**Summary**

In the Republic of the Philippines, the present Government of Arroyo came into power in January 2001 and introduced "The Medium-Term Philippine Development Plan (2001 - 2004)" in November of the same year. With the principal aim of "poverty reduction", the Plan upholds four pillars; namely, 1) macroeconomic stability with equitable growth based on free enterprise, 2) agriculture and fisheries modernization with social equity, 3) comprehensive human development and protecting the vulnerable, and 4) good governance and the rule of law. As for agricultural and fisheries sector, modernization of the sector, securing social equity through agrarian reform and sustainable utilization/management of natural resources are highlighted. To achieve an annual average growth of 3.12 to 4.02% of the sector and to newly create a million labor forces, the Plan aims to increase irrigation area of 473 thousand ha between 2001 and 2004 years, composed of 301 thousand ha by rehabilitation of existing irrigation facilities and 172 thousand ha by new irrigation projects. The Plan thus has a goal of expanding the nationwide irrigation area up to 1.70 million ha.

The agriculture and fisheries in the Philippines is leveling off between 21 to 25% in GDP since 1980. The sector occupies about 40% of the total employment. It still maintains an important share in the economy of the Philippines, although its share is coming down every year. The importance of agriculture is being recognized in terms of supply of food and creation of employment as means of food security and absorbing the unemployed in the urban area and also as a social safety net for the poor people. In addition to that, development of rural areas and assistance to agriculture occupy an important position in the policies of the Philippines as a means of reducing poverty in the rural areas which are inhabited by about 70% of the total poor population. Rice, which is staple food, achieved self-sufficiency in 1978, but in recent years rice production has not been able to meet its domestic demand so that rice import has been increasing rapidly, which makes achieving self-sufficiency of rice production all the more important. In order to cope with this situation, National Irrigation Agency is planning to increase agricultural productivity by means of rehabilitating existing irrigation systems to secure stable supply of irrigation water.

In this Study Area, Cagayan Integrated Agricultural Development Project was implemented from June 1978 to December 1991, supported by an Yen loan amounting to 6.66 billion yen, E/N for which was signed in April 1977, following a feasibility study carried out under a Japanese technical corporation. This Project benefits five provinces (Iguigu, Amulung, Alcala, Camalaniugan, Aparri) located about 500 km north of Manila by way of increasing rice production through stable supply of irrigation water by setting up 3 pumping stations, main and lateral irrigation canals and improving production infrastructure such as maintenance roads.

However, the function of these pumping stations was disrupted after the completion of the irrigation facilities due to unexpected changes in the natural conditions such as erosion of slopes in the south-western part of the Cagayan river basin caused by the earthquake which hit Bagio in 1990, many landslides caused by rain storms associated with frequent typhoons in the Cagayan state (according to the Meteorological Agency of the

Philippines, 18 typhoons passed within 100km of the Cagayan State between 1995 to 2002), destruction of forests by illegal cuttings of trees and slash-and-burn agriculture which are conducted in the various parts of the river basin. These natural disasters and environmental changes seem to have increased floating sands in the river water. Also floods caused change of river route between Tuguegarao and Iguigu. Thus lots of floating sands have come to be mixed in the water intake which resulted in the wear and tear, and damages in the pumps and ancillary facilities. Consequently securing planned amount of water has become difficult, which made double cropping also difficult, thus leading to a decrease in the rice harvest.

Under these circumstances, the Government of the Philippines requested Japanese Government to extend grant aid for the rehabilitation of the irrigation system with the aim of securing stable supply of irrigation water, improving agricultural management and recovering agricultural productivity by means of rehabilitating pumping stations, providing necessary equipments and recovering functions of water intakes.

In response to the request, Japanese Government decided to carry out the Basic Design Study. Japan International Cooperation Agency (JICA) then dispatched a Study Team twice, from September 30 to November 2, 2002 and from January 13 to January 25, 2003. The Study Team discussed with officials concerned and visited the site to conduct necessary surveys both in the rainy and dry seasons. The Study Team analyzed the results of the field survey and examined appropriateness of the Project and proper scope of cooperation, designed the scope of cooperation and a maintenance and management plan and made an Outline of the Basic Design. JICA again dispatched to the Philippines the Team to explain the Outline of the Basic Design from February 26 to March 4, 2003.

Following are the outline of the Project, which was studied in Japan in response to the request from the Philippines, to rehabilitate original facilities and recover their functions for the existing irrigation system financed by the Japanese Yen loan.

| Contents | Specifications |
|---|---|
| Rehabilitation works for pumping station | |
| Rehabilitation of building | |
| Iguigu pumping station | Water stop works against water leakage and Waterproof works on the wall of basement |
| Amulung pumping station | Water stop works against water leakage and Waterproof works on the wall of basement |
| Replacement of intake gate | |
| Iguigu pumping station | Incline gate W1,500mm×H2,000mm×1unit |
| Amulung pumping station | Incline gate W2,000mm×H2,200mm×2units |
| Rehabilitation of river bank protection works | |
| Iguigu pumping station | Concrete works for river bank protection |
| Amulung pumping station | Concrete works for river bank protection |

| Contents | Specifications |
|---|---|
| Rehabilitation of Mechanical/Electrical equipment in the pumping station | |
| Iguigu pumping station | Main pump Dia.600mm×500mm×3units<br>Overhaul<br>Motor 460V×120kw×3units<br>Rewinding<br>Auxiliary pump Replace<br>Electrical equipment Replace |
| Amulung pumping station | Main pump Dia.700mm×600mm×3units<br>Overhaul<br>Dia800mm×800mm×1unit<br>Overhaul<br>Motor 460V×315kw×3units<br>Rewinding<br>460V×240kw×1unit<br>Rewinding<br>Pipes (outside), Auxiliary pump Replace<br>Electrical equipment Replace |
| Iguigu Booster pumping station | Main pump Dia.200mm×200mm×3units<br>Replace to submersible pump<br>Pipes, Electrical equipment Replace |
| Amulung substation | 69kV Substation<br>Inspection/Maintenance |
| Magapit pumping station | Main pump Dia.1,800mm×1,500mm×3units<br>Overhaul<br>Motor 3,300V×1,050kw×4units<br>Brush Replace<br>Auxiliary pump Replace<br>Incoming Panel, Local Panel, Battery Panel<br>Replace |
| Magapit substation | 69kV Substation<br>Inspection/Maintenance |
| Procurement of equipment for removal works of the sedimentation in the water channel At Iguigu and Amulung pumping station | Amphibious excavator<br>bucket size 0.35cu.m (struck)×1unit<br>Swamp Bulldozer<br>16 ton class ×1unit |
| Procurement of equipment for excavation of the drainage canals At Iguigu and Amulung and pumping station | Backhoe<br>standard type,<br>bucket size 0.35 cu.m (struck)×1unit<br>Dump Truck<br>payload 4 ton class×1unit |
| Procurement of equipment for rehabilitation works of maintenance roads At Iguigu and Amulung and Magapit pumping station | Bulldozer<br>9ton class×1unit<br>（to be used commonly with MPIS） |
| Replacement of Head gates and Turn-out gates | Head gate CP-Type 2 14units<br>Turn-out gate 600mm×600mm 65units |

＜Rehabilitation of Building of Pumping Stations＞

Present condition:

There are leakages from the concrete wall, which are crawling down on the wall and to the floor, damaging the ducts and the electrical system.

Analysis of the Causes:

The leakage originates in groundwater which level is raised up by floods. The water comes into the pumping house through cracks, joints of the wall, which are the weak places in the concrete.

Method of the Remedial Measures:

To apply water stop works proven to be effective against water leakage, for example, for tunnel works and water storage tanks. The repair works shall be applied from the presently affected places to increase water-proof effectiveness of the walls.

＜Rehabilitation of Intake Gate and River Bank Protection Works＞

Present condition:

At Iguigu and Alcala-Amulung pump stations, part of the bank protection works was destroyed and the embankment materials were sucked away. The spindles of the gates were bent, making the gate operation impossible.

Analysis of the Causes:

The cause is probably due to consolidated subsidence of the foundation. Destruction of the protection works may possibly be due to dyke collapses, which have occurred during retarding period of big floods extending beyond the riverbanks, or by the suction effect of the embankment materials through the damaged portion of the protection works.

Method of the Remedial Measures:

To replace the intake gate and then carry out the riverbank protection works.

＜Rehabilitation of Pump Equipment＞

Present condition:

At Iguigu and Alcala-Amulung and Magapit pump stations, such parts of main pumps as impeller and casing are in good condition, but bearing and sleeve are dilapidated. Sealing water pump and drainage pump are also decrepit. There is linkage at joints of pipes. At Iguigu booster pump station, the mechanical and electrical facilities of the pump system are much damaged.

Analysis of the Causes:

The pump equipment has been damaged by such factors as accelerated deterioration, abrasion and increased volume of suspended sedimentation.

Method of the Remedial Measures:

For Iguigu, Amulung and Magapit Pumping Stations, there is no need of replacing the whole pump facilities. Replacement of parts and renovation of appurtenant equipment and electrical facilities shall be carried out. For Iguigu Booster Pump Station, the pump equipment and electrical facilities are in an advanced state of

deterioration. It is therefore proposed to replace all the pump facilities except for the screen. As per extra high tension receiving substation, this has been in use for only a few years and thus can be used further with replacement of minor parts and consumables.

＜Procurement of maintenance machinery for intake canal＞

Present condition:

To keep water intake functioning, water channels are opened by removing out the sedimentation, thereby leading the water from the flow route of the Cagayan River to the channels.

Analysis of the Causes:

Because of the increase of suspended sedimentation in the Cagayan River caused by the destruction of forests in the catchment area and erosion of mountain slopes, the flow route of the river which used to run right in front of the Iguigu Pumping Station and the Amulung Pumping Stations moved to the other side of the river, and the whole front side of the intake was submerged in sedimentation.

Method of the Remedial Measures:

As the flow route of the river has not yet been stable, it is not recommendable to construct a new intake along the present flow route. Therefore, it is proposed that an amphibious excavator and a swamp bulldozer be procured for the Amulung Pump Irrigation System Office for removing the sedimentation in the water channels of Iguigu Pumping Station and Amulung Pumping Stations.

＜Procurement of maintenance machinery for drainage canal＞

Present condition:

Farmlands in the low-lying areas are water-logged and the production has become low.

Analysis of the Causes:

The drainage capacity became small due to sedimentation aggravated by increase of suspended material in the Cagayan River.

Method of the Remedial Measures:

The maintenance works (excavation of drainage canal) will have to be continued every year due to suspended sedimentation supplied from Cagayan River. Therefore, ,maintenance machinery (backhoe and dump truck) shall be procured and NIA shall perform the excavation works of the drainage canals.

＜Procurement of maintenance machinery for maintenance road＞

Present condition:

Some important roads for local farmers are being maintained by NIA on demand from them. There are however places with overgrowth of weeds on the road surface, making passage difficult. Some part of the maintenance roads cannot be passed because of collapsed sub-base and less sand and gravel on the maintenance roads by flood and typhoon.

Analysis of the Causes:

Construction equipments were once procured for the construction of the maintenance roads as well as

the maintenance of the roads. However, the procured construction equipments have become obsolete and in part no-functional. Repair of collapsed sub-base and supplementing the sand and gravel on the maintenance roads have thus become almost impossible.

Method of the Remedial Measures:

Maintenance machinery shall be procured for the repair works of the maintenance roads, and NIA shall perform the repair works of the maintenance roads. The maintenance works must be done every year. Improving the maintenance roads leads to getting better the maintenance of the irrigation system.

＜Head Gates and Turn-out Gates＞

Present condition:

At Magapit, many head gates and turnout gates were damaged on the parts of panel and spindle. Some of them are not in operation. Planned water management is therefore difficult to carry out.

Analysis of the Causes:

Head gates and turnout gates have been maintained by NIA or IA by way of painting or greasing, but as a whole they are deteriorated by age.

Method of the Remedial Measures:

To repair head gates and turnout gates in order to secure required irrigation water to all the farmlands by regulating distribution quantity at each gate.

Obligations of Recipient Country

1. To secure lands to be required for the temporary works for the facilities and equipment in this Project,
2. To secure material necessary for the operation of the facilities in this Project such as electric power, and
3. To allocate appropriate budget and staff members for proper and effective operation and maintenance of the facilities and equipment constructed under the Project.

Implementation of this Project will take the period of: 1) 5.5 months for detail design and tender period and 2) 12 months for the construction and procurement. The total project cost estimated is 1.14 billion Japanese Yen (share to Japan: 0.978 billion Yen, Philippine: 0.162 billion Yen). Expected effects of the Project are as follows:

Direct Effects

1. Stable irrigation water for the beneficiary area will be secured by way of rehabilitating four pump stations, main canals and maintenance roads.

Indirect Effects

1. Agricultural productivities will be recovered through improved agriculture practice upheld by the stable irrigation water.
2. Farmers' income will be improved by the recovered agricultural productivity unless rice price might decline

3. Quality of agricultural products will be stabilized by the stable irrigation.

This Project benefits 8,500 families, that is, about 43 thousand farmers most of whom own about 2 ha of farmland in the irrigation area. When this Project is implemented, irrigation facilities will be improved, necessary equipments will be provided and stable supply of irrigation water will be realized for the farmlands, thus improving the agricultural productivity. Accordingly, revenues for farmers are expected to increase, contributing to the improvement of farmer's living conditions. This will help "poverty reduction" which is the principal target of "The Medium-Term Philippine Development Plan" designed by the Republic of the Philippines.

Also it will be possible for the Philippines to manage and maintain irrigation facilities and equipments after completion of the Project by using the experiences and know-how accumulated by the implementing agency of the Philippines in the past and with the support of man-powers including increased number of operators of the construction machines. It is further mentioned that there will be no negative impact on environments in implementing this Project. Accordingly, it is appropriate to implement this Project with Japanese grand aid.

It is also deemed important, in order to secure the effects of this Project, to improve the capacity of water user's associations which control branch irrigation/drainage facilities and also to keep coordination between the associations and NIA, as the maintenance and management of branch irrigation/drainage facilities are as important as those on the part of the implementing agency of the Philippine Government.

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## 〔Appendixes〕

**List of Figures & Tables**

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# Abbreviations

| | |
|---|---|
| ADB | Asian Development Bank |
| AFMA | Agriculture and Fisheries Modernization Act |
| APC | Agricultural Pilot Center |
| ASEAN | Association of Southeast Asian Nations |
| BAS | Bureau of Agricultural Statistics |
| CAGELCO | Cagayan Electric Cooperative |
| CB/CBP | Central Bank of the Philippines |
| CIADP | Cagayan Integrated Agricultural Development Project |
| CIS | Communal Irrigation System |
| CY | Calendar Year |
| DA | Department of Agriculture |
| DAR | Department of Agrarian Reform |
| DBM | Department of Budget and Management |
| DD | Drainage Ditch |
| DFA | Department of Foreign Affairs |
| DOF | Department of Finance |
| DPWH | Department of Public Works and Highway |
| FD | Farm Ditch |
| FS | Feasibility Study |
| GAA | Governmental Appropriation Act |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| HYV | High Yield Variety |
| IA | Irrigator's Association |
| IAAPIS | Iguigu-Alcala-Amulung Pumping Irrigation System |
| IBRD | International Bank for Reconstruction and Development |
| ICC | Investment Coordination Committee |
| IDD | Institutional Development Department |
| IDO | Institutional Development Officer |
| IMF | International Monetary Fund |
| IMT | Irrigation Management Transfer |
| IOSP | Irrigation Operation Support Project |
| IRRI | International Rice Research Institute |
| ISF | Irrigation Service Fee |
| JBIC | Japan Bank for International Cooperation |
| JICA | Japan International Cooperation Agency |
| LBP | Land Bank of the Philippines |
| LDC | Less Developed Country |
| LIPA | List of Irrigation and Planted Area |
| MAO | Municipal Agricultural Officer |
| MDC | Main Drainage Canal |
| MFD | Main Farm Ditch |
| MPIS | Magapit Pumping Irrigation System |
| MPRIIS | Magat River Integrated Irrigation System |
| NEDA | National Economic and Development Authority |
| NIA | National Irrigation Administration |

| | |
|---|---|
| NIS | National Irrigation System |
| NFA | National Food Authority |
| NGO | Non-Governmental Organization |
| NPA | New People's Army |
| NPC | National Power Corporation |
| NSO | National Statistics Office |
| OECF | Overseas Economic Cooperation Fund |
| PAGASA | Philippine Atmospheric, Geophysical and Astronomical Services Administration |
| PCIC | Philippines Crop Insurance Corporation |
| PDD | Project Development Department |
| PSB | Philippine Seed Board |
| SA | Service Area |
| SFD | Supplementary Farm Ditch |
| TSA | Turn-Out Service Area |
| UPRIIS | Upper Pampanga River Integrated Irrigation System |
| USAID | United States Agency for International Development |
| VAT | Value Added Tax |
| WB | World Bank |
| WRDP | Water Resources Development Project |
| WRF | Water Resources Facilities |
| WRFT | Water Resources Facilities Technician |

Unit

| | | | |
|---|---|---|---|
| cm | centimeter | ℃ | centigrade |
| cu.m | cubic meter | cms ($m^3$/sec) | cubic meter per second |
| ha | hectare | kg | kilogram (=1,000 gram) |
| km | kilometer | $km^2$ | square kilometer |
| lit. | liter | lit/sec | liter per second |
| m | meter | MCM | million cubic meter |
| mg/L | milligram per liter | meq/lit. | milliequivalent per liter |
| m/s | meter per second | ppm | parts per million |
| t | ton (1,000 kg) | % | percent |

Currency

| | |
|---|---|
| P | Philippine Peso |
| Yen or J¥ | Japanese Yen |
| US$ | US Dollar |

Exchange Rate（Average between April and October 2002）

| | |
|---|---|
| P | = ¥2.41 |
| P | = US$51.22 |
| US$ | = ¥123.41 |

# Chapter 1. Background of the Project

# Chapter 1 Background of the Project

After the conduction of Feasibility Study under Japanese finance in the project area, Exchange of Notes was signed in April 1977 (with loan amount of 6.66 billion Japanese Yen) for the Cagayan Integrated Agricultural Development Project (CIADP) which was implemented from June 1978 to December 1991. The objective of the Project was to provide production infrastructure such as the construction of three (3) pumping station main and lateral canal, maintenance road for the stable irrigation water supply to increase rice production in five (5) Municipalities (Iguigu, Amulung, Alcala, Camalaniugan and Aparri) of Cagayan Province located 500km north of Manila.

However, after the completion of Project facilities, intake of each pumping station was affected by the landslide in the southern-west area of the Cagayan River basin due to the earthquake hit Baguio in 1990 as well as many flood and erosion caused by the typhoons (18 typhoon passed within 100km radius of Cagayan Province), unexpected change of natural condition such as increase of suspended sedimentation and the sedimentation in the river caused by the destruction of forest caused by illegal logging and kaingin (fire reclamation), as well as shift of river-course between Tuguegarao and Iguigu. Furthermore, deterioration of the facilities was accelerated by the abrasion of pumps and spare parts caused by much suspended sedimentation in intake water. By such result, system has become problem in securing planned water volume, affecting productivity of rice caused by the difficulties in second crops.

Under such circumstance, the Government of the Philippines as requested for the grant-aid cooperation to the Government of Japan to secure stable irrigation water supply for the improvement of agricultural productivity through the restoration of intake function by the rehabilitation of pump station as well as provision of equipment.

