CHAPTER 5 BASIC DESIGN

5.1 Design Policy and Criteria

Taking account of the following principles, design policies and criteria of the required facilities on the Project are formulated.

- Target of the Project is to recover until the same intake capacity as that of before the earthquake.
- Design intake capacity is adjusted to the maximum water requirement in the dry season.
- Easy and economical operation and maintenance shall be considered on the design of the facilities.
- Intake facilities shall be designed to get surface water to secure stable irrigation in the wet season.
- Considering that the Project shall be taken as a pilot project, construction materials shall be locally procured as much as possible.
- Design should be based upon the design standard of the Philippines in principle.
- Structures should be simple, for minimizing the troubles on operation and maintenance.

5.2 Basic Design

(1) Water Requirement

The irrigation water requirement is calculated on the basis of the proposed cropping pattern mentioned in Chapter 4. The effective rainfall is calculated using the precipitation record (1957-1978) at San Roque station which locates about 10 km north of the Project area. As the excess rainfall is no use for crop growing, the monthly maximum effective rainfall is set at 80 mm. The evaporation is also estimated based on the observation record (1957-1971) at San Roque station. Overall irrigation efficiency is established at 50 % in the wet season and 43 % in the dry season, taking account of the seepage loss in the canals. Under the above conditions, 10 day's water requirement on the irrigation area is calculated as shown in Figure 5.3.1.

The peak water requirement for the first cropping occurs in the end of August, at 1.47 m^3/s on the Dipalo RIS and 0.73 m^3/s on the Principal CIS. It for the second cropping occurs in the middle of January, 0.80 m^3/s on the Dipalo RIS, 1.21 m^3/s on the Principal CIS.

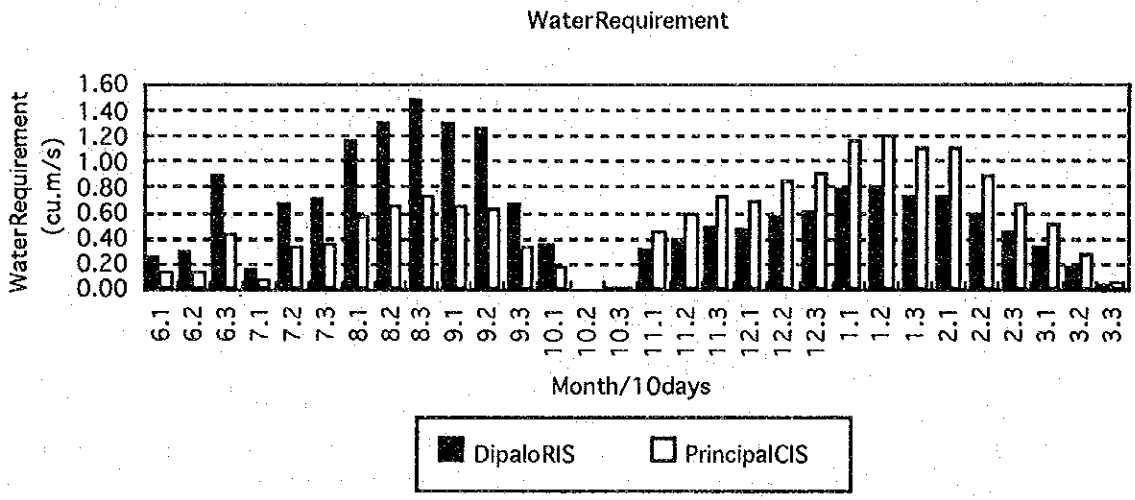


Figure 5.3.1 Water Requirement by Every 10 Days

(2) Water Resources

The purpose of the facilities is to collect water from the subsurface flow for irrigation requirement due to unavailability of the river surface flow. Water resources are the Dipalo river and the Viray river as same as before the earthquake.

1) Catchment Area

Although the proposed intake sites shall be shifted from the original sites to 100 m or 300 m upstream site, the catchment area can be estimated almost the same as the original.

Dipalo RIS: $A = 35\ km^2$
Principal CIS: $A = 55\ km^2$

2) Condition of Catchment Area

According to the site survey, vegitation on the eroded surface by the earthquake has been revived year by year, and this effects to prevent additional debris produced by erosion. Therefore, increase of debris in the river seems to be very limited in the future. This is supported by the evidence that the supply of debris was not observed at the strong typhoon (probability once in 100 - 150 years) in October, 1993.

3) Design Intake Discharge

Taking account of water requirement and actual intake record of the Principal CIS (Table 5.3.1), the design intake discharge is decided as follows.

Table 5.3.1 Monthly Intake Discharge Record in Principal CIS (before earthquake)

Month	1	2	3	4	5	6	7	8	9	10	11	12
Intake Discharge (m^3/s)	0.95	0.83	0.75	0.62	0.78	1.23	1.88	2.48	2.30	2.05	1.91	1.50

Principal CIS:

Design discharge is estimated as thirty (30) % increase of maximum required discharge occurring in January or about double amount of the minimum discharge in April.
Therefore, design discharge (Q) is,

$$Q = 0.95 * 1.3 \text{ or } 0.62 * 2 = 1.2 \text{ m}^3/\text{s}$$

Dipalo RIS:

Design discharge is estimated from the obtained discharge for Principal CIS with the use of the ratio of area between them.
Therefore,

$$Q = 1.2 * (35 / 55) = 0.8 \text{ m}^3/\text{s}$$

The above design intake discharge is reasonable corresponding to the water requirement as shown in 5.2 (1).

(3) Intake System

As the project aims at collecting adequate subsurface water in the dry season when the surface water is unavailable, a collecting conduit system is adopted. Generally, the collecting conduit system is a proper system in view of low maintenance costs in case of a river having a stable river bed and large discharge of the river flow. On the other hand, in case of the Project area, as the river bed is not stable and the discharge is comparatively small, the general collecting conduit system seems not to suitable to be introduced in the Project. Therefore, combination of impervious wall with collecting conduit system is proposed in the Project to solve the above shortcomings. Reserved subsurface water by the impervious wall can promise a stable water supply and the strong impervious wall made of reinforced concrete (RC) will show a great functions as a protection against moving of debris. River bed protection by gabion on the surface of debris will be performed at 2 or 3 sites of the upstream and the downstream of the impervious walls. Figure 5.3.2 shows its basic structure of the intake system.

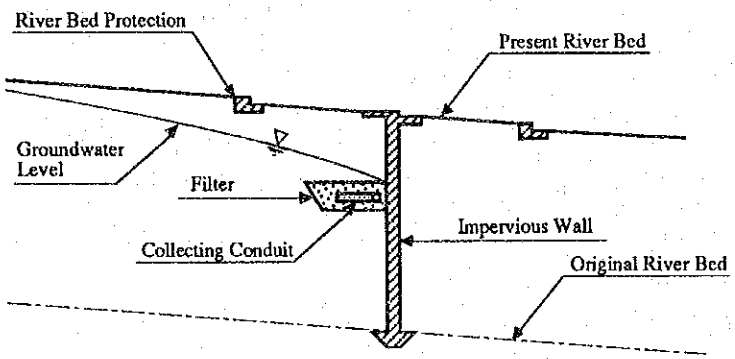


Figure 5.3.2 Basic Structure of Intake Facilities

(4) Location of Intake System

The location of intake site should be:

- at a upstream of the original intake site,
- at a suitable place for laying the collecting conduits,
- at a narrow river bed place in order to save the construction costs of the impervious wall, and
- at a place where a stable river course is expected.

Under the debris deposit, a large amount of big boulders are remained at the original intake weir, and they will be an obstacle to the impervious wall construction. Therefore, the location of intake site will be selected at an upstream at least more than 100 m from the original intake weir. Taking account of the above matters, the location of the intake system is decided as follows.

Dipalo RIS:	250 m upstream from the original intake weir
Principal CIS:	150 m upstream from the original intake weir

(5) Design of Collecting Conduit

The important factors in designing the collecting conduit are:

- the location of the collecting conduit,
- the proper filter size composition,
- to establish a optimum inflow velocity into the hole of conduit pipe,
- good conditions for the filter construction, and so on.

Followings are general features of the proposed collecting conduit.

Table 5.3.3 General Features of Collecting Conduit

Items	Dipalo RIS	Principal CIS
Collecting Conduit		
Material	F.R.P pipe with hole	F.R.P pipe with hole
Diameter	600 mm	800 mm
Total length	700 m (20 m * 35 lines)	840 m (24 m * 35 lines)
Connecting Pipe		
Material	F.R.P pipe without hole	F.R.P pipe without hole
Diameter	800 mm	1,000 mm
Total length	150 m	150 m
Appurtenant Facility	Filter: 3 layers	Filter: 3 layers
	Pressure control box: 1 unit	Pressure control box: 1 unit

1) Arrangement of collecting conduits

There are three (3) alternatives in the selection of arrangement of collecting conduits as follows,

- one (1) to three (3) long lines arrangement,
- many short lines arrangement like a comb, and
- in-between arrangement of above two (2) types.

As the impervious wall in the plan surely maintains the designated subsurface water level, the comb arrangement type is adopted because of less excavation work volume and economical and easy construction. Taking account of the width of river beds, the shape of cross section of river beds and the connection method with the facilities, the pipe setting arrangement is decided as 35 lines with 4 m intervals, and total installation width of 136 m in both sites.

2) Filter Composition

Water velocity in the filters gradually increases as reaching toward the collecting conduits. Therefore, it is a proper method to arrange coarse filters near the collecting conduits and finer filter to outer side gradually. However, such gradual arrangement of filters is actually impracticable. Therefore, three (3) kinds of filter size are fixed for this purpose shown as below. The coarse filters are arranged nearby the collecting conduits, and the middle size filters are placed next to them and the fine filters are placed at the outer side. The filters will be sorted out from the excavated materials obtained from the temporary drainage canal work in the initial stage of the construction.

- Coarse filters: 40 - 60 mm
- Middle size filters: 15 - 40 mm
- Fine filters: 2 - 15 mm

The collecting conduits are placed in the middle of deep sand-gravel layers and filters are placed like wrapping the collecting conduits so that the water can be collect from any faces of the conduits.

3) Collecting Conduit Material

The collecting conduits for the Project are required to have allowable pressure resistance and durability as they are buried in the several maters depth. As suitable materials, Hume Pipe, Prestress Concrete Pipe (P.C. Pipe) or Fiberglass Reinforced Plastic Pipe (F.R.P Pipe) come into consideration. In Philippine, only Reinforced Concrete Pipe is available and its pressure resistance is not allowable. Therefore, collecting conduits shall be imported from Japan. In view of freight charges from Japan, F.R.P Pipe is more economical than concrete pipe. Further, F.R.P has various advantages such as less roughness, less head loss and anti-abrasion. Therefore, F.R.P collecting conduits (L = 4.0 m/piece) are adopted in the Project. The hole diameter and hole arrangement are as follows.

Table 5.3.3 Holes of Collecting Conduit

Diameter (mm)	number of holes along circumference	number of holes along line	total holes	area per hole (cm^2)	hole area per meter (m^2)
600	12	32	384	3.14	0.030
800	16	32	572	3.14	0.040

4) Length of Collecting Conduits

Regarding the inflow velocity, mostly 3 to 10 cm/s was adopted in the past constructions in Japan. And function of conduit pipes having the velocity of 2 - 4 cm/s seems to be promising more long life according to the actual operations of existing conduit pipes. Therefore, 4 cm/s of the velocity shall be adopted for the calculation of design length of conduit pipe.

