised in September, 1993)

Facility	Unit	Total	Level 1	Level 2	Others
Intake Weir	Nos.	117	35	39	43
Dam	Nos.	167	49	51	67
Canal	km	944.855	392.096	293.439	259.320
Inspection Road	km	123.149	43.122	26.597	53.430
Road Structure	Nos.	9	4	5	-
Office Building	Nos.	15	4	7	4
Canal Structure	Units	796	256	334	206
Drainage Structure	Units	52	19	19	14
Drainage Canal	km	1.790	0.860	0.930	-
Siphon	Units	17	3	4	10

(4) Requested Components

The Project is a rehabilitation project on the Dipalo RIS and Principal CIS. Original idea of the Project is to restore irrigation functions by installing the suitable intake facilities to each site. The requested intake facilities consist of impervious wall, collecting conduit and transmission conduit.

(5) Review of the Requested Components

The original subsurface intake method at both sites is decided to be most suitable method in the Project area. The method is to effectively use subsurface water for irrigation by installing impervious wall and collecting conduit into debris deposit in a river. The method will not be affected by a movement of debris. The subsurface intake method is a first experience in the Philippines, but it should be adopted as a best method in consideration of technical and economical feasibility, workability on construction, operation and management and so on. The Project is expected to be a pilot project adopting to same areas as suffered by the debris deposit in the Philippines.

The existing main canal at the Dipalo RIS is lost or damaged by debris flows because the protection dike of the Dipalo river is washed out partially by flooding passing on the debris accumulation. As the main canal lies on the porous sandy soils, the seepage losses of the irrigation water have been a problem for effective water use. Consideration with the present conditions, concrete lining at the upper portion of the Dipalo main canal is considered to be necessary for effective water use. The main canal of the Principal CIS also requires reconstruction at an upper portion along the river where the canal was lost due to the debris accumulation. As mentioned above, necessity of rehabilitation on the protection dike of the Dipalo RIS and the main canals of both sites was recognized and the rehabilitation was included into components of the Project during a discussion with the NIA officials and the Team.

(6) Necessity of the Technical Assistance

The NIA, implementing agency of the Project, is an organization to manage the all irrigation systems in the country and it has a number of experiences and sufficient technical abilities on irrigation projects. The design of this new type of intake shall be considered as much as simple and easy maintenance, therefore easy transfer of the technology will be also expected. The IAs in the area have been organized and maintained the existing irrigation facilities very well. Therefore, technical assistance of Japan is deemed to be not necessary after completion of the proposed construction works.

(7) Basic Policy of the Project Implementation

In the above examinations, the Project is regarded to be suitable for a Japan's Grant Aid project in terms of necessity, urgency, feasibility, implementing organization, and scale and effects of the Project. The plan and basic design of the Project are proceeded in line with a Japan's Grant Aid Program hereinafter. The Project components include rehabilitation of intake facilities, main canal and protection dike as mentioned above.

4.3 Outline of the Project

(1) Implementation Agencies and Management System

The implementing agency of the Project is NIA and NIA Region I Office is responsible for actual operation of the construction. Operation and maintenance after the construction works will be implemented by Irrigation Associations (IAs) established in each irrigation system. The administrative guidance to the IAs will be managed by the ADRIS for the Dipalo RIS and by the Pangasinan PIO for the Principal CIS.

Even though the both irrigation systems will be rehabilitated by the Project, the water route will frequently move by every flood, because of the thick river bed debris deposit. Then, the maintenance of the water route to facilitate the surface water intake for irrigation in rainy season and desalting of the sand deposit in the main canal will be conducted by the ADRIS and Pangasinan PIO, using the granted heavy equipment.