The contents of request are as follows:

| Original Request | Contents confirmed by the Basic Design Study | Remarks |
|---|---|---|
| **Iguig Pump Irrigation System** | | |
| ・ Rehabilitation of Pump Station<br>・ Replacement of equipment related to pump<br>・ Procurement of equipment for operation and maintenance<br>・ Improvement of intake facilities | ・ Rehabilitation of Pump House<br>・ Rehabilitation/replacement of pump station facilities<br>・ Procurement of equipment for the operation/maintenance of power line<br>・ Procurement of equipment for the excavation of debris in the river<br>・ Construction of stilling pond<br>・ Rehabilitation of maintenance road<br>・ Excavation of drainage canal | Modified<br>New Request<br>New Request<br>New Request |

| Original Request | Contents confirmed by the Basic Design Study | Remarks |
|---|---|---|
| **Amulung Pump Irrigation System** | | |
| ・ Rehabilitation of Pump Station<br>・ Replacement of equipment related to pump<br><br>・ Improvement of intake facilities | ・ Rehabilitation of pump house<br>・ Rehabilitation/replacement of pump station facilities<br>・ Procurement of equipment for the excavation of debris in the river<br>・ Construction of stilling pond<br>・ Rehabilitation of maintenance road<br>Excavation of drainage canal<br>・ Procurement of vehicle for the Irrigation Service Fee (ISF) collection<br>・ Change of siphon to elevated flume<br>・ Construction of crossing structure for Carabao<br>・ Training for Irrigators Associations(IA)<br>・ Conduction of meeting for Irrigation Management Transfer (IMT) | Modified<br>New Request<br>New Request<br>New Request<br>New Request<br>New Request<br>New Request<br>New Request<br>New Request |
| **Magapit Pump Irrigation System** | | |
| ・ Procurement of equipment for operation and maintenance<br>・ Replacement of equipment related to pump | ・ Rehabilitation of head gate and turnout gate<br>・ Rehabilitation of irrigation canal and maintenance road<br>・ Lining of irrigation canal<br>・ Construction of stilling pond<br>・ Construction of post-harvest facilities<br>・ Procurement of operation and management equipment (vehicles)<br>・ Rehabilitation/replacement of pump station facilities<br>・ Training for IA<br>・ Conduction of NIA-IA meetings<br>・ Conduction of meeting for Irrigation Management and Transfer (IMT)<br>・ Conduction of meeting in each Turnout<br>・ Construction of IA administration building, warehouse and post-harvest facilities, procurement of motorcycle | New Request<br>New Request<br>New Request<br>New Request<br>New Request<br><br><br>New Request<br>New Request<br>New Request<br>New Request<br>New Request |

# Chapter 2. Contents of the Project

# Chapter 2 Contents of the Project

## 2-1 Basic Concept of the Project

(1) Overall Goal

Agricultural productions is recovered the production level which is planed in case pumps can be operated normally.

(2) Project Purpose

Supply of irrigation water is maintained stability by mean of rehabilitation of the irrigation system.

(3) Project Output improved by the Project

Irrigation system including pump equipment is rehabilitated.

(4) Objectively Verifiable Indicators of the Project

**Total Irrigated Area per year**

| IAAPIS | | MPIS | |
|---|---|---|---|
| Present ( 2001) | After project(2006) | Present ( 2001) | After project (2006) |
| 3,685 ha | 5,186 ha | 13,234 ha | 16,747 ha |

(5) Input

Japanese Input

a) Rehabilitation of revetment and intake gate in Iguigu Pumping Station
b) Rehabilitation of wall of pumping house by watertight works in Iguigu Pumping Station
c) Rehabilitation of pumps facilities in Iguigu Pumping Station
d) Rehabilitation of revetment and intake gate in Amulung Pumping Station
e) Rehabilitation of wall of pumping house by watertight works in Amulung Pumping Station
f) Rehabilitation of pumps facilities in Amulung Pumping Station
g) Rehabilitation of pumps facilities in Magapit Pumping Station
h) Rehabilitation of gates of Head gates and gates of turnout in Magapit Pumping System
i) Procurement of excavating equipments for suspended sedimentation in Cagayan River
j) Procurement of construction equipment for drainage excavation
k) Procurement of construction equipment for maintenance roads

Philippines input

a) Maintenance of the Project

(6) Project Area: Services area of the Cagayan Integrated Agricultural Development Project

(7) Beneficiary: about 43,000 persons in the Cagayan Integrated Agricultural Development Project

## 2-2 Basic Design of the Requested Japanese Assistance

### 2-2-1 Design Policy

#### 2-2-1-1 Basic Policy

(1) Basic policy for Rehabilitation Works under Japanese Grant Aid

The rehabilitation works under Japanese Grant Aid is return to original form and functional recovery of the facilities in order to recovery of the purpose and object under the existing project. Accordingly, the purpose and object of rehabilitation of the irrigation project is stabile irrigation water supply for recovery of the agricultural productions.

The rehabilitation works of this Project has a principal to recover the irrigation system by the return to original form of facilities. However, in case if the circumstance such as natural phenomenon and social conditions of the irrigation system has been changed and return to original form of facilities can not be carried out, functional recovery of the facilities will be considered within reasonable rehabilitations.

The following principal shall be considered under Japanese Grant Aid, so this rehabilitation works follows principal of the Japanese Grant Aid;

- Beneficiaries are general human including poverty.
- The project is required urgently.
- The facilities can be maintained by the budget, manpower and knowledge of the receipt country.
- The project has not high benefit. In case there is the benefit by the project, this benefit shall be within benefit to smooth operation and maintenance of the facilities.

The precondition of the rehabilitation works under Japanese Grant Aid is that manpower and expenditures for the maintenance of the facilities shall be borne by the receipt country. Because, the proper maintenance of the facilities is necessity for sustainable operation of the facilities, and operation and maintenance is the responsibility of the receipt country.

The following requests are not facilities of the project. Even those requests give the benefit to the project, those are necessary to the operation of NIA and Irrigators' Associations (IA). Therefore, following requests will be set out of the consideration:

- Service vehicle of O & M personnel in the collection of Irrigation Service Fee
- Training fund for IA's on leadership, financial and system management.
- Negotiation fee on NIA-IA IMT contracts.
- Provision of Post Harvest Facilities
- Provision of IA Buildings
- Provision of Warehouse
- Expenditures for conducting IA capability training, regular NIA-IA dialogues and meetings, negotiation contract signing with IA's for operation and maintenance works and conduct regular turnout meeting.

.

(2) Study of the Requests in view point of Rehabilitation Works

The requests are studied by viewpoint of necessity of rehabilitation by causes and necessity of the remedial measure as follows:

a) Intake

Analysis of the Causes:

Because of the increase of suspended sedimentation in the Cagayan River caused by the destruction of forests in the catchment area and collapse of mountain slopes through earthquakes as well as big floods, the flow route of the river which ran in front of the Iguigu Pumping Station and the Amulung Pumping Station moved to the other side of the river, and the whole front side of the intake was submerged in sedimentation.

Necessity of the Remedial Measures:

Presently in order to secure water intake, water channels are created by excavating the sedimentation and the water is led from the flow route of the Cagayan River. These water channels have to be excavated anew after each flood. The amphibious excavator used for sedimentation removal is being borrowed from Magapit Pumping Irrigation System Office. This machine has been in service for long years and its bucket is partly damaged and hence lower operation efficiency. The remedial measures are indispensable from the viewpoint of functional recovery.

Method of the Remedial Measures:

As the flow route of the river has not yet fixed itself, it is not recommendable to construct a new intake along the present flow route. Therefore, it is proposed herewith that an amphibious excavator and a swamp bulldozer will be procured for the Amulung Pump Irrigation System Office for the purpose of removal works of the sedimentation of the water channel for Iguigu Pumping Station and Amulung Pumping Station.

| Machine to be procured | Specifications | No. |
|---|---|---|
| Amphibious excavator | Standard type, bucket size 0.35 cu.m (struck) | 1 |
| Swamp Bulldozer | 16 ton class | 1 |

Benefit of the Remedial Measures:

By enabling excavation of the water channels whenever it is required, the water source will be secured, which is the prerequisite for the stable supply of irrigation water.

b) Intake Gate and River Bank Protection Works

(Iguigu Pumping Station and Amulung Pumping Station)

Analysis of the Causes:

As the riverbank protection works subsided, the spindles of the gates were bent, making the gate operation impossible. The cause for the subsidence of the protection works is considered to be due to consolidated subsidence. Also a part of the protection works is destroyed, which may have been caused by driftwood during the floods or possibly by the dyke collapse, which occurs during the decreasing period after big floods extending beyond the riverbanks, or by the suction effect of the embankment materials through the damaged portion of the protection works.

Necessity of the Remedial Measures:

The riverbank protection works are damaged and the embankment materials behind the protection works have been and are being sucked out. The possibility cannot be excluded that a substantial volume of the embankment behind the protection works has been lost. There is a big danger that continued sucking of embankment and subsequent collapse of the protection works would occur at every flood. Also the intake gate is required to be repaired, as inspection of the intake culvert and periodical removal of sedimentation are necessary. Repair works are indispensable for the sake of restitution of the original conditions.

Method of the Remedial Measures:

Replace of the intake gate and the riverbank protection works.

Benefit of the Remedial Measures:

The worst scenario, i.e., collapse of the riverbank protection works can be prevented by making possible the operation and maintenance of the interior of the intake culvert, which enables O&M of the pumps at appropriate times and thus full accomplishment of the pumps' life span.

c) Repair of the Intake Barrel (Magapit Pumping Station)

Analysis of the Causes:

Mud enters into the suction pit through the stop logs during the floods, and heaps up just in front of the suction pipes of the pumps. When this mud is sucked into the pumps, the pumps will vibrate and are susceptible to abrasion and damage. As an emergency measure the openings of the grating are blocked by stop logs. At the beginning a gantry crane was to be installed for the stop logs of the intake, but was never installed for lack of budget.

Necessity of the Remedial Measures:

Although the Philippine side wishes installation of crane facilities, it is not recommendable to install a stationary gantry crane, which will be submerged during the flood time. It is more desirable to perform O&M by means of stop logs using a truck crane by gaining access to the pumping station, making use of the access road made during the construction period.

Method of the Remedial Measures:

The gantry crane desired by the Philippine side shall not be installed. Instead, stop logs shall be utilized. As the access road is submerged and damaged during the floods, it shall be repaired by means of bulldozers, etc. by NIA each time when the crane is used. Therefore, this item shall be placed outside the scope of the Project.

d) Pump Equipment

Analysis of the Causes:

The pump equipment is considered to have been damaged by interaction of the following factors: Accelerated deterioration and damages due to abrasion and damages caused by increased volume of suspended sedimentation, deterioration due to ageing, and deterioration and damages due to lack of O&M.

Necessity of the Remedial Measures:

Deterioration of the pump equipment at each pumping station is conspicuous. Frequent malfunctioning at starting time and operational breakdowns are observed. Pumps are being used with frequent repairs at each such difficulty. In order to secure constant water supply by maintaining continuous full capacity operation of the pumps after rehabilitation, and for restoration of the original conditions it is indispensable that the pumps as well as electrical facilities should be repaired.

Method of the Remedial Measures:

The following remedial measures are put forward considering the operational conditions of the equipment investigated and their state of deterioration. The determination of the remedial measures concerning the necessity of renovation of equipment was made based on the "Guidelines on the Technique for Maintenance and Renovation of Agricultural Installations and Machinery"

1. Iguigu, Amulung and Magapit Pumping Stations
   There are no need of replacing the whole pump facilities. Replacement of parts and renovation of appurtenant equipment and electrical facilities shall be carried out.
2. Iguigu Booster Pump Station
   The pump equipment and electrical facilities are both in an advanced state of deterioration and damage. It is hereby proposed to replace all the pump facilities except for the screen.
3. Extra high tension receiving substation
   This substation has been in use for only a few years and thus can be used further. Some damaged parts shall be replaced.

Benefit of the Remedial Measures:

It will be possible by repairing the pump equipment to deliver water in the quantity and at the time required in the water requirement schedule. This will lead to increase of the unit yield and increase in collection rate of the irrigation service fee. Also as the cost for repairing at breakdowns decreases, the budget stabilizes and sound operation of irrigation scheme is secured.

e) Building of Pumping Stations (Iguigu Pumping Station and Amulung Pumping Station)

Analysis of the Causes:

Leakage from the concrete wall was observed and the leakage from the concrete wall is crawling on the wall and the floor, damaging the ducts and the electrical system. This is caused by seeping ground water which level was raised up by the flood tends to run through the cracks, joints, which are the weak places in the concrete. It is necessary to repair the concrete by stopping agents such as water stop mortar. At the pumping stations in question one can observe places of repairs by usual mortar, but it is assumed that the seeping water was not completely stopped, because the effect of water stopping is limited using normal mortar.

Necessity of the Remedial Measures:

The leakage from the concrete wall is crawling on the wall and the floor, damaging the ducts and the electrical system. Without improving this situation the renewed pump facilities will suffer from the same difficulties. It is indispensable, therefore, from the viewpoint of functional recovery of the pumping facilities to stop the leakage from the wall, which is the secondary cause of damage to the pumping facilities.

Method of the Remedial Measures:

Using the method of water stop works proven to be effective against water leakage for tunnel works and water storage tanks, repair works shall be applied to stop water leakage from the presently affected locations and to increase waterproof effectiveness of the walls.

Benefit of the Remedial Measures:

By stopping leakage from the walls, which is the secondary cause of damage to the pump facilities, it is possible to arrange for an environment, which will secure the accomplishment of the life span of the renewed equipment and facilities.

f) Fixtures inside Building

Analysis of the Causes:

Windowpanes, delivery gates, lighting facilities are left damaged. Most damages are caused by ageing. The lighting facilities were originally fixed on the ceiling for illumination of the whole pump

facilities as well as for workability of the crane. However, new simple lighting facilities, which were easy to maintain, were installed.

Necessity of the Remedial Measures:

Rain and wind enter into the building through broken windows and doors, and the birds also intrude the building, leaving droppings everywhere. This condition is causing breakdowns of the equipment such as the control panel. The present improvised lighting fixtures are not providing enough light, hindering smooth operation and maintenance. All these damages and insufficiency should be improved for functional recovery.

Method of the Remedial Measures:

Improvement is certainly required. However, it is considered to be within the scope of usual operation and maintenance, and thus is the works to be performed by NIA.

Benefit of the Remedial Measures:

The causes of damages to the pump facilities can be eliminated and the external conditions for the pump facilities are optimized for full life span service.

g) Stilling Basin in the Canal

Analysis of the Causes:

Usually a stilling basin is placed before intake of water in order to remove suspended sedimentation before pumping-up. However, there are no stilling basins for the 3 pumping stations in question, as it is difficult to place such stilling basin in the present situation. In correspondence with the increase of suspended sedimentation of Cagayan River, that in the pumped up irrigation water increased likewise and sedimentation is occurring all along the irrigation canals.

Necessity of the Remedial Measures:

The sediment in irrigation canal is cased by smooth irrigation flow. Those sediment deposited on the whole canal and heavy maintenance is required. Therefore, stilling basin is necessary by viewpoint of sedimentation control.

Method of the Remedial Measures:

One consideration is to create a single stilling basin to catch hold of all the sedimentation of the whole canal length in one place, which would recover the flow capacity of the irrigation canals. The grain size of the suspended sedimentation is small, a large-scale stilling basin would be required. It is possible to remove the sedimentation at one place, but volume of sedimentation is about 15% of the total according to the sieve analysis. Accordingly, the functional recovery only by stilling basin

cannot be satisfaction, then this works will be out of rehabilitation works because of out of Japanese Grant Aid principal.

h) Lining of the Irrigation Canal (Magapit Pump Irrigation System)

Analysis of the Causes:

The irrigation canals in the Magapit area is running through flat plain and there are long elevated canal, especially, main canal, lateral E and lateral F. Seeping from the toe of embankment of elevated canal can be observed, and sediment deposit and weeds grow make obstruction irrigation water flow.

Method of the Remedial Measures:

It is possible to supply irrigation water to the end of the canal with proper maintenance avoiding the obstruction of irrigation flow. Then, proper maintenance such as reducing the weeds cutting and keeping the canal section is essential. The lining of irrigation canal is necessary by viewpoint of reducing the maintenance.

Necessity of the Remedial Measures:

Lining of the irrigation will be advisable for the enough irrigation water supply to the end of the canal, improving the obstruction of irrigation water flow and reducing the maintenance. However, lining of irrigation canal is not fit to the Japanese Grant Aid principal, return to original form and functional recovery. It is recommended for NIA to carry out the lining of the irrigation canal.

Benefit of the Remedial Measures:

The O&M cost for the planned stretches of lining is presently estimated at 900,000 Pesos, whereas that after lining would become about 190,000 Pesos, which means a saving of 710,000 Pesos per year. It means also that this saved O&M cost can be used for the remaining canal sections to secure flow capacity of the canal, enabling supply of planned irrigation water requirement at the end point.

i) Head Gates and Turn-out Gates

Analysis of the Causes:

Head gates and turnout gates have been maintained by NIA or IA by way of painting or greasing, but as whole they are damaged by ageing.

Necessity of the Remedial Measures:

Due to malfunction or leakage of the gates caused by the damages occurred to the gates, excessive distribution of water is happening at the upstream, and difficulty in securing water at the downstream. Therefore, repair of the gates is indispensable for the restitution of the original conditions for an

appropriate water management.

Method of the Remedial Measures:

Repair head gates and turnout gates in order to secure supply of required irrigation water quantity to all the farmlands by securing distribution quantity at each gate.

Benefit of the Remedial Measures:

By arranging for the condition for proper water management, equitable water distribution becomes possible. The rehabilitation of the terminal irrigation facilities matches the wishes of IA, which presupposes the irrigation management transfer (IMT) and thus contributes to a smooth IMT.

j) Drainage Canals (Iguigu Pump Irrigation System, Amulung Pump Irrigation System)

Analysis of the Causes:

Mud deposited in the drainage canals, which originated from the farmlands as well as from the surrounding area washed out by rainwater. Excavation of the drainage canals has to be continued regularly. However, the maintenance has been insufficient for lack of budget and because the excavator procured under the credit loan project is out of service due to ageing, resulting in reduced drainage capacity. Another trouble for inefficient drainage is that the lands for farm drainage ditches were not compensated for land expropriation. These farm ditches were destroyed year by year and many have disappeared.

Necessity of the Remedial Measures:

The farmlands in the low-lying areas are waterlogged due to poor drainage caused by lack of O&M on drainage canals and/or deficiency at farm drainage ditches. This is one of the causes for decrease in yields. Therefore, it is indispensable in terms of restitution of the original conditions to attempt to improve the drainage.

Method of the Remedial Measures:

The excavation works are the item requested by the Philippine side, but the maintenance works are to be continued every year after the excavation. Concerning the arrangement of the farm drainage ditches, it is necessary to take into account the intentions of the local farmers such as the compensation for the land expropriation. Considering the above, the following maintenance machinery shall be procured and NIA shall perform the excavation works of the drainage canals.

| Machine to be procured | Specifications | No. |
|---|---|---|
| Backhoe | Standard type, bucket size 0.35 cu.m (struck) | 1 |
| Dump truck | Payload 4 ton class | 1 |

Benefit of the Remedial Measures:

Agricultural productivity increases when poor drainage condition is lifted in the low-lying areas after restoring the function of the drainage canals. The restored agricultural productivity will be sustained when the drainage function is upheld by maintenance using the procured construction machinery. Presently excavation cost (machinery rentals, operators and fuel costs) of the drainage canals amounts to 600,000 Pesos per year. The O&M cost after procurement of the machinery would be reduced to 280,000 Pesos (fuel cost only. NIA employees shall operate the machinery).

k) Maintenance Roads

Analysis of the Causes:

Construction equipments ware procured for construction of maintenance roads and maintenance of the roads. Some part of the maintenance rods cannot be passed because of collapsed sub-base and less sand and gravel on the maintenance roads by flood and typhoon. Reasons are that procured construction equipments become obsolete or damaged, then repair of collapsed sub-base and supplementing the sand and gravel on the maintenance roads. Some important roads for local farmers are being maintained on demand form them. There are even places with overgrowth of weeds on the road surface where passage is difficult.