Each calculation is as follows.

Dipalo RIS:

Diameter of conduit (D)	:	600 mm
Area of hole per meter (a)	:	0.03 m^2
Velocity (V)	:	0.04 m/sec
Discharge (Q)	:	0.8 m^3/sec

Therefore, required total length (L) is

$$L = Q / a * V = 0.8 / (0.030 * 0.04) = 667 \text{ m}$$

There, 35 lines layer is planned, so required length of one line (l) is

$$l = L / 35 = 667 / 35 = 19 \text{ m} \approx 20 \text{ m}$$

Therefore, five (5) pieces of 4 m conduit pipe are to be laid in one line.

Principal CIS:

Diameter of conduit (D)	:	800 mm
Area of hole per meter (a)	:	0.04 m^2
Velocity (V)	:	0.04 m/sec
Discharge (Q)	:	1.2 m^3/sec

Therefore,

$$L = Q / a * V = 1.2 / (0.040 * 0.04) = 750 \text{ m}$$

$$l = L / 35 = 750 / 35 = 22 \text{ m} \approx 24 \text{ m}$$

Therefore, six (6) pieces of 4 m conduit pipe are to be laid in one line.

5) Inflow Velocity through Filters

The inflow velocity passing through the filters should be less than the coefficient of permeability of the existing debris deposit to avoid no-functioning of the filters.

According to a pumping test and grain size analysis, the coefficient of permeability (K) of the debris deposit at the Dipalo and Principal is estimated as follows.

Dipalo RIS: $K = 2.7 * 10^{-1}$ cm/s
Principal CIS: $K = 1.4 * 10^{0}$ cm/s

On the other hand, the inflow velocity (V), is calculated as follows:

Dipalo RIS: $V = 0.8 / (140 * 20 * 2) = 0.00014$ m/s $= 0.014$ cm/s $= 1.4 * 10^{-2}$ cm/s
Principal CIS: $V = 1.2 / (140 * 24 * 2) = 0.00018$ m/s $= 0.018$ cm/s $= 1.8 * 10^{-2}$ cm/s

The inflow velocity through the filter is sufficiently lower than the coefficient of permeability, and therefore, the designated filters are adequately suitable for the Project.

6) Water Collection Capacity

The water collection capacity of conduits is verified by the following formula.

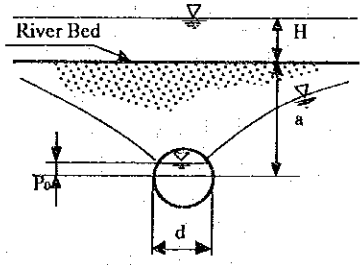


Figure 5.3.3 Collecting Conduit (1)

$$q = \frac{2\pi k(H + a - P_0)}{2.3\log_{10}(\frac{2a}{d})}$$

Where:

- q: amount of water collection per unit length ($m^3/s/m$)
- k: coefficient of permeability (m/s)
- H: depth of river (m)
- a: depth of conduit pipe (m)
- p: head loss for pressure in the pipe (m)
- d: diameter (m)

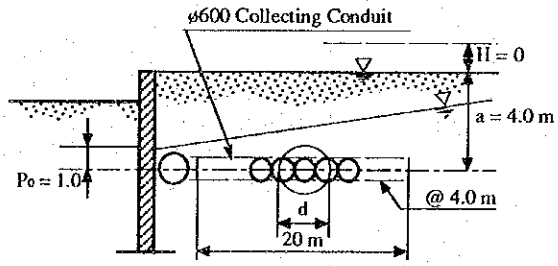


Figure 5.3.4 Collecting Conduit (2)

Dipalo RIS:

The length of the collecting conduit is 20 m and the interval of the lines is 4.0 m, and if 5 pieces of 600 mm conduit are laid per 1 m unit of the river width, the required diameter of conduit that covers the same surface area as the sum of surface area of 5 pieces of 600 mm conduit is determined as follows.

$$A = \pi * 0.30^2 * 5 = 1.41 m^2$$
$$\therefore d = \sqrt{1.41 * \frac{4}{\pi}} = 1.34 m$$

To limit the in-flow velocity into a conduit, P_0 = 1.0 m head is planned, and the coefficient of permeability at the area is K = 2.7 * 10^{-1} = 2.7 * 10^{-3} cm/s. Therefore, the capable amount of collecting water per unit is:

$$q = \frac{1}{2} * \frac{2\pi * 2.7 * 10^{-3} * (4.0 - 1.0)}{2.3 * \log_{10}(2 * \frac{4.0}{1.34})} = 0.014 m^3/s/m$$

As the total width of conduit installation is 136 m, the total amount of collecting water is:

Q = 136 * 0.014 = 1.9 m^3/s > 0.80 m^3/s O.K.

Principal CIS:

The procedure is the same with the Dipalo RIS. The length of the collecting conduit is 24 m and the interval of the lines is 4.0 m, and if six (6) pieces of 800 mm conduit are laid per 1 m unit of the river width, the required diameter of a conduit that covers the same surface area as the sum of surface area of six (6) pieces of 800 mm conduit are determined as follows.

$$A = \pi * 0.40^2 * 6 = 3.02 m^2$$
$$\therefore d = \sqrt{3.02 * \frac{4}{\pi}} = 1.96 m$$

The coefficient of permeability at the area is K = 140 * 10^0 cm/s = 140 * 10^{-2} m/s. Therefore,

$$\therefore q = \frac{1}{2} * \frac{2\pi * 1.4 * 10^{-2} * (4.0 - 1.0)}{2.3 * \log_{10}(2 * \frac{4.0}{1.96})} = 0.094 m^3/s/m$$

As the total width of conduit installation is 136 m, the amount of water collected is;

Q = 136 * 0.094 = 12.8 m^3/s > 1.2 m^3/s O.K.

7) Connecting Pipe

The length of the connecting pipe is about 150 m, and the diameter of the connecting pipe should be designed so that the head loss in the pipe remains less than 30 cm. If the diameter is designed smaller, the head loss will increase and unbalancing of water collection capacity from each conduit will occur.

Dipalo RIS:

The total head loss shall be estimated as double of net head loss taking account of safety factor.

diameter of conduit pipe	$D = 800$ mm
cross-sectional area of stream:	$A = \pi * 0.40^2 = 0.503$ m^2
section velocity:	$V_1 = 0.8 * (1 / 5) / 0.503 = 0.32$ m/s
	$V_2 = 0.8 * (2 / 5) / 0.503 = 0.64$ m/s
	$V_3 = 0.8 * (3 / 5) / 0.503 = 0.85$ m/s
	$V_4 = 0.8 * (4 / 5) / 0.503 = 1.27$ m/s
	$V_5 = 0.8 * (5 / 5) / 0.503 = 1.59$ m/s

The coefficient of friction loss (n) is obtained from coefficient of face roughness of F.R.P. and n = 0.010.

$f = 124.5 * 0.010^2 / 0.80^{4/3} = 0.0168$

The head loss for friction is obtained:

$H = f * L * V^2 / 2g = 0.0168 * (150 / 5) * (0.32^2 + 0.64^2 + 0.85^2 + 1.27^2 + 1.59^2) / 19.6 = 0.14$ m

Therefore, total head loss is,

$\Sigma H = 2.0 * H = 2.0 * 0.14 = 0.28$ m < 0.30 m O.K.

Principal CIS:

The procedure is the same as the Dipalo RIS, assuming D = 1,000 mm.

diameter of conduit pipe	$D = 1{,}000$ mm
cross-sectional area of stream:	$A = \pi * 0.50^2 = 0.785$ m^2
section velocity:	$V_1 = 1.2 * (1 / 5) / 0.785 = 0.31$ m/s

$V_2 = 1.2 * (2 / 5) / 0.785 = 0.61$ m/s
$V_3 = 1.2 * (3 / 5) / 0.785 = 0.92$ m/s
$V_4 = 1.2 * (4 / 5) / 0.785 = 1.22$ m/s
$V_5 = 1.2 * (5 / 5) / 0.785 = 1.53$ m/s

The coefficient of friction loss (n) is obtained from coefficient of face roughness of F.R.P. and n = 0.010.

$f = 124.5 * 0.010^2 / 1.00^{4/3} = 0.0125$

The head loss for friction is obtained:

$H = f * L * V^2 / 2g = 0.0125 * (150 / 5) * (0.31^2 + 0.61^2 + 0.92^2 + 1.22^2 + 1.53^2) / 19.6 = 0.10$ m

Therefore, total head loss is,

$\Sigma H = 2.0 * H = 2.0 * 0.10 = 0.20$ m < 0.30 m O.K.

8) Pressure Control Box

As the river slopes are very steep in the area, following problems will be occurred.

- the pipe line (collecting conduit-connecting pipe-transmission pipe) produced a bigger head difference that required,
- subsurface water is pulled toward collecting conduits, and
- a inflow velocity in filters increases abnormally, which will cause a hole filling.

In order to avoid this problems, a control box making free water pressure surface shall be installed at the terminal of transmission pipeline to shut out the water pressure between the upstream and downstream. In addition, a flush gate is partition at the insulated wall to discharge sedimentation in the collecting conduits and the connecting pipe. At the starting point of the transmission pipeline, a gate is also installed for easy maintenance.

(6) Design of Transmission Conduit

As the maximum internal water pressure in the transmission conduit is as low as about 3 m, local made R.C. pipes can be used with additional reinforcement by concrete.

Table 5.3.4 Features of Transmission Conduit

Items	Dipalo RIS	Principal CIS
Material	R.C. pipe covered by reinforced concrete	R.C. pipe covered by reinforced concrete
Diameter	700 mm	900 mm
Total length	950 m	950 m
Appurtenant Facility	Maintenance box: 2 units Outlet box: 1 unit	Maintenance box: 2 units Outlet box: 1 unit

1) Design of Transmission Conduit

The diameter of the transmission pipe is obtained as follows.

Dipalo RIS:

Assuming that water level of the control box is WL 176.00 m, and water level of the outlet box at the existing main canal is WL 160.00 m, the margine of the levels is H = 176.00 - 160.00 = 16.0 m. The diameter of the transmission pipe should be decided not to exceed such head loss of 16 m. The length of transmission line (l) is 950 m and the coefficient of roughness (n) is 0.018. Diameter of pipe (D) is 700 mm, therefore,

Coefficient of friction loss: $f = 124.5 * 0.018^2 / 0.70^{4/3} = 0.0649$

Velocity: $V = 0.80 / (\pi * 0.35^2) = 2.08$ m/s

Total head loss (h) is calculated on the following conditions:

coefficient of head loss due to inflow (f_1) : 0.5
coefficient of head loss due to outflow (f_0) : 1.0
coefficient of head loss due to friction (f) : 10 %

Therefore,

$$h = (3f_i + 1.1f * l + 3f_0) * V^2 / 2g$$
$$= (3 * 0.5 + 1.1 * 0.0649 * 950 + 3 * 1.0) * 2.08^2 / 19.6$$
$$= 16.0 \text{ m} \leq H = 16.0 \text{ m} \quad \text{O.K.}$$

Principal CIS:

The procedure is the same as the Dipalo RIS. Assuming that water level of the control box is WL 113.0 m and water level of the outlet box is WL 97.5 m, the difference of the levels is H = 113.00 - 97.50 = 15.50 m. The length of the transmission line (l) is 950 m and the coefficient of roughness (n) is 0.018. Diameter of pipe (D) is 900 mm, therefore,

coefficient of friction loss $f = 124.5 * 0.018^2 / 0.90^{4/3} = 0.0464$

Velocity $V = 1.20 / (\pi * 0.45^2) = 1.89$ m/s

As in the case of the Dipalo RIS,

$h = (3 * 0.5 + 1.1 * 0.0464 * 950 + 3 * 1.0) * 1.89^2 / 19.6$

$= 9.7$ m $< H = 15.5$ m O.K.