Table 4.3.1 Irrigators Associations in the Project Area

Site	Irrigators Association	Member	Area (ha)	Location
Dipalo RIS	Mapagpiaran IA	496	596	Nangapugan
	Div. VII-Dipalo RIS IA	572	608	San Quintin
	Cadongngodongo IA	579	759	San Pedro
	Sub-Total	1,647	1,963	
Principal CIS	Viray River Federated Farmers IA	685	920	Batchelor East
TOTAL		2,332	2,883	

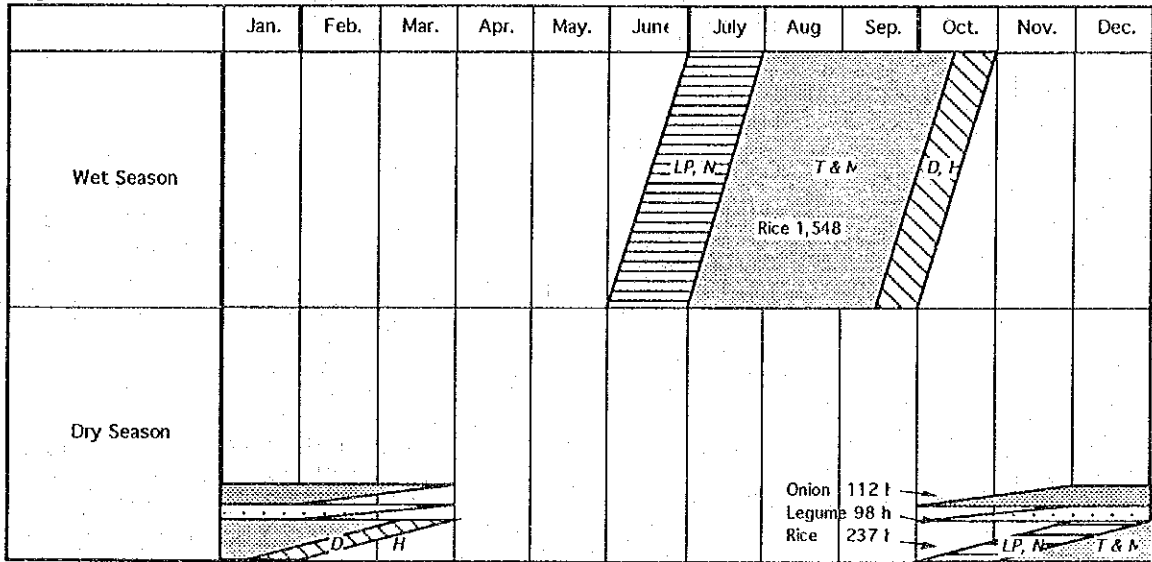
(2) Outline of the Project

The Project aims to restore irrigation function of the Dipalo RIS and Principal CIS whose intakes were damaged by debris flow caused by the earthquake in 1990. The plan is to recover irrigated farming in the area through rehabilitation of intake facilities, main canals and protection dike.

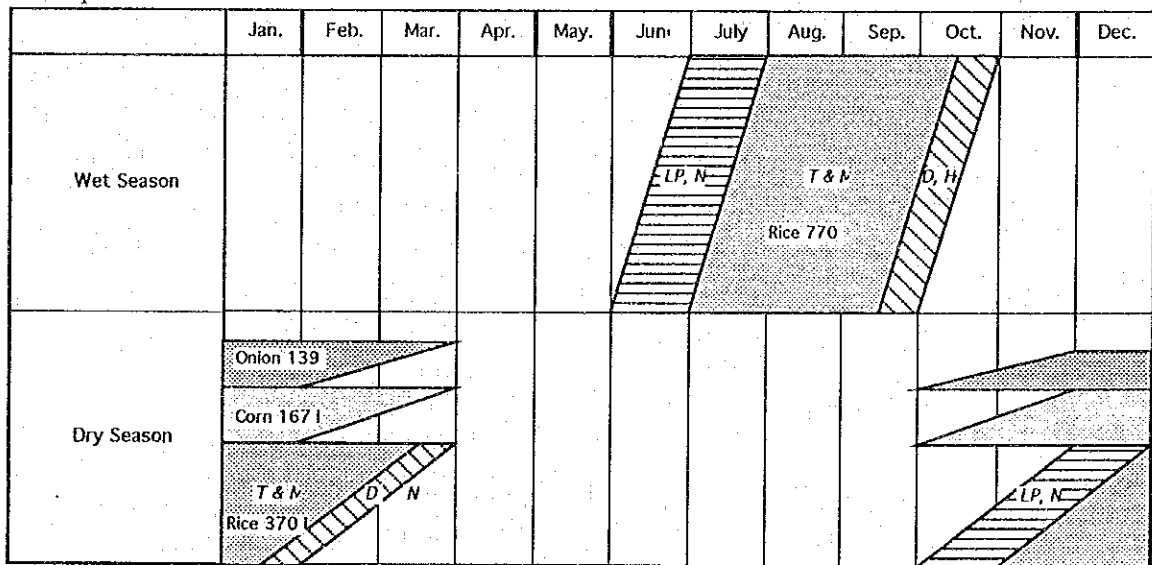
Irrigation water is supplied for paddy cropping during the wet season, and for paddy corn, legume and onion during the dry season. As the rainfall pattern during the wet season is unstable and stormy rain becomes ineffective for crops, irrigation is necessary to achieve a high, stable crop production even in the wet season. During the dry season scarce rainfall is a limiting factor for crop production, making irrigation essential.