Necessity of the Remedial Measures:

It is necessary to procure the construction equipment for maintenance roads that is procured under Japanese loan by viewpoint of return original form.

Method of the Remedial Measures:

Gravel for the maintenance roads is an item requested by the Philippine side. The maintenance works are works, which must be continued every year after rehabilitation of the roads. The arrangement to be adopted shall be as follows; the repair works of the maintenance roads shall not be part of the Project. However, a part of the construction equipment shall be procured for the repair works of the maintenance roads. NIA shall perform the repair works of the maintenance roads and thereafter the maintenance works. A backhoe and a dump truck would be required here, but those procured for drainage excavation shall be diverted temporarily for this purpose. The equipment to be procured for the repair works of the maintenance roads shall be as follows;

| Machine to be procured | Specifications | No. |
|---|---|---|
| Bulldozer | 9 ton class | 1 |

Benefit of the Remedial Measures:

By improving the maintenance roads and arranging for the maintenance machinery a desirable

environment leading to the improvement of the maintenance of the irrigation system will be established. The maintenance cost for the maintenance roads are estimated at 212,200 Pesos per year for the Amulung Pump Irrigation System Office and 844,700 Pesos per year for the Magapit Pump Irrigation System Office respectively. These costs can be covered easily by the increase of collection of the irrigation service fee, which results from the increased productivity. The restored agricultural productivity will be sustained because water management and maintenance of the irrigation system will be properly executed utilizing the improved maintenance roads.

l) Change from Siphon to Canal Bridge

Analysis of the Causes:

It is said that there is a leakage in the siphon, which hampers sufficient supply of irrigation water to the farmland at the outlet side of the siphon. The maintenance works of the siphon is also difficult. NIA wishes to switch to the canal bridge type. From our investigation it can be assumed that there is an accumulation of sedimentation at the lowest section of the siphon, narrowing the cross-section, which causes flow disturbances.

Necessity of Remedial Measures:

The planned irrigation water quantity is not being supplied, resulting in reduction of the unit yields and of the irrigated area. For restoration of the productivity of the farmland beyond the siphon, it is necessary to supply the planned water quantity by restoring the flow capacity of the siphon.

Method of the Remedial Measures:

The planned irrigation area beyond the siphon is about 103 ha or about 5% of the whole. The canal bridge would become a long one meaning high construction cost. From the point of view of the cost-benefit, it may not be justifiable. Therefore, it is hereby recommended that NIA construct mud removal facilities and remove the mud regularly. This proposal is, therefore, set outside the scope of the Project.

m) Construction of Crossing Road Structures for Carabao

Analysis of the Causes:

When traveling to the farmlands carabaos cannot cross the irrigation canal and the farmers must make a long detour. Local farmers made a request to construct a few crossing road structures. When the main irrigation canals were made of earth, carabaos used to walk on the side slopes. It became impossible with the introduction of concrete lining.

Necessity of Remedial Measures:

These structures do not directly contribute to the restoration of the irrigation system, and these are items of added value to the system. As the lining of the irrigation canals was financed by the World Bank and these canals are not the item for rehabilitation, construction of Carabao crossing road structures shall not be included in the scope of the Project.

n) Repair of the Control Panel Room of the Substation

Analysis of the Causes:

Parts of the ceiling panels of the roof are rotten causing rainwater to leak. Ageing is the cause of this trouble.

Necessity of Remedial Measures:

The damage by leaking rainwater has not reached a stage to damage the control panel. However, as water is the biggest danger to the control panel, the damage in the roof must be repaired urgently.

Method of the Remedial Measures:

As the repair is within the scope of usual maintenance of the roof, NIA shall take charge of it.

o) Maintenance Equipment and Machinery for the Transmission Line

Analysis of the Causes:

A few electrical poles are tipped or knocked down at yearly typhoons.

Necessity of Remedial Measures:

Presently the repair works are done using borrowed cranes or by manpower only. If the repair works take a long time, adverse effects will result to the crops. As the repair works always require urgency, a crane is requested by the Philippine side.

Method of the Remedial Measures:

Remedial measures such as placing the poles deeper in the ground or improving the ground may result in breakage of the poles themselves. It would be less expensive to repair the damaged poles than introducing new designs, so that the poles will stay semi-permanently by replacing the poles with concrete ones or improving the ground. Presently works of replacing the wooden poles with the concrete ones are in progress, which would lessen the number of damages to the poles. Consequently the frequency of use of a truck crane for repair works of the poles would be limited, although it can cope with the urgency at the time of repair works. Considering that the repair works for fallen poles would be possible by manpower, procurement of a truck crane was placed outside the scope of the Project.

p) Motorcycle

Analysis of the Causes:

The motorcycles procured under the credit loan project have reached old age and are being used repeating frequent breakdowns and repairs. Some of them are lent to IA. In view of the above replenishment of motorcycles is requested.

Necessity of the Remedial Measures:

The irrigation facilities of the Magapit area are scattered over a wide area, the necessity of new motorcycles is large for daily maintenance and collection of the irrigation service fee.

Method of the Remedial Measures:

It is desirable to procure some motorcycles to replenish the shortage. Compared to 4-wheeled vehicles motorcycles are more advantageous considering the conditions of the maintenance roads in rainy seasons, and because they are fit for bad roads and more maneuverable. Also for a price of one vehicle several motorcycles can be procured, and motorcycles are better in terms of mobility. However, there is a problem of storage and safekeeping, as motorcycles have a bigger chance of becoming easy objects of theft compared to vehicles. For this reason the motorcycles are not included in the scope of the Project.

### 2-2-1-2 Concepts for Natural Conditions

Project comportment will be separated as rehabilitation works for river slope protection works with coffer dam, rehabilitation works for pump equipment and wall water proof in the pump buildings and rehabilitation works of head gates and turn-out gate. The cofferdam works for river slope protection rehabilitation works will be depending to natural conditions.

The cofferdam periods is set up during low water level. According to the observed data of water level from 1995 to 2002 at Iguigu Pumping Station, the water level higher than El. 9.97 m from April to October was only one flood, which flood continued three days (see Fig 2-1-2 (2)). This flood was occurred by typhoon, and the design water level during coffer dam period can be decided second water level during coffer dam period in accordance with “Design Standard for head Works” by the Ministry of Agricultural, Fishery and Forest. Therefore, the coffer dam period will be from April to October, and design water level and top elevation level will be as follows:

| Location of Coffer Dam | Design Water Level | Top of Coffer Dam |
|---|---|---|
| Iguigu Pumping Station | Wl. 9.97 m | El. 11.0 m |
| Amulung Pumping Station | Wl 7.3 m | El. 8.3 m |

Pumps cannot be operated since cofferdam during cofferdam period, therefore paddy cultivation is required to be stopped.

### 2-2-1-3 Concepts for Social Conditions

Electric power for the operating power for motors of pumps is available, telecommunication networks, and water supply are not available. Mobile phone at pumping stations can be communicated. The drainage pumps in the cofferdam shall be operated during 24 hours, and power breakdown is occurred sometimes, therefore power sauces for construction, water supply and telecommunication shall be supplied by the contractor. However, electric power source for test running of pumps facilities after completion of rehabilitation works shall be borne by NIA because it is necessary to make test run on whole system.

### 2-2-1-4 Concept for Condition of Construction

There are several small-scale contractors in Tuguegarao and Aparri, however they do not have experience for cofferdam and waterproof works. There are many contractors in Manila having enough experience, engineers and labor power.

Within the project sites and surrounding area, it is difficult to fine office and accommodations. It is desirable to settle site camp nearby Amulung, and it is necessary to construct stockyard for construction materials, generator and office space having administration rooms, meeting room and washroom.

### 2-2-1-5 Concepts for Application of Local Contractors and Construction Materials

There are many construction companies having adequate capability to execute the construction works in the Philippines. These companies shall be positively contracted for the Project. As for the construction materials such construction equipments cements, steel bars, sand and gravel, etc. are locally available in the Philippines. Therefore, construction materials are planed to be procured in the Philippines so far as there is no problem in quality and specifications.

### 2-2-1-6 Concepts to Capability of O/M by Implementation Agency

This Project is the rehabilitation of CIADP under Japanese loan, which was operation and maintenance by NIA.

Fro improving the maintenance, pump engineers and pump operator shall be performed on job training.

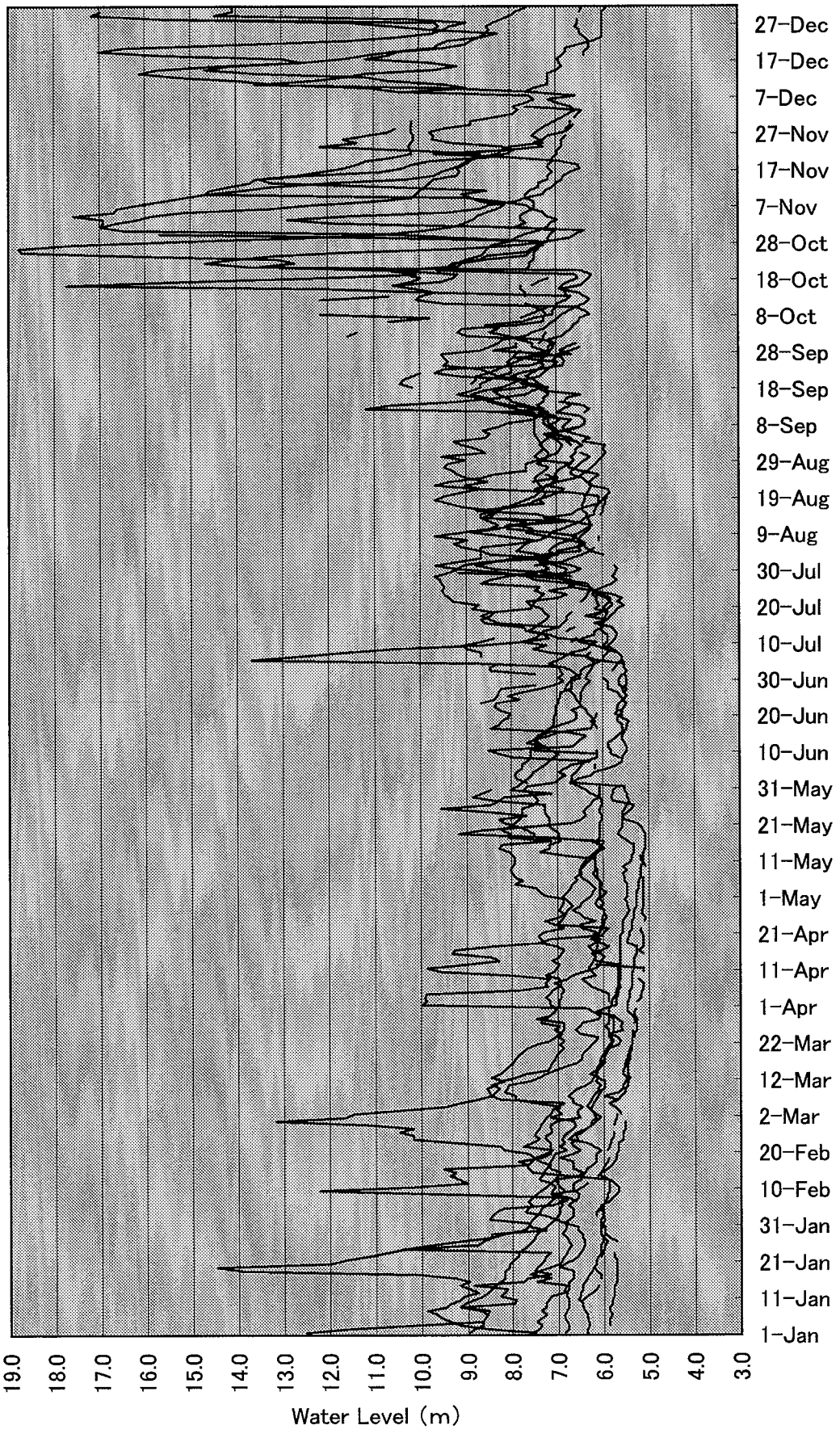
### 2-2-1-7 Concepts for Project Design Level

This Project is rehabilitation works project for the irrigation system which was implemented by Japanese loan. By this rehabilitation, functional recovery of the project is expected. The waterproof works against leakage of wall will be constructed by the materials and method which are experienced in Japan.

### 2-2-1-8 Concepts for Construction Period

Total construction period from verification of construction contract by Japanese government is 12 months.

Figure 2-2-1-8 (1) Water Level of Cagayan River at Iguigu Pumping Station



## 2-2-2 Basic Plan

### 2-2-2-1 Farming Plan

(1) Cropping

Since DA has a policy to continue to produce rice by double cropping in the irrigated paddy fields in Cagayan Province, this Rehabilitation Project follows the policy of DA. It was also the policy of the Loan Project. Cropping pattern will follow the present pattern carried out by NIA which is slightly revised from that of Feasibility Study to avoid influence of typhoon. (Details are in Figure 2-2-2-2 (1))

Cropping Pattern : Wet Season Rice 5th May – 15th September
Dry Season Rice 25th November – 5th April

(2) Yield

Past yields of IAAPIS and MPIS are as in following Table.

**Table 2-2-2-1 (1) Past Yields in IAAPIS and MPIS**

| Year | IAAPIS (ton/ha) | | MPIS (ton/ha) | |
|---|---|---|---|---|
| | Dry Season | Wet Season | Dry Season | Wet Season |
| 1990 | 3.80 | 3.75 | 4.2 | 3.8 |
| 1991 | 3.85 | 3.80 | 4.1 | 4.2 |
| 1992 | 3.95 | 3.85 | 3.8 | 2.5 |
| 1993 | 3.95 | - | 4.1 | 3.5 |
| 1994 | 3.95 | - | 4.0 | 3.2 |
| 1995 | 4.00 | 3.95 | 3.6 | 2.3 |
| 1996 | 4.05 | 4.00 | 3.7 | 1.8 |
| 1997 | 4.10 | 4.00 | 3.9 | 3.5 |
| 1998 | 3.75 | 4.05 | 3.2 | - |
| 1999 | 4.75 | 4.05 | 2.8 | - |
| 2000 | 4.15 | 4.10 | 3.3 | - |
| 2001 | 5.55 | 4.00 | - | - |
| 2002 | - | - | 3.7 | 2.1 |
| Average | 4.15 | 3.95 | 3.7 | 3.0 |

Average yields of IAAPIS are 4.15 ton/ha in dry season and 3.95 ton/ha in wet season. Although proposed yield by the Loan Project was 4.0 ton/ha for dry season rice and 3.5 ton/ha for wet season rice, yield more than 4.0 ton/ha was achieved both in dry and wet seasons in 6 years from 1990 to 2001. It is therefore proposed to consider the yield to be 4.0 ton/ha in both seasons in IAAPIS after rehabilitation. It will be able to achieve this yield in the whole area of IAAPIS.

On the other hand, average yield was only at 3.7 ton/ha in dry season and 3.0 ton/ha in wet season in MPIS. Moreover, recent 5-year average yield decreased to 3.4 ton/ha in dry season and to 2.4 ton/ha. However, the yields more than 4.0 ton/ha in dry season and more than 3.5 ton/ha in wet season were achieved in 4 years respectively since 1990. Taking this phenomena into consideration as well as stabilization of irrigation water by rehabilitation and improvement of terminal facilities by IA, it is considered to be possible to achieve the proposed yield (dry season rice: 4.0 ton/ha, wet season rice: 3.5 ton/ha) by the Loan Project after rehabilitation.

(3) Cropping Pattern and Cropped Area

Present yield and cropped area and proposed ones after rehabilitation are discussed as follows;

IAAPIS

**Table 2-2-2-1 (2) Present and Proposed Cropped Area and Yield in IAAPIS**

| Irrigation Condition | Present (2001) | | | | after Rehabilitation | | | |
|---|---|---|---|---|---|---|---|---|
| | Area | | Yield (t/ha) | | Area | | Yield (t/ha) | |
| | (ha) | Ratio | Dry S. | Wet S. | (ha) | Ratio | Dry S. | Wet S. |
| Irrigated in both seasons | 1,800 | 61% | 4.0 | 4.0 | 2,593 | 88% | 4.0 | 4.0 |
| Irrigated only in dry season | 85 | 3% | 4.0 | 1.6 * | 0 | 0% | | |
| Non-irrigated | 1,062 | 36% | 0.0 | 1.6 * | 354 | 12% | 0.0 | 1.6 |
| Area irrigated | 1,885 | 64% | 4.0 | 3.9 | 2,593 | 88% | 4.0 | 4.0 |
| Total Area | 2,947 | 100% | 2.6 | 3.1 | 2,947 | 100% | 4.0 | 4.0 |

(Notes)

1) About two thirds area will be irrigated in both seasons by stabilization of irrigated water and improvement of terminal facilities by IA after rehabilitation.
2) Present irrigated yield will be achieved in whole area after rehabilitation.
3) *: Rainfed yield in the surrounding areas. (BAS 1996)

Present irrigated area is 1,885 ha that is 64% of 2,947 ha of whole project area. Present yield of irrigated rice is 4.0 t/ha in both seasons. Whole area will be irrigated in both seasons by stabilization of irrigated water and improvement of terminal facilities by IA after rehabilitation. Present irrigated yield will be achieved in whole area after rehabilitation.

MPIS

Present irrigated area is 8,733 ha that is 76% of 11,457 ha of whole project area. Communal irrigation and 1/3 of area irrigated only in wet season are transferred to the area irrigated in both seasons after rehabilitation. Present yield of irrigated rice is 3.4 t/ha in dry seasons and 2.4 t/ha in wet season. However, proposed yield of 4.0 t/ha in dry season and 3.5 t/ha will be achieved in the irrigated area by improvement of pumps and gates after rehabilitation.

**Table 2-2-2-1 (3) Present and Proposed Cropped Area and Yield in MPIS**

| Irrigation Condition | | Present (2002) | | | | after Rehabilitation | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Area | | Yield (t/ha) | | Area | | Yield (t/ha) | |
| | | (ha) | Ratio | Dry S. | Wet S. | (ha) | Ratio | Dry S. | Wet S. |
| Irrigated in both seasons | | 4,501 | 39% | 3.4 | 2.4 | 6,963 | 61% | 4.0 | 3.5 |
| Irrigated only in dry season | | 4,232 | 37% | 3.4 | 1.6 * | 2,821 | 25% | 4.0 | 1.6 * |
| Non-irrigated | Communal irrigation | 1,051 | 9% | 3.4 | 2.4 | | | | |
| | Non-irrigated | 1,673 | 15% | 0.0 | 1.6 * | 1,673 | 15% | 0.0 | 1.6 * |
| Pump Irrigation System | | 8,733 | 76% | 3.4 | 2.4 | 9,784 | 85% | 4.0 | 3.5 |
| Total Area | | 11,457 | 100% | 2.9 | 2.0 | 11,457 | 100% | 3.4 | 2.5 |

(Notes)

1) Communal irrigation and 1/3 of area irrigated only in wet season are transferred to the area irrigated in both seasons after rehabilitation.
2) Present yield of communal irrigation area is assumed to be same yield in the irrigated area in both seasons in MPIS.
3) *: rainfed yield in the surrounding areas. (BAS 1996)

(4) Increase of Production after Rehabilitation

As the effects of rehabilitation, production will increase by 19,394 t after rehabilitation, of which 4,735 t will be increased in IAAPIS and 14,659 t in MPIS.