2) Outlet Box

The outlet box shall be designed to be able to overflow to the main canal about 1 m higher than ground elevation so as to get for domestic use.

(7) Design of Impervious Wall

The impervious wall will effectively reserve a subsurface water. As the wall is made of concrete contacted with foundation rock, moving of debris to downstream can be stopped by this. Protection from surface erosion of debris around the top of the wall shall be constructed by gabions. The overflow section is placed on the top of the wall. The inlet is also designed at the wall to divert surface water to open channel for irrigation during the wet season.

Table 5.3.5 General Features of Impervious Wall

Items	Dipalo RIS	Principal CIS
Impervious Wall		
Type	Reinforced concrete	Reinforced concrete
Location	250 m upstream from original site	150 m upstream from original site
Length	188 m	207 m
Depth	18 m	12 m
Thickness	800 mm	800 mm
Appurtenant Facility	Waterway: 80 m width	Waterway: 120 m width
	Inlet: 1 unit	Inlet: 1 unit
	River bed protection: 3 sites	River bed protection: 2 sites

1) Structures of Impervious Wall

The impervious wall shall be also designed for functioning as a river bed protection with 1 m drop between the upstream and the downstream. However, enough thickness of the impervious wall should be designed to prevent destruction in case of scouring from 3 m height. A 0.80 m of thickness is required for this wall as following calculation.

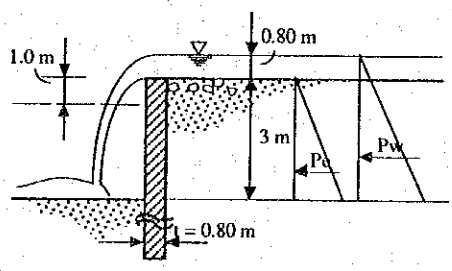


Figure 5.3.5 Impervious Wall

Soil pressure: $Pe = (1 / 2) * k * r_s * h^2 = (1 / 2) * (1 / 3) * 0.8 * 3.0^2 = 1.2$

Water pressure: $Pw = (1 / 2) * h^2 = (1 / 2) * 3.80^2 = 7.22$ t

Moment: $M = 1.20 * (1 / 3) * 3.0 + 7.22 * (1 / 3) * 3.80 = 10.3$ t-m

Shear strength: $S = 1.20 + 7.22 = 8.42$ t

Assuming width of the impervious wall as t = 0.80 m, shear strength is:

$\tau = S / b * j * d = 8.420 / 100 * (7 / 8) * 70 = 1.4$ kg/cm^2 < 3.0 kg/cm^2 O.K.

Assuming the reinforcing bar of D 16 @ 150 (As = 13.2 cm^2), flexural stress is:

$\sigma s = M / As * j * d = 1{,}030{,}000 / 13.2 * (7 / 8) * 70$

$= 1{,}270\ kg/cm^2 < 1{,}400\ kg/cm^2$ O.K.

2) Design of Waterway

The capacity of waterway is decided by a discharge which is calculated from a unit discharge. The unit discharge (q) of 5 $m^3/s/km^2$ which will occur once in several years, is adopted in the calculation. Therefore, design capacity (Q) depend on catchment area (A) is as follows.

Dipalo RIS: $Q = q * A = 5 * 35 = 175\ m^3/s$

Principal CIS: $Q = q * A = 5 * 55 = 275\ m^3/s$

With the use of the above results, the width of the water way (B) under the condition of water depth (dc) of 0.8 m is resulted as follows,

Dipalo RIS: $B = Q / (dc / 0.467)^{3/2} = 175 / (0.8 / 0.467)^{3/2} = 78\ m \approx 80\ m$

Principal CIS: $B = 275 / (0.8 / 0.467)^{3/2} = 122\ m \approx 120\ m$

3) Inlet

The facilities of surface water collection shall be simple in structures for easy maintenance. The river beds comprised of debris are unstable and movements of beds might be occurred in several years or in several decades. They will be easily suffered from floods and debris flows. Therefore, simple facilities are much better for easy maintenance in case of flood and debris flows. Therefore, a simple openings for a inlet at impervious walls are planned in this design. Removal of sedimentation around the inlet will be required after flooding.

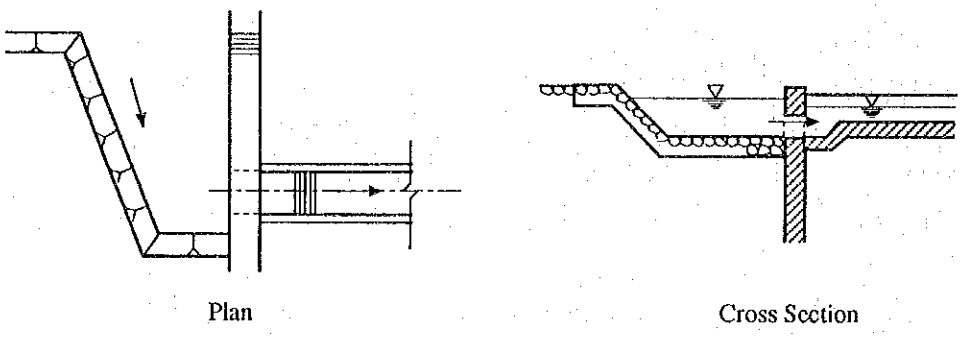


Figure 5.3.6 Inlet on Impervious Wall

The inlet structure shown in Figure 5.3.6 will prevents much of sedimentation from flowing into main canals, as the sedimentation at the initial stage of a flood will plug at the inlet.

(8) Design of Main Canal

The starting portions of both main canals of the Dipalo RIS and Principal CIS have been buried by debris deposit. The main canals shall be reconstructed at the parts from the impervious wall to the outlet box so that surface water can be taken for irrigation during the wet season.

For the Dipalo RIS, concrete lining is required on upper 3 km of the main canal to diminish seepage loss of water. Reconstruction is also required on 400 m out of the part, because that portion has been lost by floods. Further, dredging of debris is necessary on a part of the canal.

Table 5.3.6 General Features of Main Canal Rehabilitation

Items	Dipalo RIS	Principal CIS
Rehabilitation of Upper Portion of Main Canal	Length: 950 m Reinforced concrete flume type	Length: 950 m Reinforced concrete flume type
Concrete Lining of Main Canal	Total length: 3.0 km Reconstruction: 400 m of the 3 km	None
Dredging	Length: 400 m	None

1) Rehabilitation of Main Canal

The main canal has steep slopes, and in view of direct damages at the time of big floods, it should be a strong reinforced concrete flume structure. A high water velocity because of steep canal shall be slow downed by a simple dissipater system inlaid with proper size of stones.

Design discharge of the main canal (Q) is adopted a margin between maximum intake discharge and intake discharge from collecting conduits. With the use of the design discharge, following dimensions are calculated.

Dipalo RIS:

Q = 3.75 - 0.80 = 2.95 m^3/s

There, coefficient of roughness n = 0.30, slope of canal I = 1/70, width of canal B = 0.3 m, water depth h = 0.50 m, then,

cross-sectional area of flow: $A = 3.0 * 0.5 = 1.50\ m^2$

wetted perimeter: $P = 3.0 + 0.50 * 2 = 4.00$ m

hydraulic mean depth: $R = A / P = 1.50 / 4.00 = 0.375$ m

velocity: $V = \frac{1}{n} R^{\frac{2}{3}} * I^{\frac{1}{2}} = \frac{1}{0.030} * 0.375^{\frac{2}{3}} * (\frac{1}{70})^{\frac{1}{2}} = 2.07 m/s$

discharge: $Q = A * V = 1.5 * 2.07 = 3.11\ m^3/s > 2.95\ m^3/s$ O.K.

A height of side wall is designed at H = 1.00 m, considering freeboard as a water depth.

Principal CIS:

Q = 3.234 - 1.20 = 2.034 m^3/s = 2.04 m^3/s

Assuming the same conditions as the Dipalo RIS except water depth h = 0.40 m,

cross-sectional area of flow: $A = 3.0 * 0.4 = 1.20\ m^2$

wetted perimeter: $P = 3.0 + 0.40 * 2 = 3.80$ m

hydraulic mean depth: $R = 1.20 / 3.80 = 0.316$ m

velocity: $V = \frac{1}{0.030} * 0.316^{\frac{2}{3}} * (\frac{1}{70})^{\frac{1}{2}} = 1.85 m/s$

discharge: $Q = 1.2 * 1.85 = 2.22\ m^3/s > 2.04\ m^3/s$ O.K.

A height of side wall is designed at H = 0.80 m, considering freeboard as a water depth.

2) Lining of Main Canal at Dipalo RIS

In the section of about 3 km between the starting point of the main canal and the provincial road, the soil is composed of gravel-debris layers of high permeability and main canal route is aligned on this section. Therefore, water losses of leakage from the main canal will be rather big especially in dry season. So, the section should be lined by concrete. It is also necessary of reconstruction about 400 m of the canal that has been completely washed away by a flood.

Further, in about 400 m of the downstream canal from the provincial road, 20 - 50 cm sedimentation caused by flood shall be removed.

(9) Design of Protection Dike at Dipalo RIS

The Dipalo river turns sharply to the right at the 1.5 km downstream from the location of intake site. About 1 km of the bank around there was washed out by flood, and about 400 mm of the main canal was also washed out and huge amount of sand-gravel was scattered into the main canal and farm land.

Even at the normal water level in the river, the river water has been flowing into the damaged area.

Under the circumstances, protection dike is strictly to be constructed to keep a normal function of the main canal. One (1) km of a protection dike is planned, and a spur dike that smoothly guides the direction of water flow and stabilizes the water course is also planned.

Table 5.3.7 General Features of Protection Dike

Items	Dipalo RIS	Principal CIS
Type	Gabion	None
Length	1 km	
Height	3.25 m	

5.3 Construction Plan

(1) General

1) Implementing Agency

Implementing Agency of the Project is National Irrigation Administration (NIA). The NIA conducts all works regarding the Project implementation and promotion such as preparation works of contracts with consultant and contractor, procedure of banking arrangement, verification of contract documents and issuance of certifications on the progress of the construction necessary for authorization of payment and so on.

The NIA has various experiences on plan and operation of dam and irrigation projects. Therefore, the NIA is the most suitable implementing agency for the Project and the NIA personnel conduct a supervising of the construction of the Project.

The organization for the Project implementation is as shown in Figure 5.4.1.