Considering the availability of water resources, the proposed cropping pattern of the Project should be the same as before the earthquake, and extension of the irrigation area is not planned in the Project. According to the proposed cropping pattern, the cropping intensities of the Dipalo RIS and Principal CIS are 129 % and 188 %, respectively.

Dipalo RIS



Principal CIS



LP: land preparation
D: drainage
N: nursery
H: harvest
T & M: transplant, crop maintainer

Figure 4.3.1 Proposed Cropping Pattern

Table 4.3.2 Proposed Cropping Area after the Project

Site	Crop	Wet Season	Dry Season
Dipalo RIS	Paddy	1,548 ha	237 ha
	Legume	- ha	98 ha
	Onion	- ha	112 ha
	Total Cropping Area	1,548 ha	447 ha
	(Cropping Intensity)	(100 %)	(29 %)
Principal CIS	Paddy	770 ha	370 ha
	Corn	- ha	167 ha
	Onion	- ha	139 ha
	Total Cropping Area	770 ha	676 ha
	(Cropping Intensity)	(100 %)	(88 %)

The proposed intake method is to take subsurface water stably, while its capable intake capacity is relatively small. Surface water is also used for irrigation during the wet season. This proposed intake system, therefore, will secure high and stable crop production in the area.

(3) Location and Outline of the Project Area

The Project area is in the Dipalo River Irrigation System and Principal Communal Irrigation System in the eastern part of Pangasinan province. The project area and irrigation service area of both irrigation systems are shown in Table 4.3.3. The total Project area is 2,883 ha and the total irrigation service area is 2,318 ha.

Table 4.3.3 Project Area and Irrigation Service Area

Site	Project Area	Irrigation Service Area
Dipalo RIS	1,963 ha	1,548 ha
Principal CIS	920 ha	770 ha
TOTAL	2,883 ha	2,318 ha

The proposed intake sites of Dipalo RIS and Principal CIS are located in the transition points from mountain to alluvial fan on the Dipalo river and Viray river, respectively.

(4) Outline of the Facilities

The main facilities of the Project are intake facilities to secure the original irrigation level. The following alternatives were considered for the purpose.

- 1 To construct intake weir at the 2 km upstream from the original site and construct a new canal from the site.
- 2 To construct floating-type intake weir at the original site.
- 3 To install wells and lift water by pumps at the original site.
- 4 To install collecting pipes with impervious wall at the original site and take subsurface water by gravity.

Those alternative plans were examined on the following natural and social conditions of the area.

- Wet season and dry season can be divided clearly, and river water flows in debris deposit in the dry season.
- River bed is unstable yet due to debris deposit.
- Hard rock appears on both steep banks of the river.
- Irrigators Associations have not enough budget for additional O & M cost.

Based on several alternative studies, installation of collecting conduits was selected as the most suitable method for the area. The method is considered to be appropriate both technically and economically. The structure is stable against movement of debris, and the operation cost is free. This intake facility shall secure enough irrigation water supply in the wet and dry seasons.

The impervious wall is to be constructed on the downstream side of the collecting conduits to secure a more stable water supply during the dry season. Furthermore, inlet for a surface-water is installed on the impervious wall to collect additional surface water during the wet season.

Transmission conduits and open channels conveying subsurface water and surface water, respectively will connect to outlet boxes set on the existing main canal.

In the Dipalo RIS, protection dike is to be rehabilitated to prevent flood damage on the main canal and farm land. Existing main canal is also to be rehabilitated to secure effective water supply. It requires concrete lining and dredging of siltation on the upper stream portion.