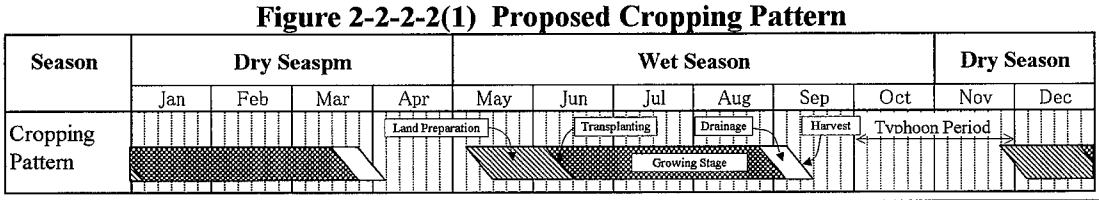
**Table 2-2-2-1 (4) Production Increase in IAAPIS**

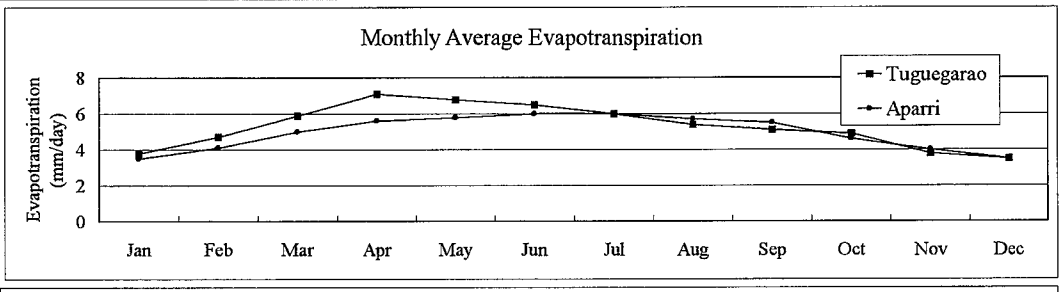
| Irrigation Condition | Present (2001) | | | | after Rehabilitation | | | | Product |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Yield (t/ha) | | Product | Area | Yield (t/ha) | | Product | Increase |
| | (ha) | Dry S. | Wet S. | (t) | (ha) | Dry S. | Wet S. | (t) | (t) |
| Irrigated in both seasons | 1,800 | 4.0 | 4.0 | 14,400 | 2,593 | 4.0 | 4.0 | 20,744 | |
| Irrigated only in dry season | 85 | 4.0 | 1.6 | 476 | 0 | | | 0 | |
| Non-irrigated | 1,062 | 0.0 | 1.6 | 1,699 | 354 | | 1.6 | 566 | |
| Total area | 2,947 | 2.6 | 3.1 | 16,575 | 2,947 | 4.0 | 4.0 | 21,310 | 4,735 |

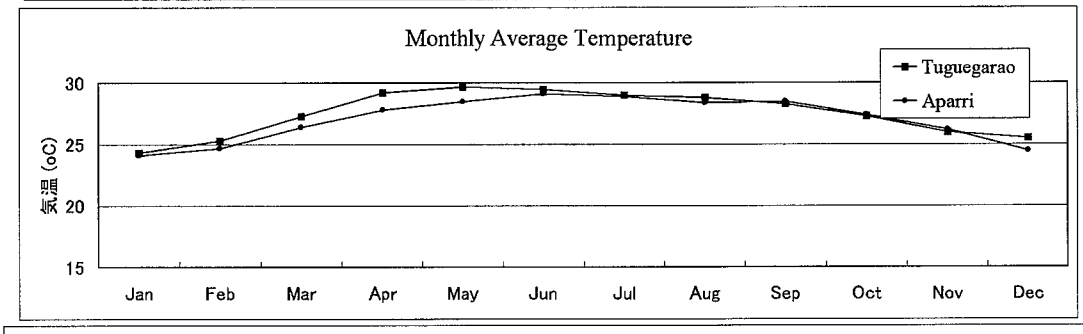
**Table 2-2-2-1 (5) Production Increase in MPIS**

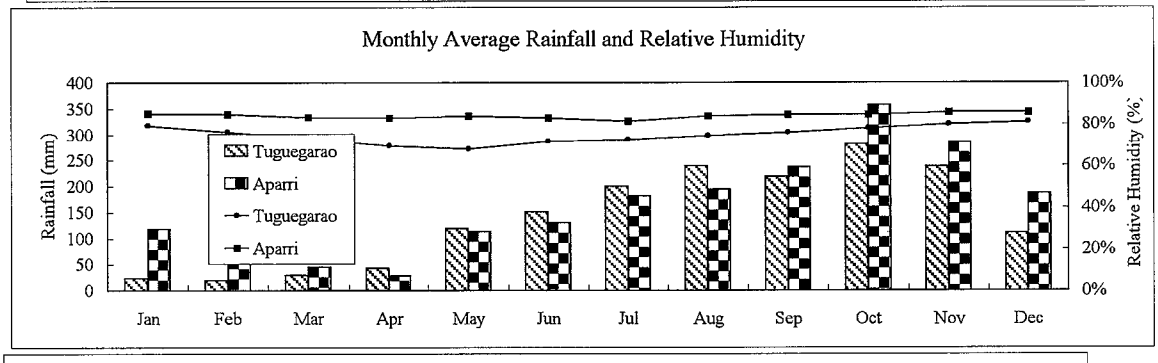
| Irrigation Condition | | Present (2002) | | | | after Rehabilitation | | | | Product |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | Yield (t/ha) | | Product | Area | Yield (t/ha) | | Product | Increase |
| | | (ha) | Dry S. | Wet S. | (t) | (ha) | Dry S. | Wet S. | (t) | (t) |
| Irrigated in both seasons | | 4,501 | 3.4 | 2.4 | 26,106 | 6,963 | 4.0 | 3.5 | 52,223 | |
| Irrigated only in dry season | | 4,232 | 3.4 | 1.6 | 21,160 | 2,821 | 4.0 | 1.6 | 15,799 | |
| Non-irrig ated | Communal irrigation | 1,051 | 3.4 | 2.4 | 6,098 | 0 | | | 0 | |
| | Non-irrigated | 1,673 | 0.0 | 1.6 | 2,677 | 1,673 | 0.0 | 1.6 | 2,677 | |
| Total area | | 11,457 | | | 56,040 | 11,457 | 3.4 | 2.5 | 70,699 | 14,659 |

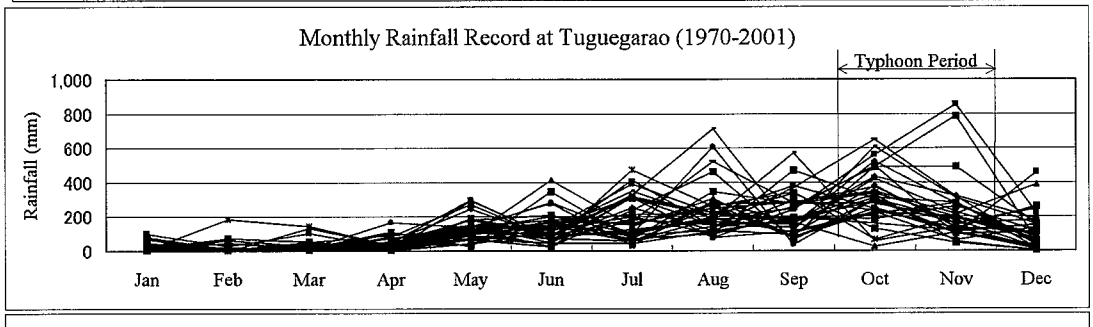
## Figure 2-2-2-2(1) Proposed Cropping Pattern

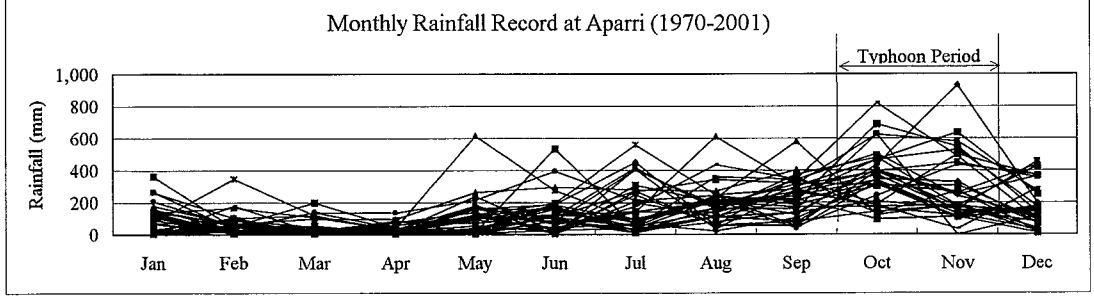


### 2-2-2-2 Irrigation Plan

(1) Unit Water Requirement and Irrigation Efficiency

Loan Project applied following criteria on field water requirement and estimated unit field water requirement by the growing stage requirement of 8.4 mm/day.

Land Preparation Stage： 130 mm (Land soaking： 130 mm)

Growing Stage： 8.4 mm/day（ETo 6.4 mm/day in June + Percolation 2 mm/day）

As shown in Figure 2-3-2-2(1), maximum evapotranspiration (ETo) during growing stage is 6.4 mm/day, average of Tuguegarao and Aparri, immediate after transplanting of wet season. Consequently, criteria of Loan Project can be applied also in the Rehabilitation Project. Unit field water requirement is estimated at 1.0 lit/sec/ha under 24-hour continuous irrigation.

(Note: Unit field water requirement = 8.4mm/day x 10,000m2/ha /86,400sec/day = 1.0 lit/sec/ha)

In the Loan Project, standard command area of one turnout was set at 50 ha, and 5-day rotation irrigation was introduced. Unit diversion requirement at pump and main canal was set at 1.84 lit/sec/ha under following irrigation efficiency;

Field application efficiency: 80% (Loss = 20%)

Conveyance efficiency of Lateral Canal: 85%(Loss = 15%)

Conveyance efficiency of Main Canal: 80%(Loss = 20%)

(Note: Diversion water requirement = 1.0 lit/sec/ha / 0.80 / 0.85 / 0.80 =1.84 lit/sec/ha)

(2) Pump Capacity

Under 24-hour continuous irrigation, required pump capacity is estimated as follows;

Iguigu Pump Irrigation System

Iguigu Pump Station: 1.84 lit/sec/ha x 775.61 ha = 1.427 $m^3$/sec

Iguigu Booster Station: 1.84 lit/sec/ha x 145.34 ha = 0.267 m3/sec

Amulung Pump Irrigation System

High-line Pump Station: 1.84 lit/sec/ha x 1,370.89 ha = 2.523 m3/sec

Low-line Pump Station: 1.84 lit/sec/ha x 801.19 ha = 1.474 m3/sec

Magapit Pump Irrigation System

Magapit Pump Station: 1.84 lit/sec/ha x 11,457.27 ha = 21.081 m3/sec

### 2-2-2-3 Rehabilitation Plan/Equipment Plan

(1) General Plan

Based on the design policy mentioned on Chapter 2 2-1, the contents of rehabilitation works and equipments for IAAPIS and MPIS are planned as follows.

**Table 2-2-2-3 (1) Rehabilitation Plan/Equipment Plan (IAAPIS)**

| Contents | Specifications |
|---|---|
| Procurement of equipment for removal works of the sedimentation in the water channel At Iguigu and Amulung pumping station | Amphibious excavator bucket size 0.35cu.m (struck)×1unit<br>Swamp Bulldozer 16 ton class ×1unit |
| Rehabilitation works for pumping station<br>Rehabilitation of building<br>Iguigu pumping station<br><br>Amulung pumping station<br><br>Replacement of intake gate<br>Iguigu pumping station<br>Amulung pumping station<br>Rehabilitation of river bank protection works<br>Iguigu pumping station<br>Amulung pumping station | <br><br>Water stop works against water leakage and Waterproof works on the wall of basement<br>Water stop works against water leakage and Waterproof works on the wall of basement<br><br>Incline gate W1,500mm×H2,000mm×1unit<br>Incline gate W2,000mm×H2,200mm×2units<br><br>Concrete works for river bank protection<br>Concrete works for river bank protection |
| Rehabilitation of Mechanical/Electrical equipment in the pumping station<br>Iguigu pumping station | <br><br>Main pump Dia.600mm×500mm×3units Overhaul<br>Motor 460V×120kw×3units Rewinding<br>Auxiliary machine Replace<br>Electrical equipment Replace |
| Amulung pumping station | Main pump Dia.700mm×600mm×3units Overhaul<br>Dia800mm×800mm×1unit Overhaul<br>Motor 460V×315kw×3units Rewinding<br>460V×240kw×1unit Rewinding<br>Pipes(outside), Auxiliary machine Replace<br>Electrical equipment Replace |
| Iguigu Booster pumping station | Main pump Dia.200mm×200mm×3units Replace<br>Pipes, Electrical equipment Replace |
| Amulung substation | 69kV Substation Inspection/Maintenance |
| Procurement of equipment for excavation of the drainage canals | Backhoe standard type, bucket size 0.35 cu.m (struck)×1unit<br>Dump Truck payload 4 ton class×1unit |
| Procurement of equipment for rehabilitation works of maintenance roads | Bulldozer 9ton class×1unit<br>（to be used commonly with MPIS） |

**Table 2-2-2-3 (2) Rehabilitation Plan/Equipment Plan (MPIS)**

| Contents | Specifications |
|---|---|
| Rehabilitation of Mechanical/Electrical equipment in the pumping station<br>Magapit pumping station | Main pump Dia.1,800mm×1,500mm×3units<br>Overhaul<br>Motor 3,300V×1,050kw×4units<br>Brush Replace<br>Auxiliary machine Replace<br>Incoming Panel, Local Panel, Battery Panel<br>Replace |
| Magapit substation | 69kV Substation Inspection/Maintenance |
| Replacement of Head gates and Turn-out gates | Head gate CP-Type 2 14units<br>Turn-out gate 600mm×600mm 65units |
| Procurement of equipment<br>for rehabilitation works of maintenance roads | (see Table 2-2-2-3(1) ) |

2) Equipment for removal works of the sedimentation in the water channel

Amphibious excavator 1 unit and swamp bulldozer 1unit will be procured for the Amulung Pump Irrigation System Office for the purpose of removal works of the sedimentation of the channel for Iguigu Pumping Station and Amulung Pumping Station.

Capacity of amphibious excavator

(a) Work Condition

- Soil : sand
- Condition of excavation: operate excavator on the surface of sedimentation at the bottom of river and excavate sand in the river water
- Altitude:

| | operation area | bottom of water channel |
|---|---|---|
| Iguigu pumping station | 9.00 m | 5.00 m |
| Amulung pumping station | 6.00 m | 2.00 m |

- Excavation required in a year

Amount of removed sedimentation at Amulung/Amulung pumping station are shown in the following table. Amount of sedimentation in the Cagayan River depends on the flood condition of each year.

Adding average amount of two pumping stations, total required amount of excavation in a year is 6,690 cu.m ( 3,570 + 3,120).

**Table 2-2-2-3 (3) Amount of removed sedimentation**

| CY | Amulung pumping station | Amulung pumping station |
|---|---|---|
| 1998 | 1,860 cu.m | |
| 1999 | 4,880 cu.m | 3,450 cu.m |
| 2000 | 3,630 cu.m | 2,080 cu.m |
| 2001 | 3,910 cu.m | 2,660 cu.m |
| 2002 | (19,620 cu.m) * | 4,280 cu.m |
| Average ** | 3,570 cu.m ** | 3,120 cu.m *** |

Note: calculation based on the expense for removal works

* including excavation of open channel

** Average from 1998 to 2001 *** Average from 1998 to 2002

・Working season

Days that river water level was higher than "1 meter below the surface of the sedimentation (operation area)" at Amulung/Amulung pumping station are shown on the following table.

**Table 2-2-2-3 (4) Days of high water level at Amulung pumping station (over WL 8.0m)**

| CY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 7 | 30 | 31 |
| 1996 | 0 | 0 | 0 | 0 | 4 | 0 | 3 | 10 | 10 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 5 | 11 | 1 | 6 | 9 | 8 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 22 | 29 | 25 |
| 1999 | 27 | 0 | 3 | 13 | 8 | 11 | 0 | 4 | 7 | 25 | 30 | 31 |
| 2000 | 17 | 12 | 6 | 0 | 8 | 0 | 7 | 7 | 4 | 17 | 30 | 31 |
| 2001 | 20 | 9 | 15 | 0 | 2 | 0 | 23 | 30 | 21 | 9 | 15 | 20 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |

**Table2-2-2-3 (5) Days of high water level at Amulung pumping station (over WL 5.0m)**

| CY | JAN | FEB | MAR | APR | MAY | JUN | JUL 7 | AUG | SEP 9 | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 12 | 30 | 31 |
| 1996 | 0 | 0 | 0 | 0 | 4 | 7 | 4 | 14 | 19 | 6 | 7 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 5 | 12 | 2 | 8 | 12 | 12 | 2 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 24 | 30 | 29 |
| 1999 | 29 | 0 | 5 | 14 | 23 | 14 | 0 | 7 | 13 | 26 | 30 | 31 |
| 2000 | 22 | 14 | 8 | 0 | 12 | 2 | 8 | 12 | 6 | 17 | 30 | 31 |
| 2001 | 25 | 10 | 20 | 0 | 2 | 1 | 26 | 30 | 25 | 13 | 17 | 23 |
| 2002 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | | | |

On the other hand, demand of pump operation is low in the nonirritating period as shown below.

Amulung pumping station: June to July, December to January in the next year

Amulung pumping station: the middle of May to the middle of July, November to December

River water level is so high after October that excavation works in the river might be impossible. Therefore, excavation work can be done from April to June. Pump is usually not operated and water level is low in this period.

Working days in a month is 22 days, considering weekend and rain days of more than 30mm rainfall.

(b) Excavator Type

Width of water channel in the river is approximately 15.0 m and the center area of water channel is beyond of the excavator's reach. Therefore, amphibious type backhoe is needed for the excavation work in the river. Appropriate bucket size of the backhoe is 0.35 cu.m (struck), considering the excavation amount, approximately 7,000 cu.m in a year. Leveling works of excavated sand is planned to be done by swamp bulldozer (16 ton class).

(c) Excavation capacity

Considering excavating condition in the water by amphibious backhoe, excavation capacity is as follows.

$$Q = d \times (3600 \cdot q \cdot K \cdot f \cdot E) / Cm$$

Q : hourly production (cu.m/h)
q : standard production per cycle (bucket size 0.35cu.m, struck)
K : bucket coefficient (0.98)
f : earth volume conversion coefficient ( 1.0)
E : work efficiency (0.45)
Cm : cycle time (135degree, 30sec.)
d : daily work hour (6.4 hr)

**Table 2-2-2-3 (6) Work Efficiency**

| Condition / Soil | Natural ground | | | Loose | | |
|---|---|---|---|---|---|---|
| | good | ordinary | not good | good | Ordinary | not good |
| Sand/Gravel | 0.75 | 0.60 | 0.45 | 0.80 | 0.65 | 0.50 |
| Rock/Stone | | | | 0.65 | 0.50 | 0.35 |

Daily production: $Q = 6.4 \times (3600 \times 0.4 \times 0.98 \times 1.0 \times 0.45) / 30 = 135.5$ cu.m/day

Monthly production: $Q_m = 135.5 \times 22$ /day = 2,981 cu.m//month

(d) Operation period of Amphibious Backhoe

6,690 cu.m / (2,981 cu.m/month) = 2.2 month

Therefore, amphibious backhoe 1 unit and swamp bulldozer 1 unit will be procured.

| Equipment | Specifications | No. |
|---|---|---|
| Amphibious Excavator | Standard type, bucket size 0.35 cu.m (struck) | 1 |
| Swamp Bulldozer | 16 ton class | 1 |

(3) Pumping Station

1) Building of Pumping Station

Water stop works will be done against the leakage on the concrete wall. Water stop material with cement crystal multiplication function will be filled at the remarkable points of leakage. Waterproof works will be done on the wall of basement part, as the way of prevention against additional leakage after water stop works.

2) River Bank Protection Works and Intake Gate

River bank protection works will be replaced at Amulung pumping station and Amulung pumping station, and then intake gates will be replaced at the both pumping stations.