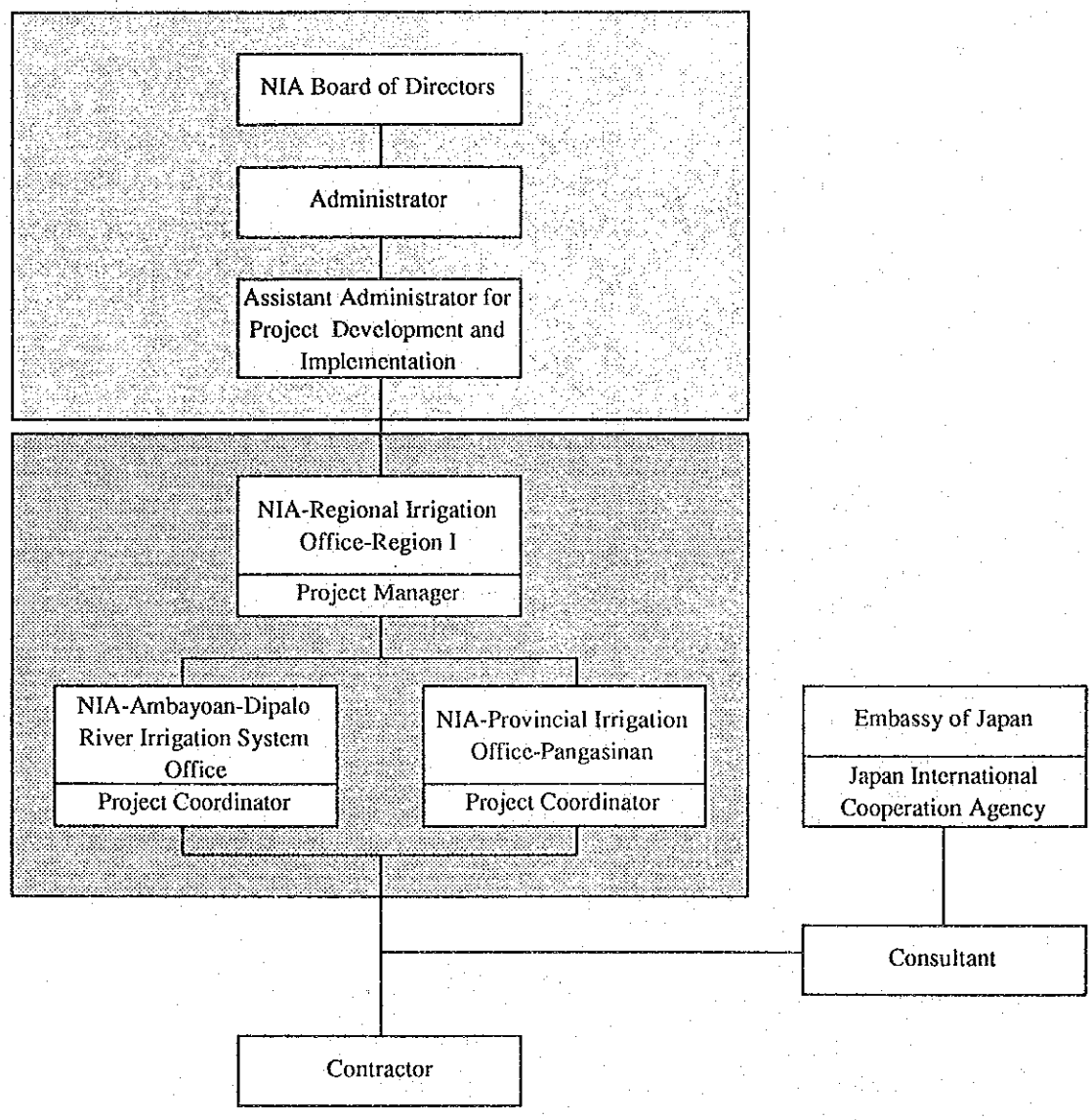


Figure 5.4.1 Implementating Organization

2) Components of the Construction Works

The construction works of the Project consist of following components.

- Impervious wall construction works: Dipalo RIS, Principal CIS
- Collecting conduit installation works: Dipalo RIS, Principal CIS
- Transmission conduit installation works: Dipalo RIS, Principal CIS
- Main canal rehabilitation works: Dipalo RIS, Principal CIS
- Protection dike rehabilitation works: Dipalo RIS

(2) Construction Method

1) Key Points on the Construction Works

Due consideration must be paid following matters on establishing the construction plan.

- As main works must be done in the water, workable day is strictly limited in dry season (November to May)

- The Project site is locating at eastern part of Pangasinan province and the distance from Manila is rather far which takes 5 to 6 hours drive. Therefore, procurement schedule of materials or equipment for the construction must be carefully considered on the economical point of view.

- Net workable day shall be estimated as 25 days per month taking account of suspended days by holiday and rain day.

2) Construction of Impervious wall, Collecting Conduit and Transmission Conduit

Excavation for impervious wall is considerable deep, and dewatering during the excavation shall be most important as temporary works. As the necessary volume of dewatering is rather big, it shall be drained basically by gravity. The pit for drain shall be excavated at upstream side of impervious wall and open channel connecting with the pit shall also be excavated. The channel is estimated as 500 m length reaching the lower existing river bed at downstream side. Excavated materials shall be used for filters, therefore, required volume for filters shall be piled at site. Excavation shall be done mainly by heavy equipment such as Bulldozer and Back hoe shovel.

After completion of the excavation, setting up forms and placing concrete shall be executed. About 50 to 100 m^3/day is required placing volume of concrete, therefore, concrete batching plant shall be installed at site for producing the required amount. During the concrete placing, dewatering from the bottom of excavated foundation shall be required by drainage pumps. After completion of the concrete works, back filling shall be executed at the height for conduit pipe setting.

At the same time, excavation required for widening for conduit pipe setting shall be done. After well face compaction for filters, lying of filter and setting of conduit and connecting pipe shall be carefully executed. Upper filter of conduit and connecting pipe shall be placed with most careful method such as man power. Back filling above filter shall be also done carefully not to affect the filter and conduit pipes.

After completion of the impervious wall, conduit pipe and connecting pipe, open channel for dewatering shall be back filled by Bulldozer.

3) Main Canal

Excavation of main canals shall be done mainly by Back hoe shovel. Concrete supplied from batching plant shall be placed by man power. Backfilling shall be done by Bulldozer and man power and compacted by man power.

4) Protection Dike

Earth works shall be done by Bulldozer and Back hoe shovel. Gabion works shall be done by man power.

(3) Supervisory Plan

Detailed design and construction supervision shall be rendered by a Japanese consultant firm under the agreement between the NIA and the said consultant firm in conformity with the Japan's grant system. Contents of the supervision are for the purpose of assisting the NIA to conclude a justifiable construction contract with a Japanese contractor, to realize the intention of the detailed design and to give the contractor technical guidance from a fair standpoint so that the construction may agree with the contract. The consultant services include the following:

a) Assistance in the conclusion of construction contract:
Preparation of detailed design and tender document, qualification of the contractor for the tender, witnessing to tendering, awarding the contract, etc.

b) Approval of construction drawings:
Inspection of construction materials and its specifications, approval of construction drawings proposed by the contractor, etc.

c) Supervision of construction:
Examination of the construction schedule, advice for technical aspects to the contractor, reporting construction progress to the client, etc.

d) Assistance for arrangement of approval to pay:
Examination of request for payment by the contractor during and after the construction, assistance for arrangement of the payment, etc.

e) Witnessing in the inspection:
Examination of specifications of the construction facilities during and after the construction, advice to the contractor for technical matters, etc.

After confirming the complete execution of the construction, and witnessing the transfer of the implemented facilities, the consultant will make its services complete with the approval of the client with the receipt of the facilities. The consultant is responsible for informing the requirement regarding construction progress, payments and transfer of the completed facilities to the Japanese government concerned.

(4) Procurement Plan of Construction Materials and Equipment

Because general construction materials and common equipment are available in the Philippines, they are basically to be locally procured, considering their availability and economy. However, since F.R.P. pipes for the collecting conduit are not manufactured in the Philippines, they shall be procured from Japan, taking into consideration shipping costs and quality. Some construction machinery such as a concrete plant shall also be procured from Japan, because the production of the local machinery is insufficient for the proposed construction work volumes.

Procurement plan of construction materials and machinery is summarized in Table 5.4.1.

Table 5.4.1 Procurement Plan of Construction Material and Machinery

Material/machine	Philippines	Japan	Reasons Selected
Construction Materials			
Cement	*		The quality varies a little, but sufficient in compressive strength.
Sand, Gravel	*		Sand and gravel of the rivers are abundant and in good quality.
Reinforcing bar	*		The quality varies a little, but sufficient in strength.
Wooden frame	*		Locally available, with good quality.
Lumber	*		Plenty of good lumber is available. Woodcraft skills are high.
F.R.P pipe		*	Not produced in the Philippines.
R.C. pipe	*		The quality varies a little, but sufficient in strength.
Construction Machinery			
Bulldozer, Backhoe, Dump truck, Tamping roller, Vibrating roller, etc.	*		Locally available, with enough capacity.
Concrete plant, Truck mixer, Generator, Submergible pump		*	Locally not available, because large capacity of the machinery is required.

(5) Implementation Schedule

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

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

Prior to the Project implementation, a detailed design study and preparation of tender documents shall be conducted. This will require 2.5 months for the first phase and 2.0 months for the second phase. A pre-qualification and evaluation of tenderers, bidding, signing of the contract shall be required another 1.5 months for each phase. Construction will require 12 months for each phase.

The implementation and construction schedules are shown in Figure 5.4.2.