(5) Operation and Maintenance

1) General

Generally, the NIA-ADRIS Office and Irrigators Associations are in charge of operation and maintenance of the irrigation facilities, as shown in Table 4.3.4. When the heavy damage occurs on the facilities, the NIA-PIO-Pangasinan supports the necessary repair works. Technical assistance is supplied from the NIA-PIO-Pangasinan and NIA-ADRIS Office to the IAs.

Table 4.3.4 Ordinary O & M Organization and Cost

Site	Item	Intake and Main Canal	Tertiary Canal
Dipalo RIS	O & M Organization	ADRIS	IAs
	O & M Cost	100 kg/ha of paddy (Wet) 150 kg/ha of paddy (Dry)	1,400 P/3.5km canal/year
	Budget Source	To be collected from IAs	To be supplied by ADRIS
Principal CIS	O & M Organization	IA	IA
	O & M Cost	Depend on the conditions	Depend on the conditions
	Budget Source	Self-funded	Self-funded

The general operation and maintenance costs mentioned above are basically not change after completion of the rehabilitation. Therefore, the above cost is not counted as an additional cost in the Project.

2) Operation and Maintenance Equipment to be Granted

Some equipment, i.e., bulldozers, backhoe shovels, pick-ups (4-wheel-drive) and motorcycles, are to be granted for operation and maintenance on the irrigation facilities of the Project area. Two sets of the equipment are supplied, because two organizations, the NIA-PIO and NIA-ADRIS, are in charge of managing of the facilities. Those offices shall manage and operate the O & M equipment.

At present, the NIA-ADRS do not have any bulldozers and backhoe shovels and NIA-PIO has only a few of them which are not enough numbers for the maintenance activities of all CIS in the province. Although the proposed intake facilities are designed as almost maintenance free, minimum number of O & M equipment are necessary to maintain a smooth operation of the intake facilities constructed in the debris deposit. Therefore, the mentioned equipments shall be granted for the above two organizations.

Besides, as main and lateral canals might be suffered from siltation, daily inspection and patrol are also necessary for well maintenance of those canals. Pick-up car (4-wheel-drive) and motorcycle shall be prepared for access to main and lateral farm road respectively.

Table 4.3.5 O & M Equipment to be Granted

O & M Equipment	Utilization	Frequency
Bulldozer	Maintenance of river	90 days a year
	Maintenance of inspection road	Irregular
	Other Maintenance	Irregular
Backhoe Shovel	Maintenance of river and canal	90 days a year
	Dredging of inlet	60 days a year
	Other maintenance	Irregular
Pick-up (4-wheel-drive, double cab)	Patrol	Once a week
	Maintenance	Irregular
	Transportation between offices	Any time
	Technical instruction and arbitration	Any time
Motorcycle	Patrol	Twice a week
	Technical instruction and arbitration	Any time

3) Operation and Maintenance Cost for the Project

The components of operation and maintenance of the proposed facilities in the Project are maintenance of the river and main canal, and dredging to remove packed debris at the inlet of the impervious wall for surface water. For these works, bulldozer and backhoe shovel shall be used. Maintenance of the main canal is required during the wet season and at the beginning of second cropping, which requires about 90 days a year. The dredging works at inlet should be done after each flood, requiring a total of 60 days a year. The annual O & M costs are estimated at 90,000 Pesos at each site, as shown in Table 4.3.6.

Table 4.3.6 Annual O & M Cost on the Project Per Site

O & M work	Calculation	O & M Cost (P)
Maintenance of Main Canal		<u>46,000</u>
Labor	120 P/man-day * 3 men * 90 days * 0.5	16,200
Backhoe Shovel	149 P/hr * 3 hr/day * 90 days * 0.5	20,115
Pick up	47.3 P/day * 90 days	4,257
Motor Cycle	16.5 P/day * 90 days	1,584
Others	10 % of above sub-total	3,844
Maintenance of Surface Intake		<u>44,000</u>
Labor	120 P/man-day * 3 men * 60 days * 0.5	10,800
Backhoe Shovel	149 P/hr * 3 hr/day * 60 days * 0.5	13,410
Bulldozer	180 P/hr * 3 hr/day * 60 days * 0.5	16,200
Others	10 % of above sub-total	3,590
TOTAL		<u>90,000</u>