Temporary Works: The coffer dam works for river bank protection work will be done in the period of low river water level. The structure of the cofferdam is embankment and sand pump will be used for drain works.

River bank protection works : After break and removal of existing river bank protection, backside banking will be repaired and compacted. Then, Concrete works will be done. Profile structure of riverbank protection works on the embankment is the following;

Protection sheet, Gravel 200mm, Reinforced concrete 150mm

Rehabilitation of Intake Gate : Intake gate will be installed on the repaired slope after removal of existing gate. Installation works of gate, spindle support and gate stand should be done elaborately. All works should be done during the cofferdam period.

(4) Mechanical/Electrical equipment in the pumping station

Equipments to be replaced and rehabilitation works are shown on the table of Appendix.

Submersible pump was not used because of its low endurance at the time of original design. After the loan project completed, sand content in the water of Cagayan River has increased and existing pumps have been damaged. Horizontal pump (Booster pump, Sealing pump) has problem of pump start caused from malfunctioned hoot valve. Vertical pump (Drain pump) has problem of fault and stop caused from worn out bearing and impeller bushing.

Submersible pump does not need priming and it has advantage on the point of pump start. Moreover, the distance between motor and impeller is short and bearing lasts longer than vertical pump. Endurance of submersible pump has improved up to these days and this type pump is used in many pumping station in the present. Therefore, malfunctioned booster pump and auxiliary pump will be replaced to submersible pump. Motor output of submersible pump at Iguigu booster pumping station is same as the existing horizontal pump. Therefore capacity of electrical equipment in Iguigu Booster pumping station will not be changed.

**Table 2-2-2-3 (7) Pump Facilities of Pumping Station**

| Irrigation System | Iguigu Pumping Irrigation System | | Amulung Pumping Irrigation System | Magapit Pumping Irrigation System |
|---|---|---|---|---|
| Pumping station | Iguigu Pumping Station | Iguigu Booster Pumping Station | Amulung Pumping Station | Magapit Pumping Station |
| Type of station | Storage pumping station | Booster pumping station | Storage pumping station (High line) | Storage pumping station |
| Discharge | 37.6 cu.m/min | 5.4 cu.m/min | 70.5 cu.m/min | 340 cu.m/min |
| Total head | 14.1m | 9.9m | 20.5m | 14.6m |
| Type of pump | Vertical mixed flow pump | Submersible Centrifugal pump | Vertical mixed flow pump | Vertical mixed flow pump |
| Dia. | 600mm x 500mm | 200mm x 200mm | 700mm x 600mm | 1,800mmx1,500mm |
| Motor output | 460Vx120kW | 230Vx15kW | 460Vx315kW | 3,300Vx1,050kW |
| Nos. | 3units | 3units | 3units | 4units |
| Type of station | | | Storage pumping station (Low line) | |
| Discharge | | | 80.0 cu.m/min | |
| Total head | | | 13.6m | |
| Type of pump | | | Vertical mixed flow pump | |
| Dia. | | | 800mm x 800mm | |
| Motor output | | | 460Vx240kW | |
| Nos. | | | 1unit | |

| 69kV substation | 69 k V-13.8kV * | | | 69 k V-13.8kV |
|---|---|---|---|---|
| 13.2kV Switchgears | 13.2kV-460V | 13.2kV-230V | 13.2kV Switchgears | 13.2kV-460V |

* Amulung substation locates in the land of IAAPIS office and supply power to 3 pumping stations.

(5) Head Gate

14 Head gates to be replaced in Magapit Pumping Irrigation System are shown on the following table.

**Table 2-2-2-3-(8) Head gate to be replaced (MPIS)**

| | Headgate | Canal | Station | Location | Gate Type | Gate Size | Nos. |
|---|---|---|---|---|---|---|---|
| 1 | Headgate of Lateral E | Main Canal | 18+940 | Along Lateral E<br>Along Main Canal | CP-Type2<br>CP-Type2 | 1.80×1.60<br>1.60×1.40 | 2<br>2 |
| 2 | Headgate of Lateral F | Main Canal | 20+484 | Along Lateral F<br>Along Main Canal | CP-Type2<br>CP-Type2 | 1.40×1.20<br>1.60×1.60 | 1<br>1 |
| 3 | Headgate of Lateral G | Main Canal | 22+641 | Along Lateral G<br>Along Main Canal | CP-Type2<br>CP-Type2 | 1.20×1.00<br>1.20×1.20 | 1<br>1 |
| 4 | Headgate of Lateral E-1 | Lateral E | 4+382 | Along Lateral E-1 | CP-Type2 | 1.10×1.00 | 1 |
| 5 | Headgate of Lateral E-2 | Lateral E | 5+733 | Along Lateral E-2<br>Along Lateral E | CP-Type2<br>CP-Type2 | 2.00×1.80<br>1.00×1.00 | 1<br>1 |
| 6 | Headgate of Lateral E-2a | Lateral E-2 | 0+738 | Along Lateral E-2 | CP-Type2 | 1.00×0.80 | 1 |
| 7 | Headgate of Lateral E-2b | Lateral E-2 | 1+347 | Along Lateral E-2b<br>Along Lateral E-2 | CP-Type2<br>CP-Type2 | 1.80×1.00<br>1.00×1.00 | 1<br>1 |
| | | | | | | Total | 14 |

(6) Turn-Out Gate

The following 65 Turnout Gate in Magapit Pumping Irrigation System will be replaced.

**Table 2-2-2-3 (9) Turn-Out Gate to be replaced (MPIS)**

| | Canal | Turn-out | Station | Location | Area | Note |
|---|---|---|---|---|---|---|
| 1 | Lat. A | 1 | 1+317 | Right | 19.58 | Size 600x600mm |
| 2 | | 3 | 3+043 | Right | 24.89 | |
| 3 | | 4 | 4+421 | Right | 13.31 | |
| 4 | | 5 | 5+631 | Right | 10.47 | |
| 5 | Lat. B | 6 | 4+610 | Right | 6.31 | |
| 6 | | 7 | 5+340 | Right | 37.00 | |
| 7 | | 8 | 5+340 | Left | 30.38 | |
| 8 | | 9 | 6+248 | End Check | 41.47 | |
| 9 | Lat. A-Ext. | 1 | 0+020 | Left | 6.09 | |
| 10 | Lat. B-Ext. | 2 | 1+000 | Left | 8.81 | |
| 11 | | 3 | 1+300 | Left | 25.37 | |
| 12 | | 4 | 1+300 | Left | 19.72 | |
| 13 | Main Canal | 1a | 1+100 | Left | 13.00 | |
| 14 | | 5 | 8+680 | Left | 10.00 | |
| 15 | | 6 | 8+860 | Left | 10.00 | |
| 16 | Lat. C2 | 12 | 4+105 | Left | 46.35 | |
| 17 | Lat. C | 5 | 6+785 | Left | 11.34 | |
| 18 | | 5a | 6+810 | Left | 43.58 | |
| 19 | | 6 | 9+100 | Left | 58.67 | |
| 20 | | 5b | 6+820 | Right | 1.33 | |
| 21 | | 4-1 | 5+600 | Left | 7.61 | |
| 22 | | 4-1a | 5+635 | Left | 7.43 | |
| 23 | | 4-a | 6+750 | Left | 6.41 | |
| 24 | Lat. C3 | 2 | 0+400 | Left | 34.62 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | | 3 | 0+750 | Left | 51.66 | |
| 26 | Lat. C4 | 1 | 0+025 | Left | 17.97 | |
| 27 | | 2 | 0+080 | Right | 32.43 | |
| 28 | Main Canal | 6 | 14+734 | Right | 4.00 | |
| 29 | | 7 | 15+700 | Right | 19.00 | |
| 30 | | 9 | 18+473 | Right | 30.00 | |
| 31 | Lat. E-2b | 7 | 3+200 | Left | 24.91 | |
| 32 | | 8 | 3+250 | Right | 36.98 | |
| 33 | | 9 | 3+720 | Right | 48.49 | Size 600x600mm |
| 34 | | 10 | 5+020 | Left | 31.06 | |
| 35 | | 12 | 5+630 | End Check | 19.18 | |
| 36 | Lat. E-2b-1 | 1 | 0+040 | Left | 48.61 | |
| 37 | | 1a | 0+040 | Left | 23.09 | |
| 38 | | 3 | 0+680 | Left | 15.06 | |
| 39 | | 4 | 0+680 | Right | 17.00 | |
| 40 | | 5 | 1+380 | Left | 18.10 | |
| 41 | | 6 | 1+380 | Right | 20.37 | |
| 42 | | 7 | 2+220 | Left | 15.18 | |
| 43 | Lat. E-2b-1 | 8 | 2+220 | Right | 21.01 | |
| 44 | | 9 | 2+911 | End Check | 35.43 | |
| 45 | Lat. G | 1a | 0+190 | Right | 17.00 | |
| 46 | Main Canal | 18 | 22+641 | Left | 41.00 | |
| 47 | | 22 | 23+500 | Left | 71.00 | |
| 48 | | 25-b | 24+100 | Left | 15.00 | |
| 49 | Lat. E-1 | 2 | 0+720 | Left | 67.01 | |
| 50 | Lat. E-2 | 1a | 0+580 | Right | 12.39 | |
| 51 | | 2 | 1+347 | Right | 12.41 | |
| 52 | | 3 | 1+710 | Left | 18.40 | |
| 53 | | 4 | 1+690 | Right | 18.07 | |
| 54 | | 6a | 3+640 | Right | 25.88 | |
| 55 | Lat. E-2A | 1 | 0+600 | Right | 40.23 | |
| 56 | | 3 | 1+620 | Right | 17.95 | |
| 57 | | 4 | 1+460 | Right | 51.86 | |
| 58 | Lat. E-2b | 1 | 0+740 | Left | 113.86 | |
| 59 | | 1a | 0+239 | Right | 10.34 | |
| 60 | | 3 | 1+620 | Right | | |
| 61 | | 5 | 2+940 | Right | | |
| 62 | | 5b | 2+040 | Right | 33.45 | |
| 63 | | 6 | 2+970 | Left | | |
| 64 | Lat. C | 2 | 1+868 | Left | | |
| 65 | Lat. C-1 | 6 | 2+000 | Left | | |
| | Total | | | 65 units | | |

(7) Equipment for excavation works of the Drainage Canals

Excavator 1 unit will be procured for the removal of sedimentation in the drainage canals. Considering the work condition that the excavator is used for the works at the drainage canals and the small scale drainage channels, bucket size of the excavator shall be determined. According to the standard of estimation for civil works published by Ministry of land, Infrastructure and Transport, Japan, crawler type backhoe with bucket of 0.35 cu.m (struck) is appropriate for the loading loose soil.

Capacity of excavator

| | | |
|---|---|---|
| Amount of sedimentation to be excavated in a year: | | 19,800 cu.m |
| Daily production: | (bucket size 0.35 cu.m(struck) ) | 160 cu.m |
| Work days in a year: | (19,800 / 160) | 124 days |

Dump Truck (Payload 4 ton class) will be procured for the works of conveying excavated soil

(8) Equipment for rehabilitation of Maintenance Roads

Bulldozer 1 unit will be procured for the gravel supply and compaction on the maintenance roads. The width of the roads is 3.0-3.5m and bulldozer with plate width 3.0m, 9 ton class is appropriate. Equipment for loading/unloading and conveying gravel is needed for the rehabilitation works. Backhoe and dump truck which will be procured for the excavation of the drainage canals will be used for the maintenance roads commonly.

### 2-2-3 Basic Design Drawing

DRAWING LIST

| Dwg. No. | Title |
|---|---|
| 1 | Iguigu Pumping Station General Plan |
| 2 | Iguigu Pumping Station River Bank Protection Works |
| 3 | Iguigu Pumping Station Flow Sheet |
| 4 | Iguigu Pumping Station Single Line Diagram |
| 5 | Amulung Pumping Station General Plan |
| 6 | Amulung Pumping Station River Bank Protection Works |
| 7 | Amulung Pumping Station Flow Sheet |
| 8 | Amulung Pumping Station Single Line Diagram |
| 9 | Magapit Pumping Station Flow Sheet |
| 10 | Magapit Pumping Station Single Line Diagram |
| 11 | Iguigu Booster Pumping Station General Arrangement |
| 12 | Iguigu Booster Pumping Station Single Line Diagram |
| 13 | Amulung Substation Single Line Diagram |
| 14 | Magapit Substation Single Line Diagram |

* Drawings are shown at the end of Report.

## 2-2-4 Implementation Plan / Procurement Plan

### 2-2-4-1 Implementation policy / Procurement policy

This project will rehabilitate irrigation facilities and the procurement of materials and equipment for Iguigu Pumping Irrigation System, Amulung Pumping Irrigation System and Magapit Pump Irrigation system in Cagayan province. Executing organization is NIA, and agencies in charge are Regional Irrigation Office II, Amulung Pumping Irrigation Office and Magapit Pumping Irrigation Office.

The project consists of the construction of facilities and the procurement of and equipment, and works will be carried out based on one contract with Japanese contractor. The procurement of materials and equipment is from the Philippines and Japan. Concerning the civil works and the installation of the equipment, local contractor will be used, and Japanese dispatched engineers will ensure the quality.

(1) Implementation Policy

- Rehabilitation of Buildings at the Pumping Station:

Leaking of water at basements in Iguigu pumping station and Amulung pumping station will be rehabilitated. Leaking points will be filled up with material that has function of cement crystal multiplication so that they are partially intensified, and rehabilitated the performance of stop water. Waterproof work will do to whole wall of basements as prevention from other leaking after the treatment for the current points.

- Rehabilitation of River Bank Protection Works:

The riverbank protection works will be rehabilitated after cofferdam construction in front of the intake during the low water season of Cagayan River. The cofferdam are made by banking, and the inside river water is drained by a sand pump. There are some gaps in the back banking of protection concrete as drawing of river water, and existing river bank protection works have to be removed, and after the banking and strengthen them, the bank is covered by material for prevention of water drawing, and crushed stone. Reinforced concrete work is undertaken on there, finally.

- Rehabilitation of Intake Gates:

Intake gates will be rehabilitated during cofferdam is setting. Firstly, the existing gate is removed, and a gate stand, shaft bearing part and body of gate are installed on the new-concreted banking.

- Rehabilitation of Head Gates and Turn-out Gates:

In Magapit Pumping Irrigation System, damaged gates dotted in the main and branch canal will be changed one by one.

A site office for above constructions will be set inside of the premise of Amulung Pumping Irrigation Office, and warehouse for materials and equipment will be prepared in each pumping station of Iguigu, Amulung, Magapit and Iguigu Booster Pumping Station.. The head gates and Turnout gates will be carried to each installation place depending on the progress of the removal works of the existing gates after store in

Magapit Pumping Irrigation Office in Camalaniugan.

Local contractor will be applied in this project, since there are many construction companies which have experience of these types of the constructions in the Philippines. But, Japanese civil engineers will be dispatched to ensure the quality of construction throughout the construction period because quality management of each construction is a very important matter for a rehabilitation project such as the stop water work for the buildings of pumping stations.

(2) Procurement Policy

The construction needs materials and equipment showing under table;

| Item | Materials and Equipment | Facilities |
|---|---|---|
| Materials for Civil Construction | reinforcing bar, aggregate, cement, material for stop water, form, scaffold | pumping station (building, river bank protection works) |
| Gate | intake gate, head gate, turn out gate | pumping station, gate works in canal |
| Mechanical/Electrical Equipment | pump, motor, pipes, electric panel, switchgear, cables | pumping station |
| Construction Machine | amphibious excavator, swamp bulldozer, backhoe, dump truck, bulldozer | Intake, drainage canal, maintenance road |

Concerning procurement of equipment, the companies will be selected considering the local situation of agencies, repair shops and so on, since pump irrigation office have to maintain the facilities, and need exchange malfunctioned parts after the construction. Especially, regarding mechanical and electrical equipment, local dealers will be applied for procurement and installation of equipment, considering maintenance, inspection and repair after the rehabilitation of facilities. Local company in Manila has done the service work of rewinding of motor and inspection of transformers until now. Japanese engineers will be dispatched according to the construction schedule of mechanical works, electrical works and substations, since high level engineer will be required for guidance of installation, adjustment, test run, and maintenance of equipment.

## 2-2-4-2 Implementation Conditions

(1) Rehabilitation Works of Pumping Station Buildings

As a measure of ensuring safety during works period, the following facilities should be maintained in good condition.

- Lighting facilities under ground floor
- Submergence on the under ground floor
- Ventilation in basement space

(2) Rehabilitation Works of River Bank Protection Works and Installation of Intake Gates

The cofferdam period should be planned with sufficient analysis of the site condition in rain season/dry

season. According to the past record, water level rises suddenly caused by flood even in dry season. Considering these conditions, control of work schedule should be done for the safety of works.

There is no ready mixed concrete plant in the vicinity of the work site, therefore concrete will be purchased through local constructor.

Good care for the existing facilities basement which is out of scope of the rehabilitation works, should be taken in the works of embankment at pumping station.

(3) Installation of Mechanical/Electrical equipments in Pumping Station

Coordination between civil works and mechanical/electrical works should be taken to shorten irrigation stop period. Especially detail schedule should be planned in the case that rehabilitation works will be done with pump operation.

Through the mechanical/electrical works, installation, adjustment and test-run of equipments in the pumping station, technical training regarding operation and maintenance of pump facilities will be done for the Philippines side engineer in charge of pumping station.

(4) Rehabilitation Works of Intake Gates and Turn-out Gates

Work schedule of Intake Gates and Turn-out Gates should be planned with consideration of the condition of roads to the site in rain season. In the case of replacing gates in irrigation period, work schedule should be planned based on irrigation plan.

(5) Custom Clearance of Materials and Equipments

Custom clearance will be done at Manila. Procedure and cost of tax exemption and VAT will be borne by the Philippines side.

### 2-2-4-3 Scope of Works

The Philippines side should take proper measures on the construction site regarding the following matters.

- Deliberate on matter of occupying a part of river and road, and obtain permission
- Assist consultant in discussion with owner/user of the land occupied for temporary works
- Make agreement with farmer on the matter of stop irrigation during works of pumping station

### 2-2-4-4 Consultant Supervision

The Philippines side executive agency for the project shall make agreement with Japanese consultant firm recommended by JICA. The consultants firm shall carry out the detail design and the supervision of the construction and procurement of equipment as follows.

Detail Design

- Site investigation for the detail design
- Detail design and preparation of tender documents on the construction and procurement of equipments

- Conducting the tender operation on behalf of the Philippines governments
- Evaluation of tender and attending negotiations on the contract between the Philippines government and contractor related to the above tendering

Supervision

- Approval to the construction drawings and shop drawings
- Inspection and approval to the equipments before shipping
- Supervision of the construction progress, quality control and safety of works
- Supervision of the installation, adjustment and test-run of equipments
- Inspection the work progress and issuing completion certificate

One civil engineer will supervise whole the works through construction and procurement period. One architectural engineer, one mechanical engineer and one electrical engineer will supervise each part of works temporally based on work schedule.

### 2-2-4-5 Quality Control Plan

Consultant will inspect the progress of works and check the records as the specifications and performance mentioned on the contract will be kept. Mechanical analysis of aggregate grain, concrete strength test and compaction test shall be done for riverbank protection works. Pump facilities will be examined on the points such as adjustment of shaft tolerance, leveling of installation, vibration, performance of electric panel, insulation, grounding resistance and so on.

The Philippine side, consultant and contractor hold monthly meeting and discuss the matter of work progress and solve the problems on the site.

### 2-2-4-6 Procurement Plan

(1) Materials and equipments to be procured in the Philippines are the following.

- Construction machine for works:

  Road/bridge construction works are done in the area including project site and construction machine are procured and used on the works. There are many leasing company of construction machine at Manila and they hold sufficient number of machines for the project.