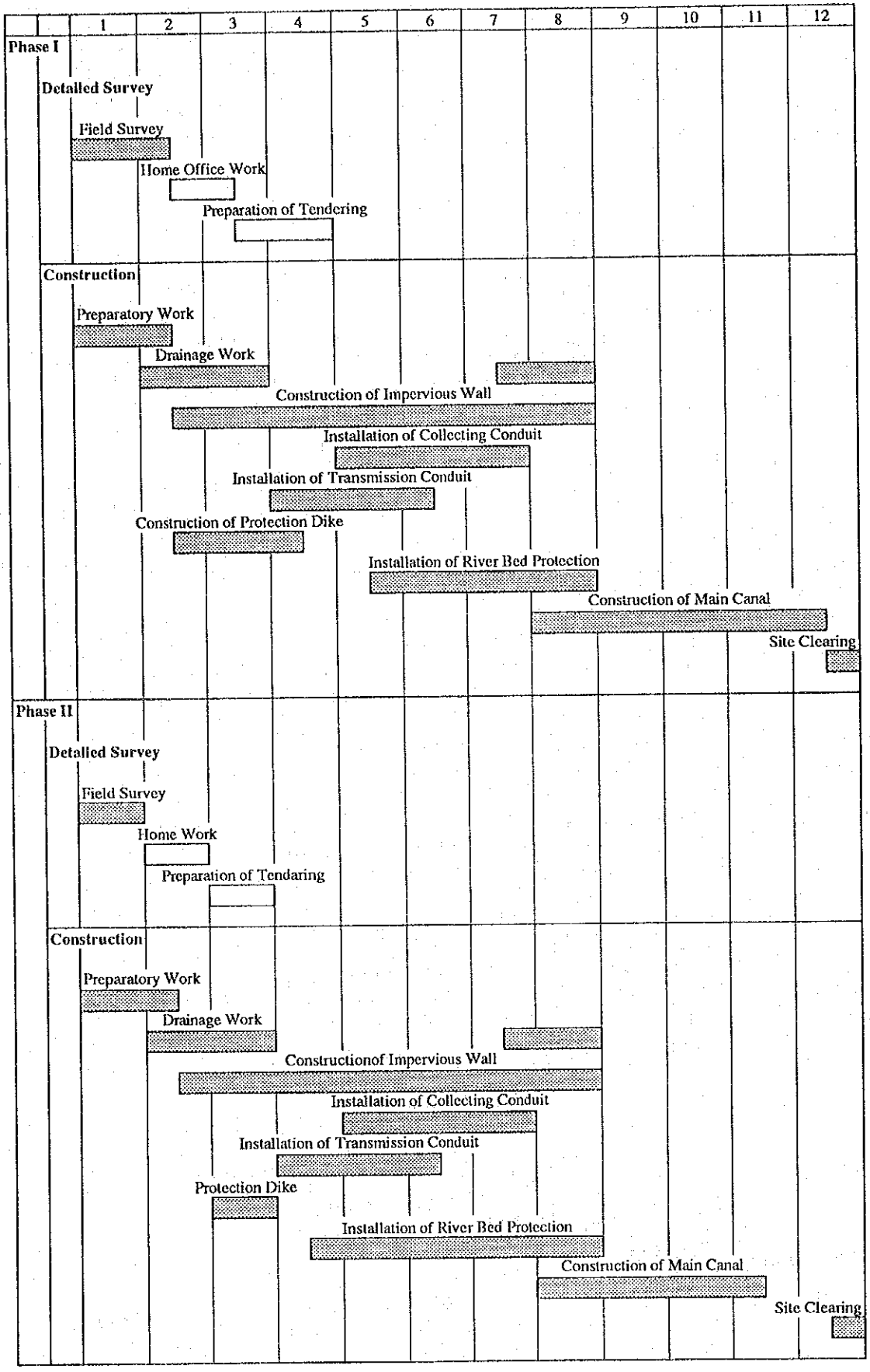


Figure 5.4.2 Implementation Schedule

CHAPTER 6 PROJECT BENEFITS AND CONCLUSION

6.1 Project Benefits

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

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

Table 6.1.1 Number of Direct Beneficial Household and Beneficiaries

Irrigation System	No. of Households	Number of Beneficiaries
Dipalo RIS	1,647	8,877
Principal CIS	685	3,624
Total	2,332	12,501

The Project will directly contribute to recovering the cropping area and cropping intensity to the pre-earthquake level. This Project will not extend the irrigation service area beyond the pre-earthquake area due to limitation of water resources.

Table 6.1.2 Cropping Area under With- and Without-Project Conditions

Irrigation System	Crop	Without-Project		With-Project	
		Wet Season	Dry Season	Wet Season	Dry Season
Dipalo RIS	Paddy	387 ha	5 ha	1,548 ha	237 ha
	Legume	- ha	2 ha	- ha	98 ha
	Onion	- ha	3 ha	- ha	112 ha
	Total Cropping Area	387 ha	10 ha	1,548 ha	447 ha
	(Cropping Intensity)	25 %	1 %	100 %	29 %
Principal CIS	Paddy	208 ha	5 ha	770 ha	370 ha
	Corn	- ha	2 ha	- ha	167 ha
	Onion	- ha	2 ha	- ha	139 ha
	Total Cropping Area	208 ha	9 ha	770 ha	676 ha
	(Cropping Intensity)	27 %	1 %	100 %	88 %

Because of the effective use of surface and subsurface water in the Project, unit crop yields in the area will increase and stabilize at a higher level. The yield rates of the crops under with- and without-project conditions are estimated on the basis of field survey and provincial statistics and plans, and shown in Table 6.1.3.

Table 6.1.3 Crop Yield Rate under With- and Without-Project Conditions

Crop	Without Project	With Project
Paddy (Wet and Dry Seasons)	3.20 ton/ha	4.15 ton/ha
Legume (Peanut)	0.85 ton/ha	1.40 ton/ha
Corn	2.85 ton/ha	3.20 ton/ha
Onion	2.50 ton/ha	3.00 ton/ha

The improvement of cropping areas and yield rates of the crops as mentioned above will cause great increment of the crop production. As shown in Table 6.1.4, annual production amount of paddy in the Project area is estimated at 12,204 ton under with-project condition, whereas 1,936 ton under without-project condition. Also production of the other crops is expected to increase considerably by the Project implementation.

Table 6.1.4 Crop Production under With- and Without-Project Conditions

Crop	Without-Project	With-Project	Increment
Paddy (Wet and Dry Seasons)	1,936 ton	12,140 ton	10,204 ton
Legume (Peanut)	2 ton	137 ton	135 ton
Corn	6 ton	534 ton	528 ton
Onion	13 ton	753 ton	740 ton

The net income of the farmers is calculated on the basis of production cost and unit price of products used in the Feasibility Study by NIA, as shown in Table 6.1.5. The total increase in net farm income in the area is estimated at 39.61 million Pesos per annum between with and without-project conditions. The annual net income of each farm household in the beneficial area is expected to increase of 17,000 Pesos.

Table 6.1.5

Irrigation System	Without-Project	With-Project	Increment	Per Household
Dipalo RIS	3.36 million P	25.56 million P	22.20 million P	13,476 P
Principal CIS	2.08 million P	19.50 million P	17.42 million P	25,426 P
Total	5.44 million P	45.05 million P	39.61 million P	16,986 P

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

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

The effects of the Project mentioned above are summarized in Table 6.1.6.

Table 6.1.6 Direct Effects of the Project

Current Problems	Measures in the Project	Effects of the Project
Decrease of Cropping Intensity After the intake facilities were buried by debris, shortage of irrigation water caused decrease of paddy cropping area in wet season, and few areas for second cropping in dry season.	Stable Water Supply in Wet Season Irrigation water from surface and subsurface water will be supplied stably even in wet season, because rainfall pattern fluctuates significantly.	Recover of Cropping Intensity All paddy field will be planted by paddy in wet season, and some area is planted by paddy and second crops in dry season. Annual cropping intensity is: Dipalo RIS 26% -> 129% Principal CIS 28% -> 188%
Decrease of Productivity Since irrigation water coming from temporary intake is not sufficient and stable, yield rate of the crops became lower than pre-earthquake level.	Irrigation in Dry Season In dry season, irrigation water will be supplied to farm land through subsurface water intake facilities.	Increase of Yield Rate Increase of average yield rate of crops will be: Paddy 3.20t/ha -> 4.15t/ha Legume 0.85t/ha -> 1.40t/ha Corn 2.85t/ha -> 3.20t/ha Onion 2.50t/ha -> 3.00t/ha
Decrease of Crop Production The crop production is considerably decreased due to decrease of cropping area and yield rate. As a result, farmers' income level falls considerably.	Stable Irrigation Farming Surface and subsurface water will be effectively used for irrigation by means of impervious wall and collecting conduit. Upper portion of the main canal will be also improved by concrete lining and so on to reduce water loss in the canal.	Increase of Crop Production Crop production in the area will be: Paddy 1,936ton -> 12,140ton Legume 2ton -> 137ton Corn 6ton -> 534ton Onion 13ton -> 753ton Total net farm income will be: W/O Project 5.44 million P W Project 45.05 million P
Flood Damage The farm land and main canal of Dipalo RIS are faced with a danger of flood damage because the existing dike was broken.	Rehabilitation of Protection Dike Protection dike and also spur dikes are installed to control flood water.	Prevention of Flood Damage The flood damage on the farm land and main canal will be prevented.
Construction Cost for Temporary Intake The construction cost for temporary intake is a serious burden on the farmers.	Installation of Permanent Intake The proposed intake is a structure that is permanent easy to maintain.	Cancellation of Construction Cost The permanent intake will cut the farmers' payments for the temporary works.

6.2 Conclusion

As described above, the Project is expected to create direct and indirect effects in recovering or upgrading the agricultural outputs and contribute in various ways to enhance the lives of inhabitants in the Project area. The Project is considered as a pilot project for groundwater intake method in rivers, and the NIA hopes to extend this type of irrigation to the many irrigation systems that suffer from siltation in the rivers.

The executing agency of the Project, NIA, is capable organizationally, technically and financially to execute the Project. Also, respective offices of the NIA and the Irrigators Associations in the Project Area which responsible for operating and maintaining the facilities have already been established.

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

6.3 Recommendation

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

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

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

- Regarding the Dipalo RIS, Ambayoan Dipalo RIS shall be responsible to the Operation and Maintenance of the main facilities of the RIS such as gate operation, intake facilities and main canals, and shall control the IAs, which shall conduct the Operation and Maintenance of the terminal facilities including secondary canals.

- Regarding the Principal CIS, Provincial Irrigation Office Pangasinan shall control the IAs, and the IAs shall be responsible to the entire system.

- The NIA shall work to strengthen relationships with IAs for successful operation and maintenance of this irrigation systems. For this purpose, NIA shall provide regulations regarding operation and maintenance of intake facilities and canals, collection of irrigation service fees, etc. and execute them with guiding IAs.

- The respective Irrigation Offices should properly manage the furnished O & M equipment, giving priority to O & M activities in the Project area, and also allowing the use in other daily concerned activities as well.

APPENDIX

APPENDIX

Appendix 1. Appendix on Basic Design Study

1-1 Member List of the Team

Name	Position
OSHIMA Katsuhiko	**Leader** Director Study Review and Coordination Division Grant Aid Study and Design Department Japan International Cooperation Agency
TAJIRI Teruhisa	**Water Use Facilities Planner** Senior Engineer Development Division Chugoku-Shikoku District Office Construction Department Ministry of Agriculture, Forestry and Fisheries
FUJIWARA Jyunko	**Project Coordinator** First Project Basic Design Study Division Grant Aid Study and Design Department Japan International Cooperation Agency
YUKAWA Yoshimitsu	**Chief Consultant** Senior Managing Director Overseas Project Department Nippon Giken Inc.
WADA Kiyoo	**Irrigation Facilities Engineer** Managing Director Engineering Department Nippon Giken Inc.
OMIYA Masahiro	**Facilities Designer** Engineer Engineering Division Engineering Department Nippon Giken Inc.

1-2 Survey Schedule

Day	Date	Week	Member	Itinerary	Activities
1	Nov. 1	Mon.	OS, F, T, Y, W, OM	Tokyo - Manila	Arrival at Manila (OS, F, T, Y, W, OM)
2	2	Tue.	OS, F, T, Y, W, OM	Manila	Courtesy call and general discussion with JICA Philippine Office
3	3	Wed.	OS, F, T, Y, W, OM	Manila - Pangasinan	Courtesy call and Discussion meeting with NIA Central Office Move to the site Courtesy call and Discussion meeting with NIA RIO & PIO
4	4	Thu.	OS, F, T, Y, W, OM	Pangasinan	Field reconnaissance and survey Courtesy call with Mayor of San Quintin Courtesy call with Governor of Pangasinan
5	5	Fri.	OS, F, T, Y, W, OM	Pangasinan Pangasinan - Manila	General and technical discussion with NIA RIO & PIO Move to Manila (OS, F, T, Y)
6	6	Sat.	OS, F, T, Y W, OM	Manila Pangasinan	Data collection Data collection
7	7	Sun.	OS, F, T, Y W, OM	Manila Pangasinan	Data arrangement Data arrangement
8	8	Mon.	OS, F, T, Y W, OM	Manila Pangasinan	Discussion and preparation of Minutes of Meetings Courtesy call with Vice-governor of Pangasinan Site survey
9	9	Tue.	OS, F, T, Y W, OM	Manila Pangasinan	Signing for Minutes of Discussions with NIA Courtesy call and reporting of Minutes of Meetings with NEDA Courtesy call and reporting with Embassy of Japan Site survey
10	10	Wed.	OS, F, T Y W, OM	Manila - Tokyo Manila Pangasinan	Leaving for Japan (OS, F, T) Discussion on technical matter with Asst. Administrator of NIA Site Survey
11	11	Thu.	Y W, OM	Manila - Pangasinan Pangasinan	Move to the site Site survey & office work
12	12	Fri.	Y, W, OM	Pangasinan	Site survey & office work
13	13	Sat.	Y, W, OM	Pangasinan	Data collection and arrangement
14	14	Sun.	Y, W, OM	Pangasinan	Data arrangement

Day	Date	Week	Member	Itinerary	Activities
15	15	Mon.	Y, W, OM	Pangasinan	Data analysis Discussion on O & M with manager/RIO
16	16	Tue.	Y, W, OM	Pangasinan	Site survey Pumping test & installation of observation well (Dipalo RIS)
17	17	Wed.	Y, W, OM	Pangasinan	Site survey & office work Measuring test of water level using the prepared measuring instrument
18	18	Thu.	Y, W, OM	Pangasinan	Site survey & office work Discussion on technical matter with JICA expart for NIA
19	19	Fri.	Y W, OM	Pangasinan - Manila Pangasinan	Move to Manila Data collection Office work & data collection
20	20	Sat.	Y W, OM	Manila Pangasinan	Site survey Pumping test & installation of observation well (Principal CIS)
21	21	Sun.	Y W, OM	Manila Pangasinan	Data arrangement Data analysis
22	22	Mon.	Y W, OM	Manila Pangasinan	Discussion with NIA central office Design of the facilities
23	23	Tue.	Y W, OM	Manila - Pangasinan Pangasinan	Move to Pangasinan Office work
24	24	Wed.	Y, W, OM	Pangasinan	Office work Courtesy call with Mayor of Natividad Courtesy call and discussion with superintendent of ADRIS
25	25	Thu.	Y, W, OM	Pangasinan	Preparation of Progress Report Field check of elevation
26	26	Fri.	Y, W, OM	Pangasinan	Preparation of Progress Report Discussion with NIA RIO & PIO
27	27	Sat.	Y, W, OM	Pangasinan - Manila	Move to Manila
28	28	Sun.	Y, W, OM	Manila	Data arrangement
29	29	Mon.	Y, W, OM	Manila	Discussion with NIA Central Office Reporting to JICA Philippine Office and Embassy of Japan
30	30	Tue.	Y, W, OM	Manila - Tokyo	Leaving for Japan (Y, W, OM)

Note: OS (OSHIMA, Katsukiko), F (FUJIWARA, Jyunko), T (TAJIRI, Teruhisa),
Y (YUKAWA, Yoshimitsu), W (WADA, Kiyoo), OM (OMIYA, Masahiro)

1-3 List of Personnel Concerned

Office/Position	Name
NIA Central Office	
Administrator	Engr. Apolonio V. Bautista
Asst. Admr, Project Development & Implementation	Engr. Jorge B. Obordo
Manager, Project Development Dept.	Engr. Edilberto B. Punzal
Manager, System Management Dept.	Engr. Edilberto B. Payawal
PM, Earthquake Rehabilitation Project	Engr. Rogelio F. Gusilatar
Irrigation Engineer	Mr. Reynald R. Santos
Agronomist	Mr. Romeo A. Umagat
Geologist	Mr. Arturo F. Torralba, Jr.
NIA Regional Office-I	
Director	Dr. Orlando L. Bulseco
Chief Engineer, O & M Div.	Engr. Leodencio Baraquio
Chief Engineer, Engineering Div.	Engr. Eduardo Andaya
Construction Engineer	Mr. Antonio Lamsen
Design Engineer	Ms. Dolores Nicer
NIA Provincial Office-Pangasinan	
Provincial Irrigation Engineer	Engr. Helsy Bermudez
NIA Ambayoan Dipalo Irrigation System Office	
Irrigation Superintendent	Engr. Roger Q. Alangui
Engineer A	Engr. Camilo F. Baraquio
Provincial Govenment-Pangasinan	
Governor	Mr. Aguedo F. Agbayani
Vice Governor	Mr. Ranjit Shahani
Municipality-San Quintin	
Mayor	Dra. Digna Reyes
MPDC	Mr. David A. Cabaniua
Municipal Agricultural Officer	Mr. Aniceto Cada
Municipality-Natividad	
Mayor	Ms. Rowena Bernabe
MPDC	Engr. Marlene C. Soria
Municipal Agricultural Officer	Ms. Warina N. Peros
Municipality-Umingan	
Mayor	Manolo B. Gonzales
MPDC	Mr. Randolph Santos
Municipal Agricultural Officer	Mr. Leynaldo S. Escobar

1-4 List of Collected Data

No.	Title	Publisher	Date
	Corporate Plan, 1993-2002	NIA-CO	June, 1993
	Equipment Rental Rates, Reviced in 1993	NIA-CO	Oct. 1993
	Design Mannual for Canals and Canal Structures	NIA-CO	
	Rainfall Data: Brgy Bathelor East, Natividad, June 5,1989 - Dec. 31, 1992	Municipal Agricultural Office, Natividad	1993
	Documents on Dipalo RIS	NIA-ADRIS	1985-1993
	Documents on Principal CIS	NIA-PIO-Pangasinan	1983-1990
	Socio-Economic Profile of Pangasinan	Provincial Government	1992
	Development Plan, Province of Pangasinan, 1992-1995	Provincial Government	1992
	Provincial Irrigation Profile, Province of Pangasinan, 1993	NIA-PIO-Pangasinan	May, 1993
	Medium-Term Development Plan, 1993-98	NEDA	1993
	Soil, Land Use, Land Classification Maps, Principal CIS	NIA-PIO	
	Drawings, Principal CIS	NIA-PIO	
	Drawings, Dipalo RIS	NIA-ADRIS	
	Rainfall and Discharge Data, San Roque, 1982-1992	PAGASA-Rosales	1993
	Documents on Damages on Irrigation Systems by the Earthquake	NIA-CO, NIA-RIO	
	Unit Price Ceiling	NIA-CO	Aug. 1993

1-5 Minutes of Discussions

MINUTES OF DISCUSSIONS

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

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

JICA sent to the Philippines a study team, headed by Mr. Katsuhiko Oshima, Director of Study Review and Coordination Division, Grant Aid Study and Design Department, JICA, and scheduled to stay in the country from November 1 to November 30, 1993. (hereinafter referred to as "the Study Team")

The Study Team held discussions with the officials concerned of the Government of the Philippines and conducted a field survey at the study area.

In the course of discussions and the field survey, both parties have confirmed the main items described on the attached sheets. The Study Team will proceed to further works and prepare the Basic Design Study Report.

Manila November 9, 1993

MR. KATSUHIKO OSHIMA
Leader
BASIC DESIGN STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

MR. APOLONIO V. BAUTISTA
Administrator
NATIONAL IRRIGATION
ADMINISTRATION

ATTACHMENT

1. **Objectives**

The Objectives of the Project are contributing to restore a large output of agricultural production and to motivate farmers to work by rehabilitating the intake facilities damaged by earthquake in Dipalo River Irrigation System and Principal Communal Irrigation System.

2. **Executing Agency**

National Irrigation Administration is responsible for administration and execution of the Project.

3. **Project Sites**

The Project sites are located in Dipalo River Irrigation System at San Quintin and Principal Communal Irrigation System at Natividad, Pangasinan Province which is shown in ANNEX -I.

4. **Items requested by the Government of the Philippines**

After discussions between the Study Team and the Philippine side, the items listed in the ANNEX-II are finally requested by the Philippine side. However, the final components of the Project will be decided after further studies in Japan.

5. **Japan's Grant Aid System**

(1) The Philippine side has understood the system of Japan's Grant Aid explained by the Team.

(2) The Philippine side will take necessary measures, described in ANNEX-III for smooth implementation of the Project, on the condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. **Tentative Schedule of the Study**

(1) The Study Team will proceed to further studies in the Philippines until November 30, 1993.

(2) JICA will prepare a draft final report of the study and dispatch a mission in order to explain its contents in February, 1994.

(3) Based on the Minutes of Discussions and technical examination of the study results, JICA will complete a final report and send it to the Government of the Philippines by March, 1994.

7. **Observation of the Ground-water Level**

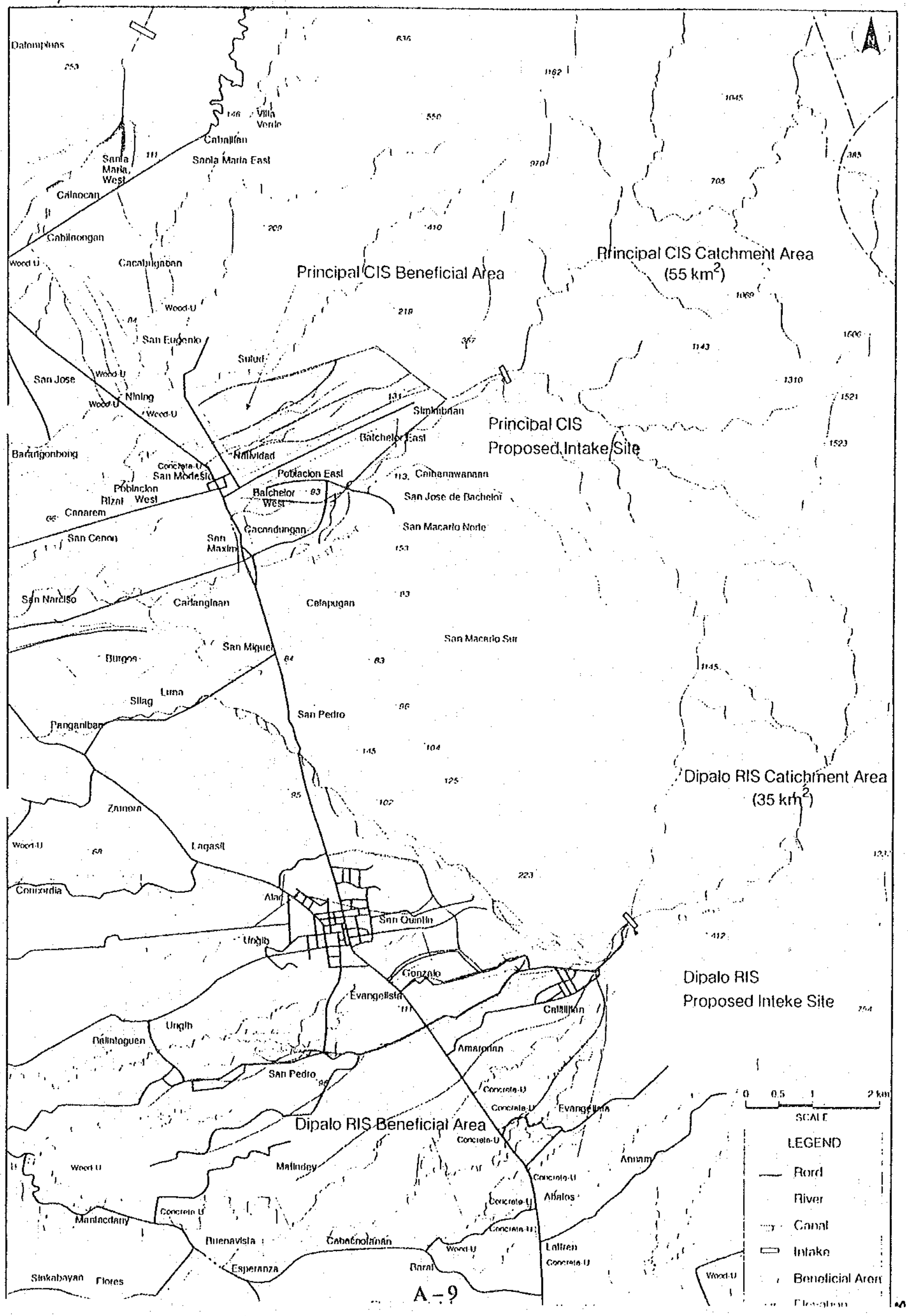
(1) Ground-water level shall be observed by the Philippine side with the use of the observation wells installed by the Study Team.