- Concrete:

  There is no ready mixed concrete plant near the project site and concrete will be purchased through local constructor.

- Aggregate:

  Sand and gravel for concrete works can be picked at near the concourse of Cagayan River and Penablanka River and the site of Donmuan River.

- Reinforcing bar:

Reinforcing bars are produced and supplied in sufficient quality in the Philippines.

- Pipes:

  Rolled steel pipes are produced based on the standard and supplied in the Philippines

- Coil of motor

  There are service shops dealing with motor overhaul works at Manila. Motor coil can be supplied in the Philippines.

- Electrical panel

  There are some manufacturers of electrical panel at Manila. They have sufficient achievement of supply panels based on JIS or IEC standard.

(2) Materials and equipments to be procured from Japan are the following.

- Water stop material for concrete works:

  Water stop materials of high quality, having much past good achievement contain materials which have function of cement crystal multiplication. This kind of materials made in Japan is recommended for the water stop works in the basement of pumping station.

- Exchange parts of main pump/Auxiliary pump:

  Parts of main pump and auxiliary pumps are based on the peculiar design and specifications for each pumping station and multipurpose parts are not suitable for them. It is recommended that pump parts and pumps are designed and manufactured in Japan.

- Cooling unit/Duplex strainer/Actuator of motor valve:

  Regarding the above mentioned equipments, there are only imported equipments in the Philippines. These equipments will be procured from Japan.

- Battery panel:

  There are few manufacturers of battery panel in the Philippines and it is recommended that
  Battery panel is designed and manufactured in Japan.

- Cables:

  It is recommended that cables made in Japan are used for the electric works considering unification of quality and standard.

- Construction machine to be procured:

  Construction machine will be procured from Japan or the Philippines depending on the kind of machine.

### 2-2-4-7 Implementation Schedule

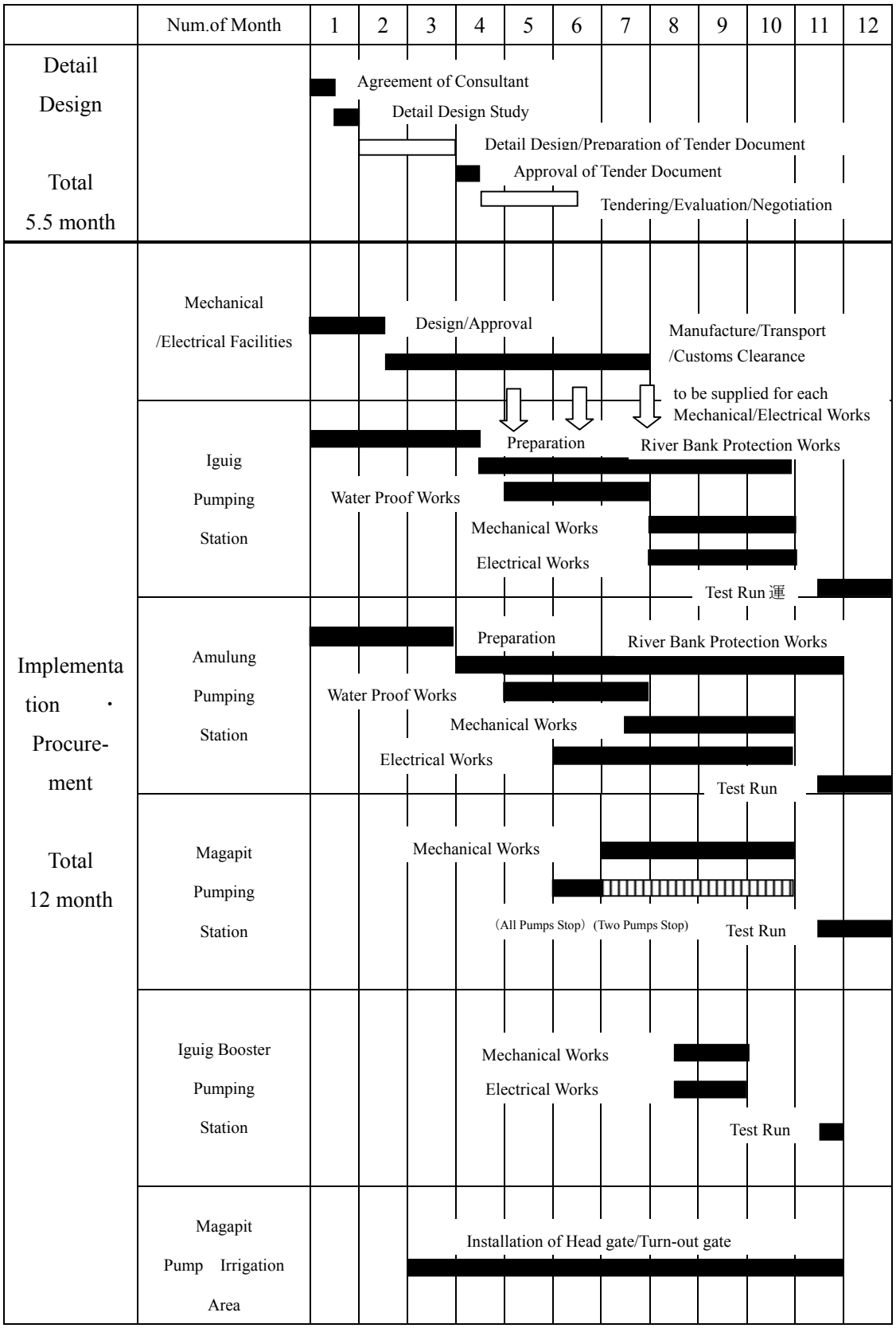
Implementation of this project will take the period as follows.

Detail design and tender period 5.5 months

Construction and Procurement 12 months

Schedule of implementation and each works are shown on the next table.

**Figure 2-2-4-7 (1) Implementation Schedule**



## 2-3 Obligations of Recipient Country

In the implementation of the Grant Aid project, the recipient country shall undertake following items for the project.

### 2-3-1 General

(1) After the implementation of this project is determined, necessary materials and information shall be provided to the detailed design study conducted by the Japanese consultant.

(2) The land for the temporary works necessary for the facilities and equipment in this project shall be secured.

(3) The material necessary for the operation of the facilities in this project such as electric power shall be secured.

(4) Based on the bank arrangement, necessary commissions shall be paid to the banks.

(5) Measures shall be provided for the prompt unloading, customs clearance, and the transportation within the Philippine of the materials and equipment to be delivered for this project.

(6) VAT, the import taxes and customs clearance, the domestic taxes, and other financial surcharges charged to the preparation of materials, equipment and provision of services by the Japanese nationals for this project shall be exempted or born by the Government of Philippine.

(7) Necessary measures for Japanese nationals to supply services for the implementation of this project shall be taken for their entry into the recipient country and the staying.

(8) The permit necessary for the implementation of this project and ratification of the said permit shall be obtained in advance according to the laws of the Government of Philippine.

(9) Appropriate budget and staff members for proper and effective operation and maintenance of the facilities and equipment constructed under the project shall be assigned.

(10) The facilities and equipment constructed under the project shall be maintained and operated appropriately and effectively. The operating situation of the facilities and equipment shall be reported to Japan as requested from Japan.

(11) All the other necessary expenses not included in the Japanese grant aid shall be born.

### 2-3-2 Cost Borne by the Government of Philippine

Total costs borne by the Government of Philippine for the project implementation is estimated as follows.

| Cost Description | Amount (Thousand PHP ) | |
|---|---|---|
| (1) Expenditures (include necessary commissions based on the bank arrangement) | Approx | 27,700 |
| (2) VAT, the import taxes and customs clearance | Approx | 39,500 |
| Total | Approx | 67,200 |

## 2-4 Project Operation Plan

The project shall be maintained and operated by MPIS Office and IAAPIS Office according to the present operation systems. The other hands, the Irrigation System Offices are supervised by the Region II Irrigation Office of NIA. The Offices have operated and maintained irrigation facilities such as pumps, canals and maintenance roads of each system after completion of CIADP, which was implemented under Japanese loan. And, the Offices have enough knowledge and technology for the irrigation system operation and maintenance. NIA is now transferring a part of the operation works of gates and maintenance works of irrigation canals to Irrigators' Associations (IA's) and will completely transfer to IA's such works in future (Irrigation Management Transfer = IMT). After completion of transferring such works, the main works of the Offices are direction of IA's, operation and maintenance works of pump stations.

### 2-4-1 Operation Plan for Irrigation System Office

(1) Purpose and Function of Irrigation System Office

The purpose and the main works of the Irrigation System Offices before IMT are:

a) Operation and Maintenance of the irrigation systems and related facilities, and

b) Irrigation service fee collection activity.

The main works of the Irrigation System Office are maintenance of intake channel in Cagayan River, pump operation, maintenance of irrigation and drainage canals, etc. Operations of Head Gates and Turn-Out Gates have turned over or are being tuned over to IAs. Canal clearing and repairing works are executed by IAs under the contract with the Irrigation System Office. Irrigation Services Fee (ISF) collection activities are undertaken by NIA office in MPIS and undertaken by IA's and sent to NIA office in IAAPIS.

(2) Organization of the Irrigation System Office

The organization of the Irrigation System Office is composed of Administrative section, O & M section and Institutional Development section under supervision of Irrigation Superintendent. The administrative section has four units such as Disbursing unit, Accounting & Collection unit, Personnel & Record unit and Property unit. The O & M section composed of O & M unit for canal system and equipment unit for pump operation and construction equipment operation in IAAPIS Office. In MPIS Office, the O & M section has responsible only the operation and maintenance works of canal systems, and the other hand pump operation unit and equipment operation unit are under the Equipment Operation section. The Equipment Operation section of MPIS Office has a function as the main workshop of NIA agencies located in the province of Cagayan. Thus the supplied construction equipment such as a Backhoe, a Dump Truck and a Bulldozer are installed in MPIS Office and supervised by the Equipment Operation section in the Office. Therefore, three (3) additional heavy equipment operators shall be employed in the Office. On the other hand in IAAPIS Office, one (1) heavy equipment operator will be needed in addition to existing operators. The numbers of personnel for existing and after Project in both Irrigation System Offices are shown in the Table hereunder.

**Table 2-4-1 (1) Number of Personnel Existing and Proposed for After Project in the Iguigu, Amulung Pump Irrigation System Office**

| Section | Number of Personnel | Additional Personnel | Proposed Personnel |
|---|---|---|---|
| Irrigation Superintendent (IS) | 1 | | 1 |
| Assistant I.S. | 1 | | 1 |
| Property Unit | 1 | | 1 |
| Disbursing Unit | 2 | | 2 |
| Personnel & Record Unit | 2 | | 2 |
| Account & Collection Unit | 3 | | 3 |
| O & M Unit | 3 | | 3 |
| Equipment Unit | 7 | 1 | 8 |
| Institutional Development Unit | 1 | | 1 |
| Total | 21 | 1 | 22 |

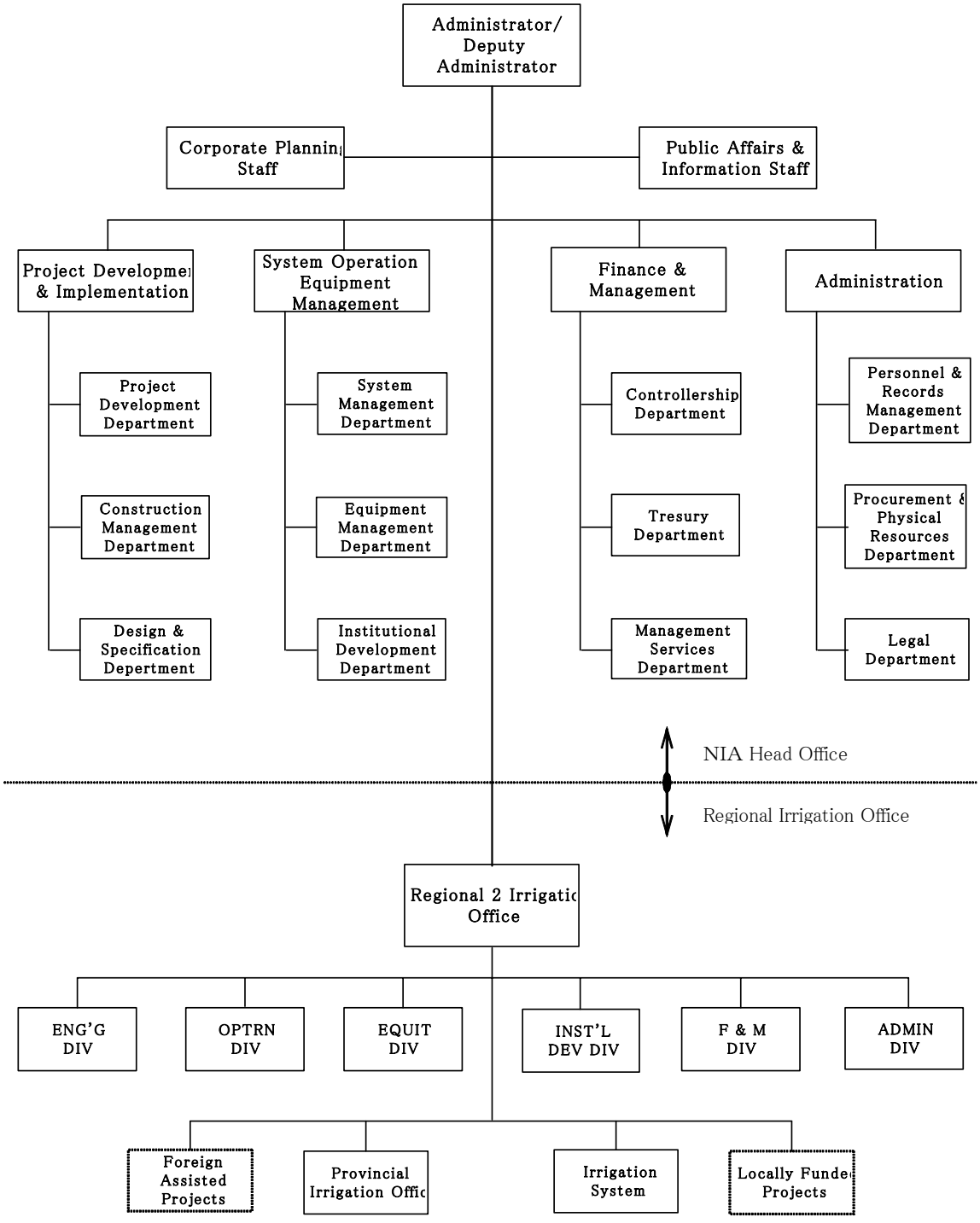
**Table 2-4-1 (2) Number of Personnel Existing and Proposed for After Project in the Magapit Pump Irrigation System Office**

| Section | Number of Personnel | Additional Personnel | Proposed Personnel |
|---|---|---|---|
| Irrigation Superintendent (IS) | 1 | | 1 |
| Assistant I.S. | 1 | | 1 |
| Property Unit | 1 | | 1 |
| Irrigation Fee Collection Unit | 2 | | 2 |
| Accounting Unit | 5 | | 5 |
| Personnel & Record Unit | 5 | | 5 |
| O & M Technology Unit | 4 | | 4 |
| O & M Unit | 34 | | 34 |
| Equipment Unit | 14 | 3 | 17 |
| Institutional Development Unit | 1 | | 1 |
| Total | 68 | 3 | 71 |

(3) Organization Chart

Both Offices is different from the size but almost same organization. Depending on the present condition as on going of IMT transfer, enforcement for organization and technology of IA's is the issue of the future Irrigation System Operation. After completion of IMT transfer, reduction of NIA personnel will be required as transferring to the IA officer or etc. Following Chart shows the Organization before IMT.

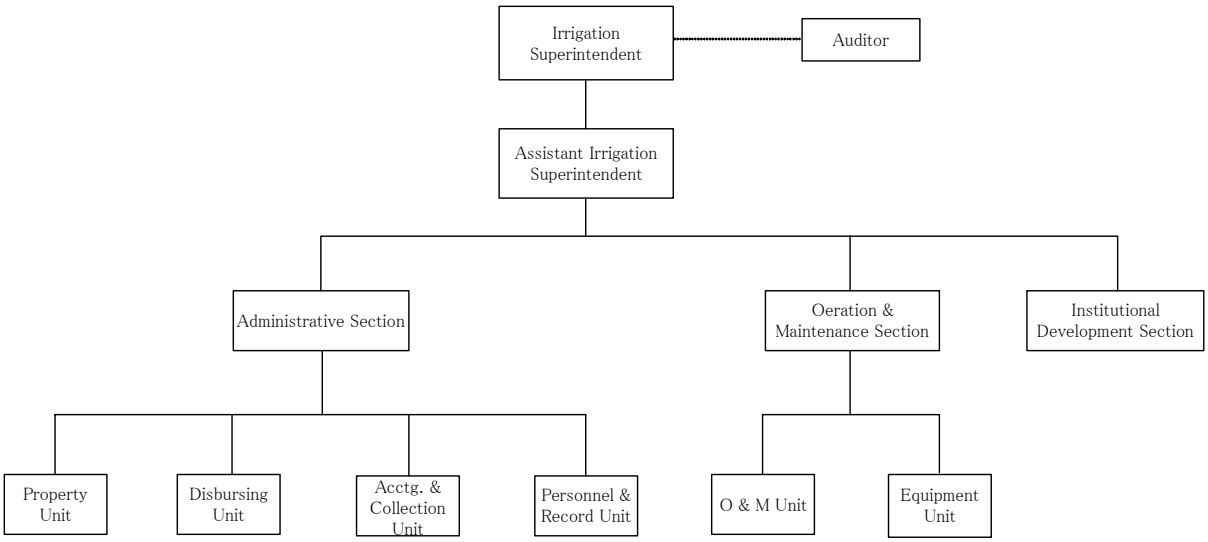
**Figure 2-4 (1) Organization chart of NIA**




source: NIA

**Figure 2-4 (2) Organization chart of IAAPIS Office**

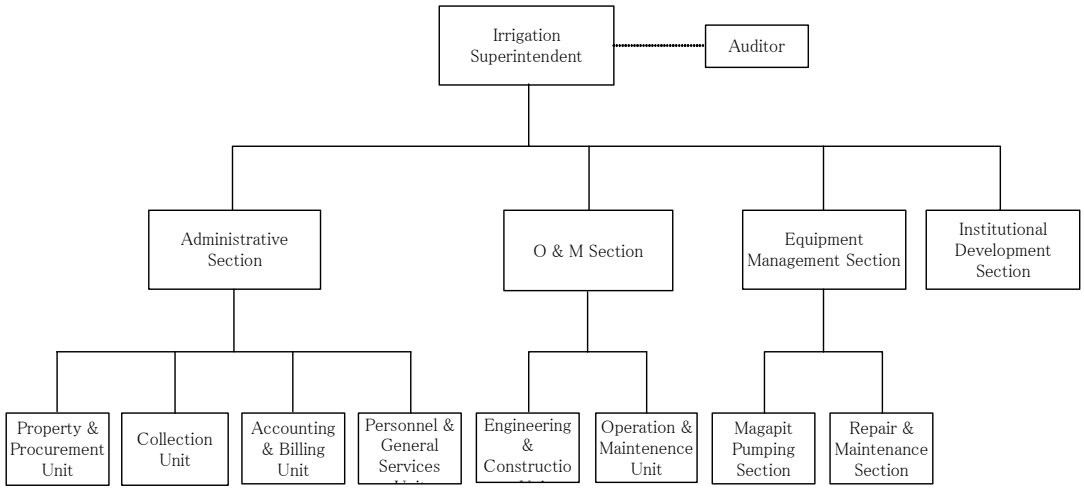
(as of October 2002)




source : IAAPIS Office

**Figure 2-4 (3) Organization chart of IAAPIS Office**

(as of October 2002)




source : MPIS Office

(4) Office Operation

As mentioned the above, MPIS Office and IAAPIS Office are under supervision of Region II Irrigation Office of NIA. Each System Office works are executed under the supervision of Irrigation Superintendent. Budget of the personnel expenditure for the office staff is delivered from the Regional Irrigation Office. Operation cost is distributed to the Irrigation System Office according to the condition of ISF collection. Rehabilitation cost of pumps, equipment and irrigation facilities is also distributed depending upon the evaluation of the request from the Irrigation System Office.

## 2-4-2 Operation and Maintenance Plan

(1) Maintenance of Intake Canal of Pump Station

One (1) amphibious excavator and one (1) swampy bulldozer will be managed at the Iguigu and the Amulung Pumping Stations. The equipments are delivered in IAAPIS Office. The equipment will be operated for the excavation work of the intake channel of the Pump Stations at Iguigu and Amulung Pumping Stations under the supervision of the Irrigation Superintendent of IAAPIS. The desilting works shall be done during the idle period of pump operation as a rule. However, due to avoid concentration of works, excavation works may execute during pump operation as observing the water elevation of the River according to the report of sediment condition, especially after heavy flood happens.

The equipments are operated by the operators of the Office in charge. The operators shall responsible to maintain the equipment in good condition all the time.

(2) Operation and Maintenance Plan for Pumping Station

The responsible mechanical for pumping operation are assigned in both MPIS and IAAPIS Offices, and five other operators are assigned also in each office. The engineer assigned in charge operates the pumps according to the irrigation program instructed by the Irrigation Superintendent. The responsible engineer in charge shall guide mechanical and electrical operation technique to the operators depending on the operation manual. Operators shall be assigned at the sites at least one for each Pump Station of IAAPIS, and two for MPIS during the pump operation.

The operation note shall be installed at the each station for operator in charge to record mechanical and electrical checkpoints as a rule. In addition to the operation record, it is desirable to record weather, temperature, humidity, water elevation, water condition, etc, and the Pumping Stations and pump equipments shall be clean at anytime.

The emergency communication system shall be established to inform the condition of the stations to the responsible engineer or the Irrigation Superintendent. The emergency personnel assignment plan shall be established for typhoon or heavy flood in order to avoid unexpected calamity.

(3) Maintenance Plan for Irrigation Canal

One (1) Irrigation Supervisor is assigned for the area of each IA, and his responsible works are:

a) to prepare and submit irrigation and cropping schedule,
b) to coordinate with all concerned system personnel regarding the timely releases of irrigation water based on approved cropping pattern and irrigation schedules,
c) to check regularly irrigation and drainage canals and related facilities,
d) to educate IAs' member,
e) to prepare the maintenance and rehabilitation plan and to submit it's budgetary request, and
f) to prepare the daily irrigation record, etc.

Irrigation Supervisor executes ordinal irrigation activities under the supervision of the Irrigation Superintendent. Recently, the System Office commits the canal maintenance works to IA or the beneficiaries. The Supervisor shall coordinate or guide them as the works function in good condition.

The operations of head gates and turnout gates are turned over to IA activities. Accordingly, the Supervisor shall guide the operation method of those gates according to the operation manual. Furthermore, the Supervisor shall prepare the operation program of the supplied equipment for the drainage excavation and the service road maintenance works coordinating other Supervisor under the supervision of the Irrigation Superintendent.

The procured equipments for maintenance works are a Backhoe, a Dump Truck and a Bull Dozer. These equipments are managed at MPIS Office and supervised by the Equipment Section. The annual operation program for the maintenance of equipments shall be prepared with the cooperation of the Irrigation Superintendent for MPIS and IAAPIS. As driving of heavy equipment reduces durability, the equipment shall be well maintained and enough spare parts shall be stocked at anytime.

## 2-4-3 Operation and Maintenance

(1) Operation and Maintenance of Pump Equipment and Electrical Facilities

① Conduction of check-up and management of records

- Check-up standard, operation record, trouble record and facilities replacement record shall be prepared.
- Check-up standard shall contains check point, frequency, judgment criteria, diagnosis, repair and/or replacement of parts.
- Each records shall be in format of log book for each equipment number, so the record of check-up, maintenance, repair and troubles can be utilized.
- In accordance with check-up standard and maintenance record, operation check-up (monthly and annual) as well as periodical check-up (5 years, 10 years) shall be conducted. Finding of unusual condition in its early stage will prevent deterioration, which will contribute to the stable water supply and decrease of repair cost (prediction on maintenance).
- Maintenance record shall be managed chronologically for the analysis of the tendency of trouble which shall be reflected to repair/replace planning (tendency management).

② Management of Operation and Maintenance Equipment

- Measurement equipment for check-up, special tools for disassemble of machinery, spare parts and consumables shall be always ready by periodical check.
- Storage place shall be secures for such tools and spare parts, which shall be well cleaned and records of the numbers of tools/parts shall be well managed.
- Necessary maintenance work shall be effectively conducted by the improvement and utilization of workshops.

③ Reaction to Troubles

- Re-confirmation of O/M Manual by engineers of pump stations.
- To determine parts and causes of troubles, engineers shall conduct diagnosis of mal-function of facilities in accordance with O/M Manual. After grasping causes, repair work and/or replace of parts shall be made in accordance with the work flow.
- Emergency information networks and organization shall be prepared for emergency contact upon mal-function.

④ Maintenance inside Pump House and Countermeasure for Deterioration

- As for the places inside pump house which triggered deterioration, periodical clean-up and check-up shall be recommended after the rehabilitation works. Especially, it shall be recognized that high humidity inside pump house due to leakage, submerge of wires /pipes by flooding on the floor is the cause of deterioration of mechanical and electrical facilities.
- Siltation of suction sump Periodical flash by using intake gate and sand pump
- Leakage Determination of leaking portion such as concrete wall, pipes and valves, and early treatment
- Lighting facilities, crane Check lighting facilities and operation of crane before check-up and maintenance of equipment.
- Measures for damages by birdsCheck-up and repair of all opening in pump house and electric distribution panel.

(2) Operation and Maintenance of Irrigation Facilities (intake, canal, turn-out, maintenance road and drainage canal)

① Check-up, clean-up and repair in accordance with Operation and Maintenance Manual

- Check-up shall be conducted in accordance with facilities operation and maintenance manual for the OM of irrigation facilities, and necessary repair work shall be done based on the result of check-up.
- Check-up shall be conducted during non-irrigation period for each subject facilities.

② Contents of Operation and Maintenance Works

- Desiltation of intake by using amphibious excavator
- Removal of garbage, tree and leafs as well as clean-up of canal
- Removal of siltation in canal by using excavator
- Removal of glass by using glasscutter
- Repair of leakage portion at toe of embankment
- Repair of damaged portion, painting and oiling of gates
- Repair of wash-out portion of facilities in down stream
- Monitoring on illegal destruction of irrigation canal
- Rehabilitation of on-farm drainage canals and its maintenance
- Leveling, supply of gravel and compaction of the surface of maintenance road by using operation and management expert.
- Excavation of drainage canal by using excavator.

(3) Recommendation on the Strengthening of Irrigators Association

Present Irrigators Association is facing various problems such as difficulty in secure agricultural land, insufficient drainage, shortage of fund, lack of agricultural technology and organization strength, insufficient on-farm drainage facilities and maintenance roads as well as shortage of micro-credit. Especially, improvement of on-farm drainage facilities and maintenance roads are recognized by the farmers as quite necessary for the effective irrigation, however difficult to be implemented due to the difficulty in the consensus among beneficiaries.

To improve such circumstance, it is considered that IA, with technical assistance by NIA, is recommended to perform important role in securing consensus among beneficiaries as well as compensate on the land for on-farm facilities. To materialize re-organization of on-farm facilities improvement plan, IA shall select target area by turn-out level and facilitate development plan with NIA's technical assistance, and secure consensus among beneficiaries through the conduction of workshops. Construction work shall be made by the heavy-equipment rented from NIA, as well as the labor and cost contributed from IAs. Such development plan shall be monitored and evaluated both by IA and NIA.

### 2-4-4 Operation and Maintenance Plan of Terminal Irrigation Facilities

(1) Organization of O/M for Terminal Irrigation Facilities

IA are organized 3 IAs in IAAPIS and 13 IAs in MPIS. Average number of IA members is 724 in IAs in IAAPIS and 461 in MPIS.

As shown in Figure 2-4-3 (1), each IA sets an IA Office under the Board of Directors (BOD) that is selected from the Turn-Out Presidents. IA Office is composed of five officers, namely President, Vice President, Secretary, Treasure and Auditor. They are selected among BOD. IA Office organizes four committees, namely Membership & Education, Service, Finance and Audit Committees. Those committees carry out services and trainings to the members and coordination to NIA and related agencies. This

organization is transferred just like that when IMT, and O/M Staff Office is newly organized. O/M staffs are newly employed or transferred from NIA staffs. They work under IA Office to operate and maintain lateral canals and turnouts as well as to monitor and instruct operation and maintenance of farm ditches controlled by TSA IAs. Thus, function of IA is strengthened in case of IMT.

**Figure 2-4-4 (1) Present IA Organization**

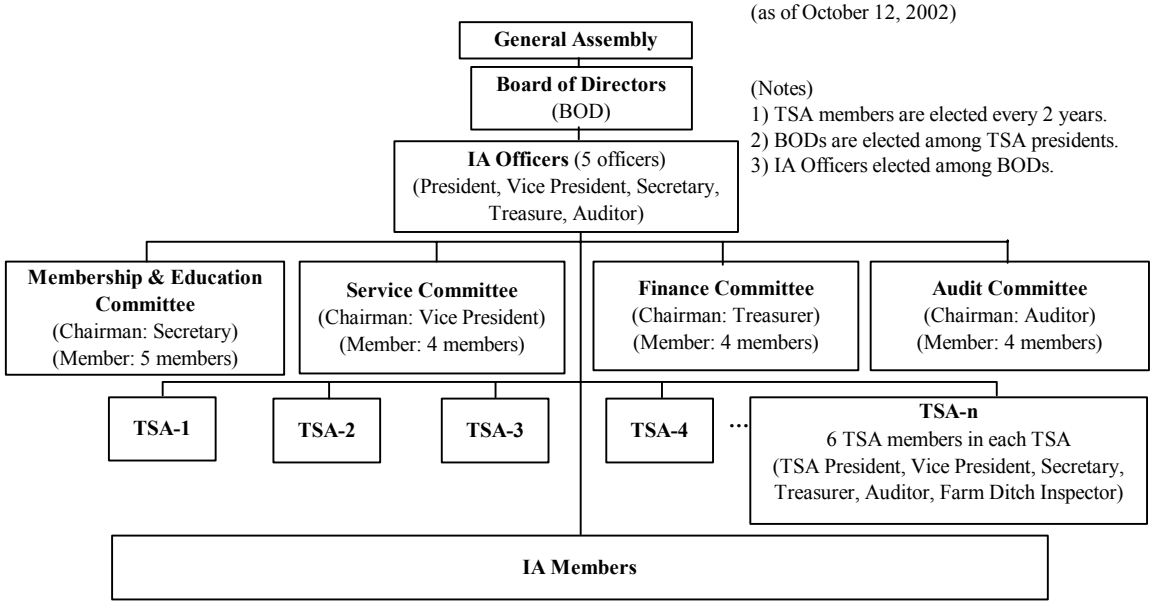
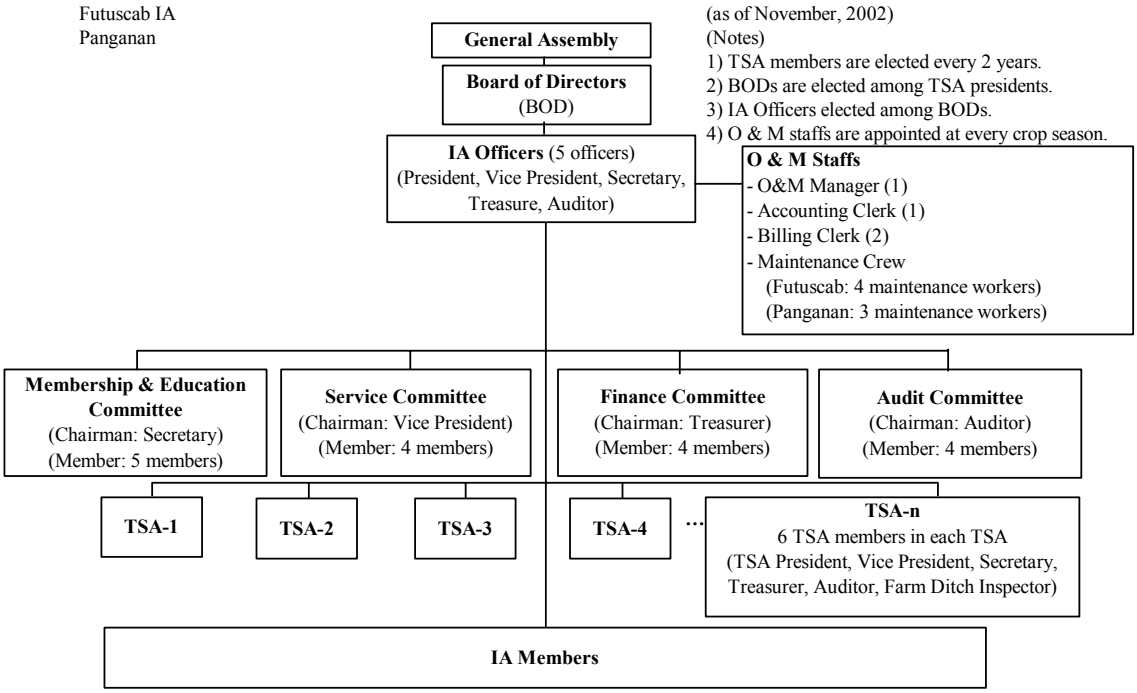



**Figure 2-4-4 (2) IA Organization after IMT**



## 2-4-5 Expenditures for Operation and Maintenance of Irrigation Facilities

Expenditures for O/M of the facilities is on of very important factor for operation and maintenance of irrigation facilities. The expenditures for O/M after procured equipments is estimated based on the present expenditures, and minimum ISF collection efficiency is calculated.

(1) Current Situation of O&M Cost

i) IAAPIS Office

Over the last three years, average O&M cost of IAAPIS Office was 1,801 thousand Pesos. Planned irrigated area is 2,945ha. Annual averaged O&M Cost per ha is estimated as 1.3 Cabang/ha/year. This means 0.67Cabang/ha in one irrigation cropping season. This annual basis O&M cost estimation is equal to one third of original estimation in F/S report. However recently, unexpected additional excavation cost has been raised affected by sedimentation in front of intake facility. This increase of excavation volume will affect to the fluctuation of O&M cost.

ii) MPIS Office

It has not appropriated enough O&M funds from the start of MPIS. In the past three years, however, WRDP funds were allocated for rehabilitation and restoration of damaged irrigation and drainage facilities. Consequently this WRDP funds for MPIS were included in O&M cost allocation in the past three years.

Average O&M cost of MPIS over the last three years was estimated 39,060 thousand Pesos. Planned irrigated area is 11,455 ha. Annual averaged O&M Cost per ha is estimated as 7.2 Cabang/ha. This means 3.6 Cabang/ha in one irrigation cropping season. This amount is roughly equal to the original estimated amount in F/S report.

(2) Required O&M Cost after the Project Completion

Estimation of expenditures for Operation and Maintenance will be carried out based on the past expenditures and expenditures necessary for operation and maintenance after newly procurement of equipments as shown below tables:

Required expenditures for O&M of the facilities to sustain the irrigation system after the completion of the Project will be estimated 2,371 thousand Pesos in IAAPIS Office and 11,923 thousand Pesos in MPIS Office respectively. This O&M Cost will be covered by increased irrigation area by the Project and expected increase of ISF collection ratio in the amount of 60% in IAAPIS Office and 80% in MPIS Office respectively, as shown in Table 2-4-4(1) “Targeted ISF Collection Efficiency after Rehabilitation”.

**Table 2-4-5 (1) Necessary Expenditures for IAAPIS & MPIS**

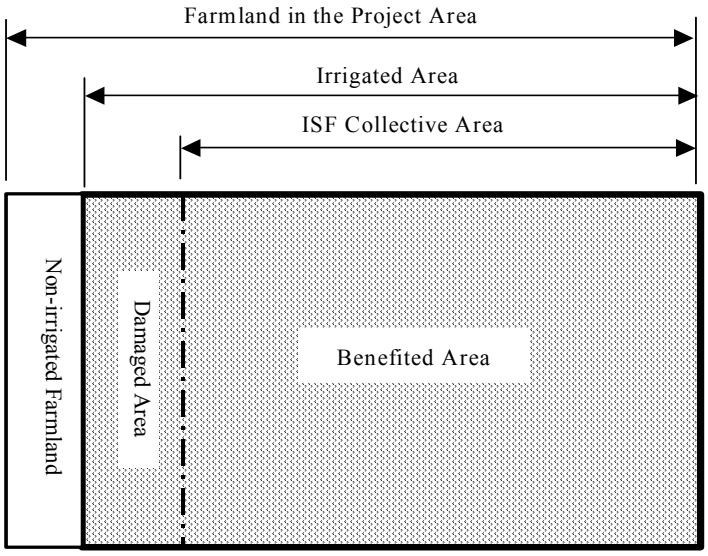
| | IAAPIS | MPIS |
|---|---|---|
| Irrigation Area (Dray and Wet) | 2,947 ha / 2,593 ha | 9,784 ha / 6,963 ha |
| Irrigation Area (Total) | 5,540 ha | 16,747 ha |
| Fixed Expenditures | | |
| Personnel Expenditures | 3,434,000 | 10,674,000 |
| Office Expenditures | 117,000 | 1,455,000 |
| Incentive for ISF | 130,000 | 0 |
| Operation Cost for Pumps | 3,895,000 | 12,896,000 |
| Sub-Total | 7,576,000 | 25,025,000 |
| O/M Cost | | |
| Pomp Repair | 200,000 | 500,000 |
| Sedimentation Excavation | 137,000 | ― |
| Irrigation Canal | 857,000 | 3,725,000 |
| Drainage Canal | 792,000 | 6,177,000 |
| O/M Road | 385,000 | 1,531,000 |
| Sub- Total | 2,371,000 | 11,933,000 |
| Total | 9,947,000 | 36,958,000 |

## 2-4-6 Irrigation Service Fee Collection Plan

Irrigation system has to be maintained and operated by irrigation service fee (ISF). In this section, targeted ISF collection efficiency, which is able to sustain the irrigation system, has been analyzed. Analysis is based on the following conditions.

- Irrigated area is the area that will be irrigated after rehabilitation.
- ISF collective area is the benefited area that is the area subtracting the damaged area from the irrigated area.
- Damaged area is estimated at a damaged ratio of 15 % to the irrigated area, that ratio is assumed taking past ratio and effect on damage reduction by rehabilitation into consideration.
- ISF is 8 cavan/ha = 400 kg/ha in IAAPIS and 7.5 cavan/ha = 375kg/ha in MPIS in paddy rice.
- Price of paddy rice is P9.5/kg that is an average of government supporting prices for wet and dry season rice in 2002.

**Figure 2-4-6 (1) Imagery of ISF Collective Area**




In order to obtain sufficient O/M cost for the irrigation system after rehabilitation, it is necessary to realize the ISF collection efficiency more than 55 % in IAAPIS and 73 % in MPIS as shown in Table 2-4-6 (1).