(2) The observation shall be carried out on the daily basis, and the monthly record shall be submitted to the Study Team through JICA Philippine office.

8. **An Important Issue Related to the Project**

The Philippine side should secure approval from the Investment Coordination Committe (ICC) as soon as possible and send copies of this to JICA Philippine Office immediately.

ANNEX-1


Principal CIS Beneficial Area
Principal CIS Catchment Area
(55 km²)
Principal CIS
Proposed Intake Site
Dipalo RIS Catchment Area
(35 km²)
Dipalo RIS
Proposed Inteke Site
Dipalo RIS Beneficial Area
SCALE
LEGEND
Road
River
Canal
Intake
Beneficial Area
Villa Verde
Caballitan
Santa Maria East
Santa Maria West
Calnocan
Cabilnongan
Cacabugnoan
San Eugenio
San Jose
Nining
Salud
Simimbaan
Batchelor East
Natividad
San Modesto
Poblacion East
Poblacion West
Rizal
Batchelor West
San Jose de Bachelor
Canarem
San Cenon
San Maxim
Cacandungan
San Macario Norte
San Narciso
Cadanglaan
Calapugan
San Macario Sur
San Miguel
Burgos
Luna
Silag
San Pedro
Panganiban
Zamora
Lagasit
Concordia
San Quintin
Ungib
Gonzalo
Evangelista
Calitlitan
Dalintoguen
Amatorian
Maliodey
Manlocdany
Buenavista
Cabacnolanan
Esperanza
Baral
Lotten
Abalos
Annam
Sinkabayan
Flores

ANNEX-II ITEMS REQUESTED BY THE GOVERNMENT OF THE PHILIPPINES

1. INTAKE FACILITIES

1) Components of the intake facility in Dipalo River Irrigation System

a) Impervious wall
b) Subsurface collecting conduit
c) Transmission conduit to the existing main canal.

2) Components of the intake facility in Principal Communal Irrigation System.

a) Impervious wall
b) Subsurface collecting conduit
c) Transmission conduit to the existing main canal.

2. MAIN CANALS

Rehabilitation of the existing main canals.

3. PROTECTION DIKE

Rehabilitation of the existing protection dike in Dipalo River Irrigation System.

ANNEX-III NECESSARY MEASURES TAKEN BY THE GOVERNMENT OF THE PHILIPPINES

1. To secure the sites for the Project at Dipalo River Irrigation System and Principal Communal Irrigation System.

2. To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the sites.

3. To bear commissions to the Japanese foreign exchange bank for the banking services based on the Banking Arrangement.

4. To ensure prompt unloading and custom clearance at the port of disembarkation in the Philippines and prompt internal transportation of the products provided under the Grant Aid.

5. To exempt Japanese nationals involved in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in the Philippines with respect to the supply of the products and the services under the verified contracts.

6. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Philippines and stay herein for the execution of the Project.

7. To maintain and use properly and effectively the equipment provided under the Grant Aid.

8. To bear all the expenses other than those to be borne by Grant, necessary for the transportation and installation of the equipment.

Appendix 2. Appendix on Explanation of Draft Final Report

2-1 Member List of the Team

Name	Position
HARA Yuto	**Staff of 1st Design Study Div.** Grant Aid Study and Design Department Japan International Cooperation Agency
YUKAWA Yoshimitsu	**Chief Consultant** Senior Managing Director Overseas Project Department Nippon Giken Inc.
WADA Kiyoo	**Irrigation Facilities Engineer** Managing Director Engineering Department Nippon Giken Inc.

2-2 Schedule

Day	Date	Week	Member	Itinerary	Activities
1	March 3	Thu.	H, Y, W	Tokyo - Manila	Arrival at Manila Meeting with JICA Office
2	4	Fri.	H, Y, W	Manila	Meeting with JICA expert assigned to NIA Courtesy call on Assistant Administrator Discussion Meeting with NIA officials concerned Courtesy call on Embassy of Japan
3	5	Sat.	H, Y, W	Manila	Holiday
4	6	Sun.	Y, W	Manila – Urdaneta	Move to the site Investigation of site conditions
5	7	Mon.	Y, W	Urdaneta – Manila	Discussion meeting at NIA Region-1 Discussion meeting with NEDA Region-1 Move back to Manila
6	8	Tue.	H, Y, W	Manila	Discussion meeting with NIA officials concerned Preparation of Minutes of Discussions (M/D) Signing of the M/D at NIA Central Office
7	9	Wed.	H, Y, W	Manila	Report to JICA Office Report to Embassy of Japan Report to NEDA Central Office
8	10	Thu.	Y, W	Manila - Tokyo	Leaving for Japan

Note: H (HARA Yuto), Y (YUKAWA, Yoshimitsu), W (WADA, Kiyoo)

2-3 List of Personnel Concerned

Office/Position	Name
NIA Central Office	
Administrator	Engr. Apolonio V. Bautista
Asst. Admr, Project Development & Implementation	Engr. Jorge B. Obordo
Officer in charge, Project Development Dept.	Engr. Edilberto B. Punzal
Officer in charge, Plan Formulation Division	Engr. Abelardo Y. Armentia
Manager of Land Resources and Economic Division	Mr. Epifanio C. Gacusan
Officer in charge, Civil Work Design Division	Engr. Rodolfo D. Gales
Officer in charge, Water Resources Utilization Div.	Engr. Roelio P. Delarosa
NIA Regional Office-I	
Director	Dr. Orlando L. Bulseco
Chief Engineer, Engineering Div.	Engr. Leodencio Baraquio
Design Engineer	Ms. Dolores Nicer
NIA Provincial Office-Pangasinan	
Provincial Irrigation Engineer	Engr. Helsy Bermudez
NIA Ambayoan Dipalo Irrigation System Office	
Irrigation Superintendent	Engr. Roger Q. Alangui
NEDA Central Office	
Asst. Director, Public Investment Staff	Mr. Enqenio B. Inocentes, III
Public Investment Stafff	Mr. Florante G. Igtiben
NEDA Regional Office-I	
Director	Mr. Leonardo Quitos
Director	Ms. Agnes Grace A. Cargamento
Embassy of Japan, First Secretary	Mr. Yugo Matsuda
NIA Central Office, JICA Expert	Mr. Takashi Ishido

2-4 Minutes of Discussions

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY TEAM ON THE REHABILITATION PROJECT

FOR

THE DIPALO RIVER AND PRINCIPAL
COMMUNAL IRRIGATION SYSTEM

IN

PANGASINAN PROVINCE

IN

THE REPUBLIC OF THE PHILIPPINES
(CONSULTATION ON DRAFT FINAL REPORT)

In November 1993, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team on the Rehabilitation Project for the Dipalo River and Principal Communal Irrigation System in Pangasinan Province (hereinafter referred to as "the Project") in the Republic of the Philippines. Through discussions, field survey, and technical examination of the results in Japan, the team has prepared the draft final report of the study.

In order to explain and to consult the Philippine side on the components of the draft final report, JICA sent to the Philippines a study team, (hereinafter referred to as "the Team"), which is headed by Mr. Yuto Hara, Ist Basic Design Study Division, Grant Aid Study & Design Department, JICA from March 3 to March 10, 1994.

As a result of discussions, both parties have confirmed the main items described on the attached sheets.

MANILA, MARCH 8, 1994

MR. YUTO HARA
LEADER
DRAFT REPORT EXPALATION TEAM
JAPAN INTERNATIONAL COOPERATION
AGENCY

MR. APOLONIO V. BAUTISTA
ADMINISTRATOR
NATIONAL IRRIGATION
ADMINISTRATION

ATTACHMENT

1. Components of Draft Final Report

The Government of the Philippines has agreed and accepted in principle the components of the draft final report proposed by the Team.

2. Japan's Grant Aid System

2.1 The Philippine side has understood the system of Japan's Grant Aid explained by the Team.

2.2 The Philippine side will take necessary measure, described in ANNEX-I for smooth implementation of the Project, on the condition that the Grant Aid by the Government of Japan is extended to the Project.

3. Further Schedule

The Team will prepare a final report in accordance with the confirmed items, and send it to the Government of the Philippines by March, 1994.

4. Operation and Maintenance of the Facilities

4.1 The Philippine side has affirmed that it shall allocate necessary budget for operation and maintenance of the facilities to be provided and equipment to be procured under the Project.

4.2 The Philippine side has affirmed that it shall constantly take necessary maintenance work described in ANNEX-II for the facilities to be provided under the project.

ANNEX-I : NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE PHILIPPINES

1. To secure the sites for the Project at Dipalo River Irrigation System and Principal Communal Irrigation System.

2. To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the sites.

3. To bear commissions to the Japanese foreign exchange bank for the banking services based on the Banking Arrangement.

4. To ensure prompt unloading and custom clearance at the port of disembarkation in the Philippines and prompt internal transportation of the products provided under the Grant Aid.

5. To exempt Japanese nationals involved in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in the Philippines with respect to the supply of the products and the services under the verified contracts.

6. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Philippines and stay therein for the execution of the Project.

7. To maintain and use properly and effectively the equipment provided under the Grant Aid.

8. To bear all the expenses other than those to be borne by the Grant, necessary for the transportation and installation of the equipment.

ANNEX-II : MAINTENANCE OF THE FACILITIES AND EQUIPMENT

1. Maintenance of the River and Main Canal

1.1 Inspection and patrol for checking the condition of siltation periodically

1.2 Dredging to remove sedimentation and debris during the wet season and at the beginning of second cropping

2. Maintenance of the Intake Facilities

2.1 Inspection and patrol for checking the conditon of sedimentation, debris deposision and erosion of gabion periodically

2.2 Dredging to remove packed debris at inlet of the impervious wall for surface water after each flood

2.3 Making gabion up to the right dimension at the upstream and downstream portion of the impervious wall after each flood

3. Maintenance of the equipment

3.1 Inspecting the equipment periodically

3.2 Inspecting the equipment before and after operation

TECHNICAL DATA

TECHNICAL DATA

1. *Basic Development Indicator of Pangasinan Province (1991)*
2. *Irrigation in Pangasinan Province*
3. *Water Bodies in Pangasinan Province*
4. *National Irrigation System in Pangasinan Province*
5. *Communal Irrigation System in Pangasinan Province*
6. *Ambayoan - Dipalo River Irrigation System*
7. *Population and Number of Household of Barangays Concerned*
8. *Soil Map*
9. *Monthly Rainfall*
10. *Monthly Evaporation*
11. *Monthly Runoff*
12. *Water Requirement by 10 Days*
13. *Cropping Area of Paddy in Barangays of Dipalo RIS (1998 - 1992)*
14. *Cropping Area, Yield and Production of Paddy in Barangays of Principal CIS (1998 - 1992)*
15. *Geo-Resistivity Survey Data*
16. *Geo-Resistivity Map*
17. *Grain Size Accumulation Curve*
18. *Crop Production under With- and Without-Project Conditions*
19. *Crop Production Value under With- and Without-Project Conditions*
20. *Groundwater Level Observation Record*