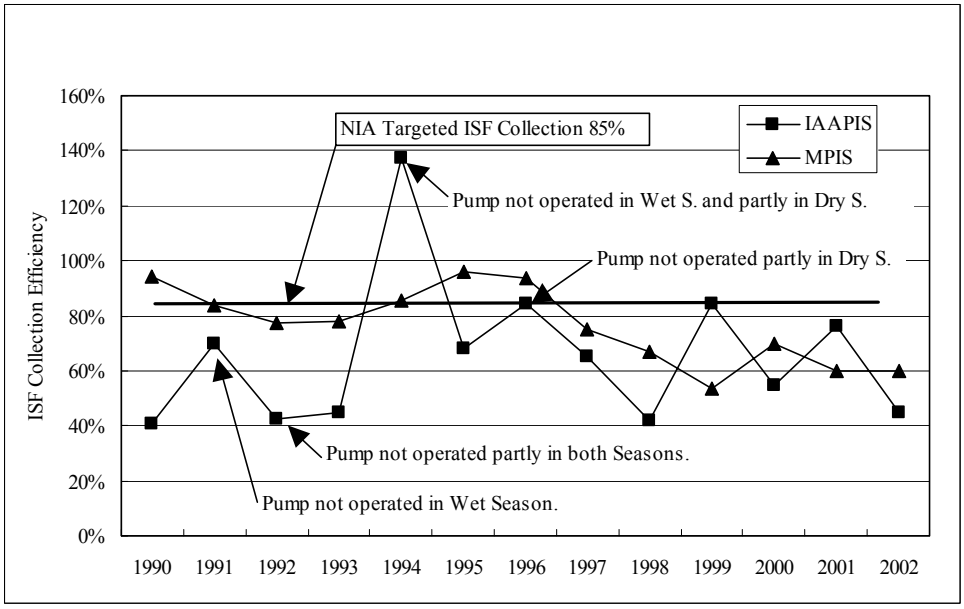
**Table 2-4-6 (1) Targeted ISF Collection Efficiency after Rehabilitation**

| Items | Unit | Estimation Equation | IAAPIS | MPIS |
|---|---|---|---|---|
| Fixed Fee | P | | 7,576,000 | 25,025,000 |
| Project Fee (O/M Fee) | P | | 2,371,000 | 11,933,000 |
| Total | P | ① | 9,947,000 | 36,958,000 |
| Irrigated Area (Wet & Dry Season) | Ha | | 2,947 ha / 2,593 ha | 9,784 ha / 6,963 ha |
| Total Irrigated Area | Ha | ② | 5,186 ha | 16,747 ha |
| Damaged Ratio | | ③ | 15% | 15% |
| Collective Ratio | | ④＝１－③ | 85% | 85% |
| ISF Collective Area | Ha | ⑤＝②×④ | 4,408 | 14,110 |
| ISF per Hector | /ha | ⑥ | 8cavan (400kg) | 7.5cavan (375kg) |
| Government Supporting Price | P/kg | ⑦ | P 9.5/kg | P 9.5/kg |
| Collective ISF | P | ⑧＝⑤×⑥×⑦ | 16,750,400 | 50,266,875 |
| Minimum ISF Collection Efficiency | | ⑨＝①／⑧ | 59% | 73% |

For achievement of appropriate O/M, it is necessary to realize above mentioned minimum ISF collection efficiency from the ISF collective area.

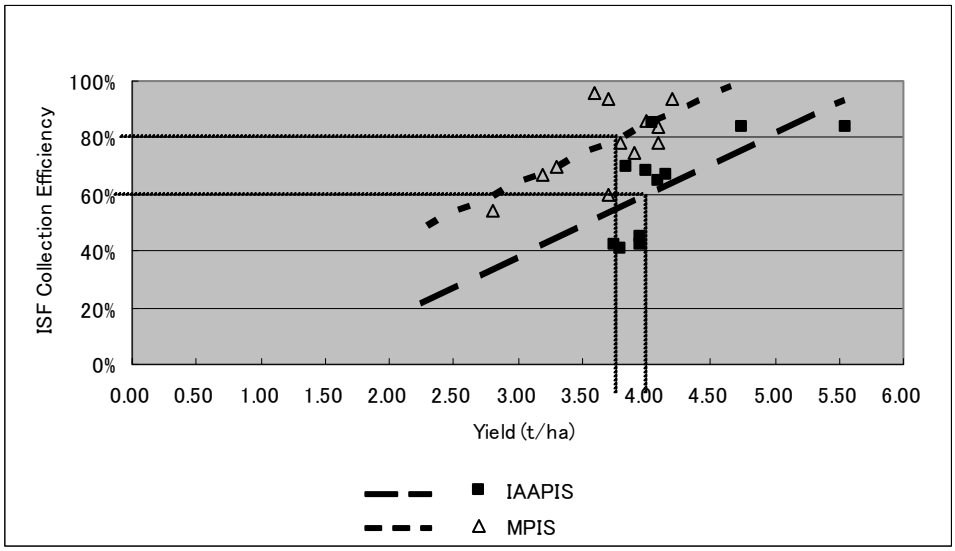
Past ISF collection efficiencies experienced in IAAPIS and MPIS are as shown in Figure 2-4-6 (2).

**Figure 2-4-6 (2) ISF Collection Efficiency experienced in IAAPIS and MPIS**




On the other hand, relation between ISF collection efficiency and yield of dry season rice has been as shown in Figure 2-4-6 (3).

**Figure 2-4-6 (3) Relation between ISF Collection Efficiency and Dry Season Rice**




ISF Collection efficiency is estimated as below in case of realization of the proposed yield after rehabilitation.

| Pump Irrigation System | Proposed Yield | ISF Collection Efficiency |
|---|---|---|
| IAAPIS | 4.0 t/ha | 60 % |
| MPIS | 3.75 t/ha | 80 % |

ISF collection efficiency of IAAPIS was 66 % in average and 77 % in year 2001, and MPIS was 78 % and 60 %, respectively. At IAAPIS, in case of low ISF collection efficiency, pump operation was started after ISF collection. This is one way to maintain high ISF collection, however, it has high risk to damage the paddy because of paddy growing period will be extended to the typhoon reason. Accordingly, low ISF collection and farmer's insincerity will be happened. For improving these conditions, NIA is advised to operate the pump according to irrigation schedule and to produce the high yield of paddy.

## 2-4-7 Farm Management and ISF Payment Capability

In order to examine ISF payment capability of farmers for both cases "Present and after Rehabilitation", farm economy has been analyzed based on landholdings, yield, cropping and irrigation conditions and family expenditure. The results are as follows;

**Table 2-4-7 (1) Agricultural Income and Family Expenditure at Present and after Rehabilitation**

| Irrigation System | IAAPIS | | | | MPIS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Present/After Rehabilitation | Present | | A/Rehabilitation | | Present (1) | | Present(2) | | A/Rehabilitation (1) | | A/Rehabilitation (2) | |
| Cropping Season | Dry S. | Wet S. | Dry S. | Wet S. | Dry S. | Wet S. (Rainfed) | Dry S. | Wet S. | Dry S. | Wet S. (Rainfed) | Dry S. | Wet S. |
| ISF | 8 cavan/ha (400 kg/ha) | | | | 7.5 cavan/ha (375kg/ha) | | | | | | | |
| Price of Paddy Rice | | | | | | | | | | | | |
| Government Price (P/kg) | 10.0 | 9.0 | 10.0 | 9.0 | 10.0 | 9.0 | 10.0 | 9.0 | 10.0 | 9.0 | 10.0 | 9.0 |
| Market Price (P/kg) | 9.4 | 9.0 | 9.4 | 9.0 | 9.4 | 9.0 | 9.4 | 9.0 | 9.4 | 9.0 | 9.4 | 9.0 |
| Yield (t/ha) | 4.0 | 4.0 | 4.0 | 4.0 | 3.4 | 1.6 | 3.4 | 2.4 | 4.0 | 1.6 | 4.0 | 3.5 |
| Production Cost (P/ha) | | | | | | | | | | | | |
| Labor Cost | 11,573 | 11,360 | 11,573 | 11,360 | 10,737 | 8,144 | 10,737 | 9,216 | 11,573 | 8,144 | 11,573 | 10,690 |
| Input Materials | 6,442 | 6,442 | 6,442 | 6,442 | 5,573 | 2,967 | 5,573 | 4,125 | 6,442 | 2,967 | 6,442 | 5,718 |
| ISF | 4,000 | 3,600 | 4,000 | 3,600 | 3,750 | 0 | 3,750 | 3,375 | 3,750 | 0 | 3,750 | 3,375 |
| Total | 22,015 | 21,402 | 22,015 | 21,402 | 20,060 | 11,111 | 20,060 | 16,716 | 21,765 | 11,111 | 21,765 | 19,783 |
| Gross Income (P/ha) | 37,600 | 36,000 | 37,600 | 36,000 | 31,960 | 14,400 | 31,960 | 21,600 | 37,600 | 14,400 | 37,600 | 31,500 |
| Net Farm Income (P/ha) | 15,585 | 14,598 | 15,585 | 14,598 | 11,900 | 3,289 | 11,900 | 4,884 | 15,835 | 3,289 | 15,835 | 11,717 |
| Cropped Area (ha) | 2.0 | 1.9 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Gross Income (P) | 75,200 | 68,400 | 75,200 | 72,000 | 63,900 | 28,800 | 63,900 | 43,200 | 75,200 | 28,800 | 75,200 | 63,000 |
| Production Cost (P) | 44,000 | 40,700 | 44,000 | 42,800 | 40,100 | 22,200 | 40,100 | 33,400 | 43,500 | 22,200 | 43,500 | 39,600 |
| Net Farm Income (P) | 31,200 | 27,700 | 31,200 | 29,200 | 23,800 | 6,600 | 23,800 | 9,800 | 31,700 | 6,600 | 31,700 | 23,400 |
| Family Income (P) | | | | | | | | | | | | |
| Farm Income | 58,900 | | 60,400 | | 30,400 | | 33,600 | | 38,300 | | 55,100 | |
| Non-agricultural Income | 25,500 | | 25,500 | | 25,500 | | 25,500 | | 25,500 | | 25,500 | |
| Total | 84,400 | | 85,900 | | 55,900 | | 59,100 | | 63,800 | | 80,600 | |
| Family Expenditure (P) | | | | | | | | | | | | |
| Fuels | 6,000 | | 6,000 | | 6,000 | | 6,000 | | 6,000 | | 6,000 | |
| Foods | 31,000 | | 31,000 | | 31,000 | | 31,000 | | 31,000 | | 31,000 | |
| Education Fee | 16,000 | | 16,000 | | 16,000 | | 16,000 | | 16,000 | | 16,000 | |
| Total | 53,000 | | 53,000 | | 53,000 | | 53,000 | | 53,000 | | 53,000 | |
| Balance (P) | 31,400 | | 32,900 | | 2,900 | | 6,100 | | 10,800 | | 27,600 | |
| Production Cost (P) | 84,700 | | 86,800 | | 62,300 | | 73,500 | | 65,700 | | 83,100 | |
| ISF (P) | 14,840 | | 15,200 | | 7,500 | | 14,250 | | 7,500 | | 14,250 | |
| Ratio to Production Cost | 18% | | 18% | | 12% | | 19% | | 11% | | 17% | |
| Ratio to Farm Income | 25% | | 25% | | 25% | | 42% | | 20% | | 26% | |

(Notes)
1) assuming family size at 5 persons, and 1.7 children in school age.
2) Cost for input materials is proportioned to that for 5 t/ha yield.
3) Cost for harvesting and threshing is 1/7.5 of product so that labor cost becomes different in dry and wet seasons due to differences of paddy price.
4) Average landholdings of farmers in IAAPIS is 2 ha, but 1 ha of which is held in the surrounding upland. However there are many cases having 2 ha within the project area. Analysis, therefore, has been carried out in the later case.
5) Almost farmers have side business such as pig raising, public service, driver, carpenter so that family economy is analyzed including those incomes.
6) Gross income=Yield (kg/ha) x Market Price of Paddy Rice (P/kg) x Cropped Area (ha), Net Income=Gross Income-Production cost

As shown in above Table, farmers holding irrigated 2 ha land in IAAPIS have enough payment capability of ISF due to high level of yield. Such farmers will be born in whole project area of IAAPIS after rehabilitation.

On the other hand, it is difficult for farmers of cases of Present (1) and Present (2) to sustain their economy without side business and is forced into low quality of life. Therefore, their ISF payment capability is low.

However, ISF payment capability will be considerably improved due to increase of irrigated land and yield after rehabilitation. In case of After Rehabilitation (2), farmers will be able to realize the proposed yield targeted by Loan Project and will have high income and high ISF payment capability. Such farmers will become 61% of whole farmers and 83% in collective area ratio.

# Chapter 3. Project Evaluation and Recommendations

# Chapter 3 Project Evaluation and Recommendations

## 3-1 Project Effect

The beneficial area of the project is as same as the one where Cagayan Integrated Agricultural Development Project, funded from Japanese Loan scheme, had implemented. Direct beneficiaries are estimated as approximately 43,000 farmers or 8,000 households, who cultivate farmlands with irrigation in the beneficial area of five (5) districts such as Iguigu, Amulung, Alcala, Camalaniugan, and Aparri located in northwestern area of Cagayan province.

Expected effects of the project are as follows:

(1) Direct Effects

(a) Rehabilitation of four (4) pump stations, a unit of main canals and maintenance roads would secure stable irrigation water.

(2) Indirect Effects

(a) Agricultural productivities would be improved by stable irrigation water.

Design irrigation water with 1.427m3/s in Iguigu pumping irrigation system, 3.997m3/s in Amulung pumping irrigation system, and 21.081m3/s in Magapit pumping irrigation system are available in the Project area. In the case of Iguigu and Amulung pumping systems, it is expected that annual irrigated land area would be increased from 3,685 ha in 2002 to 5,186 ha in the future, while annual products of rice would be increased from 16,575t to 21,310t in total. In the case of Magapit pumping irrigation system, on the other hand, it is estimated that annual irrigated land area would be increased from 13,234 ha in 2002 to 16,747 ha while annual products of rice would be increased from 56,040t to 70,698t in total. Following tables show the details;

Iguigu and Amulung Pumping Irrigation System

Table 3-1 (1) Planned Irrigated Land Area in Iguigu, Amulung Pumping Irrigation System

| | Present | | Plan | |
|---|---|---|---|---|
| | Irrigated Area | Non-irrigated Area | Irrigated Area | Non-irrigated Area |
| Irrigation in dry season | 1,885 | | 1,885 | |
| Irrigation in wet season | 1,800 | | 1,800 | |
| No-irrigation in dry season | | 1,062 | 708 | 354 |
| No-irrigation in dry season | | 1,147 | 793 | 354 |
| total | 3,685 | 2,209 | 5,186 | 708 |

Table 3-1 (2) Planned Annual Product of Rice in Iguigu, Amulung Pumping Irrigation System

| | Present | | | | Plan | | | | Increased Product |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Yield(t/ha) | | Product | Area | Yield(t/ha) | | Product | |
| | (ha) | Dry Season | Wet Season | (t) | (ha) | Dry Season | Wet Season | (t) | (t) |
| Irrigation in dry season | 1,885 | 4.0 | | 7,540 | 2,593 | 4.0 | | 10,372 | |
| Irrigation in wet season | 1,800 | | 4.0 | 7,200 | 2,593 | | 4.0 | 10,372 | |
| No irrigation in dry season | 1,062 | 0.0 | | 0 | 354 | 0.0 | | 0 | |
| No irrigation in wet season | 1,147 | | 1.6 | 1,835 | 354 | | 1.6 | 566 | |
| Total | | | | 16,575 | | | | 21,310 | 4,735 |

Magapit Pumping Irrigation System

Table 3-1 (3) Planned Irrigated Land Area in Magapit Pumping Irrigation System

| | Present | | Plan | |
|---|---|---|---|---|
| | Irrigated Area | Non Irrigated Area | Irrigaed Area | Non Irrigated Area |
| Irrigation in every season (dry season) | 4,501 | | 6,963 | |
| Irrigation in every season (wet season) | 4,501 | | 6,963 | |
| Irrigation in wet season (Dry season) | 4,232 | | 2,821 | |
| Irrigation in wet season (Wet season) | | 4,232 | | 2,821 |
| Collaborative irrigation in dry season | | 1,051 | | 0 |
| Collaborative irrigation in wet season | | 1,051 | | 0 |
| No irrigation in dry season | | 1,673 | | 1,673 |
| No irrigation in wet season | | 1,673 | | 1,673 |
| Total | 13,234 | 9,680 | 16,747 | 6,167 |

Table 3-1 (4) Planned Annual Product of Rice in Magapit Pumping Irrigation System

| | Present | | | | Plan | | | | Increased Product |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Yeild(t/ha) | | Product | Area | Yield(t/ha) | | Product | |
| | (ha) | Dry season | Wet season | (t) | (ha) | Dry season | Wet season | (t) | (t) |
| Irrigation in every season (dry season) | 4,501 | 3.4 | | 15,304 | 6,963 | 4.0 | | 27,852 | |
| Irrigation in every season (wet season) | 4,501 | | 2.4 | 10,802 | 6,963 | | 3.5 | 24,371 | |
| Irrigation in wet season (Dry season) | 4,232 | 3.4 | | 14,389 | 2,821 | 4.0 | | 11,284 | |
| Irrigation in wet season (Wet season) | 4,232 | | 1.6 | 6,771 | 2,821 | | 1.6 | 4,514 | |
| Collaborative irrigation in dry season | 1,051 | 3.4 | | 3,574 | 0 | | | 0 | |
| Collaborative irrigation in wet season | 1,051 | | 2.4 | 2,523 | 0 | | | 0 | |
| No irrigation in dry season | 1,673 | 0.0 | | 0 | 1,673 | 0.0 | | 0 | |
| No irrigation in wet season | 1,673 | | 1.6 | 2,677 | 1,673 | | 1.6 | 2,677 | |
| Total | 22,914 | | | 56,040 | 22,914 | | | 70,698 | 14,658 |

(b) Farmers' income would be improved by recovering agricultural productivity unless rice price declines.

(c) Quality of agricultural products would be stabilized by stable irrigation

## 3-2 Recommendations

Followings show the items, which should be improved in order to implement the project smoothly and effectively.

(a) Operation and maintenance (O&M) of irrigation facilities and machineries are absolutely important after completion of the project.

NIA takes a great role of O&M at the existing system with the cooperation with Irrigator's Associations. Basically, NIA is supposed to cover the cost of O&M by the water fee from the farmers, however, in the past, NIA was not in such a situation as to be able to collect competent amount of water fee. After the completion of the rehabilitation of irrigation facilities, stable irrigation would enable to increase the irrigated land area as well as the productivity. Such effects would stimulate the farmers' economy, which in turn enable concrete collection of water fee. Therefore, NIA is highly expected to make a great effort to collect water fee and secures a proper amount of budget for O&M.

(b) Although NIA takes a great role of existing O&M, NIA also has a plan to shift its role on O&M to Irrigator's Associations (IA). To this end, the following is now under going to be improved.

- Maintenance and repairing of tertiary canals:
  According to the contract with NIA on maintenance and repairing of tertiary canals, IAs are conducting small-scale rehabilitation, repairs and lubrication of the gates by man power. Through the practices with the direction from NIA, IAs are improving their own capability on O&M.
- On the job training for staff of IAs and farmers:
  NIA had prepared 191 times of on the job trainings and meetings by the year of 2002. Due to the trainings, participants are cultivating their understanding on the system, structure, and duties of the Irrigation Management Transfer.
- Supports on agricultural such as credit, extension services and agricultural cooperatives:
  NIA prepares credit for the farmers in the area where O&M had been transferred to IA so that farmer could launch the farming. And this encourages smooth transfer of the IMT.
- Maintenance of the law on IA:
  It is expected to enact and enforce such a law that empowers the IAs as like the Agriculture and Fisheries Modernization Act (AFMA) of 1997.

(c) NIA is highly expected to distribute the irrigation water properly on the plan to keep a good relationship with the farmers that in turn is believed to contribute smooth collection of the water fee.

(d) The government of Philippines shall pay its allocation on implementation of the grant fund program such as financial surcharges, VAT, and refund of importing taxes.