Basic Development Indicator of Pangasinan Province (1991)

(1/5)

DEVELOPMENT INDICATORS	UNIT OF MEASURE	PANGASINAN
1. GENERAL		
a. Land Area	km2	5,368.18
b. Municipalities	no.	46
c. Cities	no.	2
d. Barangays	no.	1,354
2. DEMOGRAPHIC		
a. Population (1990 Actual Census on Population)	no.	2,020,273
Relative Share to Total Region	%	56.90
b. Average Annual Population Growth Rate (1980-1990)	%	2.13
c. Population Density	persons/sq.km	376
d. Households	no.	366,908
e. Household Size	no. of persons/households	5.51
3. LABOR FORCE PARTICIPATION AND EMPLOYMENT		
a. Labor Force Participation Rate (LFPR)	%	57.38
b. Employment Rate	%	94.09
c. Unemployment Rate	%	5.91
d. Absorption Rate in the Agricultural Sector	%	46.90
4. CONSUMER PRICES AND INFLATION RATE		
a. Consumer Price Index	Index	
All Items		577.54
Food, Beverage and Tobacco		548.63
Clothing		658.11
Housing and Repairs		374.51
Fuel, Light and water		742.17
Services		817.50
Miscellaneous		590.32
b. Inflation Rate (Ave. for 12 months)	%	11.62
c. Perchasing Power of the Peso		0.17
5. AGRICULTURE, FISHERY		
a. Crops		
Food crops		
Production	t	322,396
Area Harvested	ha	291,662
Productivity	t/ha	3.16
Rice		
Production	t	594,458
Area Harvested	ha	195,533
Productivity	t/ha	3.04
Corn		
Production	t	75,480
Area Harvested	ha	102,850
Productivity	t/ha	0.73
Vegetables		
Production	t	85,360
Area Harvested	ha	12,190
Productivity	t/ha	7.00

Basic Development Indicator of Pangasinan Province (1991)

(2/5)

DEVELOPMENT INDICATORS	UNIT OF MEASURE	PANGASINAN
Legumes		
Production		19,600
Area Harvested	ha	22,305
Productivity	t/ha	0.88
Fruits		
Production	t	147,498
Area Harvested	ha	207
Productivity	t/ha	712.50
Commercial Crops		
Production	t	108,911
Area Harvested	ha	21,976
Productivity	t/ha	4.96
Sugarcane		
Production	t	32,870
Area Harvested	ha	1,348
Productivity	t/ha	24.38
Cotton		
Production	t	498
Area Harvested	ha	382
Productivity	t/ha	1.30
Tobacco		
Production	t	23,401
Area Harvested	ha	11,310
Productivity	t/ha	2.07
Coconut		
Production	t	52,142
Area Harvested	ha	8,936
Productivity	t/ha	5.83
b. Livestock		
Production	no.	526,463
No. of Raisers	no.	271,501
Carabao		
Production	no.	89,630
No. of Raisers	no.	60,920
Cattle		
Production	no.	115,336
No. of Raisers	no.	73,826
Goat		
Production	no.	91,007
No. of Raisers	no.	51,797
Swine		
Production	no.	230,490
No. of Raisers	no.	84,958
c. Poultry		
Production	no.	681,699
No. of Raisers	no.	69,852
TOTAL PRODUCTION	no.	1,208,162
TOTAL NO. OF RAISERS	no.	341,353

Basic Development Indicator of Pangasinan Province (1991)

(3/5)

DEVELOPMENT INDICATORS	UNIT OF MEASURE	PANGASINAN
d. Fishery		
Municipal Fishing		
Bancas	no.	9,799
Production	t	19,895.55
Fishermen	no.	15,799
Commercial Fishing		
Vessels	no.	31
Production	t	3,571.20
Fishermen	no.	28
Aquaculture (bangus, prawn, malage)		
Area	ha	14,880
Production	t	21,461.36
Fishermen	no.	5,100
Freshwater (Tilapia, dalag, carpa, etc.)		
Area	ha	1,002.90
Production	t	1,020.467
Fishermen	no.	2,271
Seafarming (Oyster)		
Area	ha	48
Production	t	4,628.93
Fishermen	no.	575
Communal Bodies of Water		
Area	ha	7,239
Production	t	392.669
TOTAL		
Area	ha	23,169.90
Production	t	50,970.176
Fishermen	no.	15,827
Operators	no.	7,946
Bancas	no.	9,799
Vessels	no.	31
6. TRADE, INDUSTRY, TOURISM		
Value of Investment Generated	million P	296.78
Total Employment Generated	no.	7,639
Exports Generated	million $	5.87
Trainings Assisted/ Coordinated/ Organized	no.	174
Tourist Attractions	no.	42
Natural	no.	14
Cultural/Historical	no.	10
Resorts and Beaches	no.	16
Scientific	no.	2
Number of Tourist Arrivals*		
Domestic	no.	65,184
Foreign	no.	4,983

Basic Development Indicator of Pangasinan Province (1991)

(4/5)

DEVELOPMENT INDICATORS	UNIT OF MEASURE	PANGASINAN
7. SOCIAL SERVICES		
EDUCATION AND MANPOWER DEVELOPMENT		
a. Total Enrolment (SY 1991-1992)		
Elementary Level		
Public	no.	341,137
Private		NDA
Secondary Level		
Public	no.	151,989
Private		NDA
b. School Teachers (SY 1991-1992)		
Elementary Level		
Public	no.	8,917
Private		NDA
Secondary Level		
Public	no.	3,235
Private		NDA
c. Literacy Rate	%	89.57
HEALTH, NUTRITION AND POPULATION		
1. Health		
a. Crude Birth Rate	0/00	26.07
b. Crude Death Rate	0/00	4.73
c. Infant Mortality Rate	0/00	18.81
d. Material Mortality Rate	0/00	0.36
e. Health Facilities		
Hospital (Govt. & Private)	no.	45
Hospital Beds	no.	1,687
Bed to Population Ratio	ratio	1:1,197
Health Center	no.	65
Health Center to Population Ratio	ratio	1:31,081
Barangay Health Station	no.	411
Barangay Health Center to Population Ratio	ratio	1:4,915
2. Nutrition		
Pre-School Children		
Malnutrition Rate	%	13.88
Second Degree (Moderate)	%	12.27
Third Degree (Severe)	%	1.61
3. Population		
Contraceptive FP activeness*	%	80.32
4. Social Welfare	no.	
Clients Served by Category		357,334
Family		28,862
Children		34,001
Women		7,242
Youth		8,771
Disabled		7,457
Distressed		271,051
Ratio of Social Workers to Client Served	ratio	1:4,641
Day Care Centers to Clientele Served	ratio	1:31

Basic Development Indicator of Pangasinan Province (1991)

DEVELOPMENT INDICATORS	UNIT OF MEASURE	PANGASINAN
8. INFRASTRUCTURE AND UTILITIES		
a. Land Transport		
1. Total Road by Surface Type	km	5,081.90
Paved		932.10
Unpaved		4,149.80
2. Total Road by Type of Administration	km	
National		485.23
Provincial		391.24
Municipal		425.90
Barangay		3,279.53
3. Road Density	km/sq.km of total land area	0.9145
4. Motor Vehicles Registered	no.	39,203
b. Communications		
1. Telegraph Stations (Govt. & Private)	no.	70
Municipalities Served	%	100
2. Telephone System	no.	6
Municipalities Served	no.	28
3. Post Office/Postal Stations	no.	57
Postal Density	Pop'n. served by 1 post office	1:35,443
Letter Carriers	no.	218
Letter Carrier to population ratio	Pop'n. served by 1 letter carrier	1:9,368
4. Radio Broadcasting Stations	no.	12
5. Local Print Media (Periodicals)	no.	6
c. Electrification		
Municipalities Served	%	100
Barangay Served	%	86
d. Water Supply		
Households served by potable water	%	94.01
e. Irrigation		
Irrigation Coverage	ha	46,778
Irrigation Development	%	55
9. DEVELOPMENT ADMINISTRATION AND FINANCING		
a. Local Government Income	million P	307.13
b. Local Government Expenditure	million P	296.94
c. Internal Revenue Collection	million P	9.77
d. Customs Collection	million P	-
e. Income Classification	rank	First Class

* as of 1990

NDA - No Data Available

Irrigation in Pangasinan Province

(1/1)

	Number	Area (ha)
Potential Area for Irrigation Development		181,261
1 Total Service Area		98,917
(1) National Irrigation Systems	7	38,240
1) Reservoir	0	0
2) Gravity	7	38,240
3) Pump	0	0
(2) Communal Irrigation Systems	1,140	60,677
1) NIA Assisted Systems	858	21,157
a) Reservoir	0	0
b) Gravity	91	15,926
c) Pump (including 23 CLGIP)	767	5,231
2) Constructed/Assisted by Other Government Agencies	212	27,502
a) Reservoir	0	0
b) Gravity	212	27,502
c) Pump	0	0
3) Privately Owned Systems	70	12,018
a) Pump	0	0
b) Gravity	70	12,018
Percentage of Irrigation Development		54.57%
2 Total Area to be Developed		82,344
(1) National Irrigation Projects	11	69,000
(2) Communal Irrigation Projects	17	1,630
(3) Pump Irrigation Projects (Includes 1,310 individual pump units)	1,332	6,560
(4) Small water Impounding Management Projects	21	5,154

Water Bodies in Pangasinan Province

LOCATION/MUNICIPALITY	WATER BODIES
1. Agno	Cayungnan Creek
	Pandan Creek
	Pau River
	Nangwang Creek
2. Alaminous	Conconig River
	Linmansangan River
	Alaminos River
	Bugarin Creek
	Dulacac Creek
	Enerangan River
	Tangcarang River
	Baracbac River
3. Bani	Ambabaay Creek
	Balingbuaya Creek
	Soguey River
	Quinaoayanan River
	Oboy-oboy River
4. Bolinao	Cabasaan Creek
	Manlumanat River
	Balingbuaya River
	Subran Creek
	Zaragosa Creek
5. Burgos	Balincaguing River
	Mabolitec Creek
6. Dasol	Dosoc River
	Bayambang River
	Salabosoban Creek
	San Vincente River
7. Infanta	Sawang River
	Batang River
	Fontelera Creek
	Bayambang River
8. Labrabor	Anawang River
	Pantol River
	Bolosan River
	Colingat Creek
	Uyong River
	Tobuan River
9. Mabini	Mabini River
	Balaang River
	Balincaguing River
10. Sual	Capantolan River
	Siwasiw River
	Caoayan River
	Macaycayaoan River
	Sto. Domingo River
	Yuntoog Creek
	Manurang Creek
11. Aguilar	Parlan River
	Cagubay River
	Bayaoas River
	Quiray River
	Sobol River
12. Bugallon	Dumuloc River
	Boanga River
	Pantol River
	Sobol River
13. Malasiqui	Waig River
	Pamaranum Creek
	Langis Creek
	Caoayan River
	Padua Creek
	Umangao Creek
	Agno River
14. Mangatarem	Ungab Creek
	Maglong Creek
	Balococ Creek
	Baracbac Creek
	Bayaoas River
	Pila River
	Cabulauan Creek
	Batacan River
	Vogtong Creek
	Muclang River
	Magalong Creek
	Boris River
	Malibong Creek
	Olo River
	Sapang Creek
	Bued Creek
	Massing Creek
	Sanchez Creek
15. Binalonan	Casabawil Creek
	Alibeng Creek
	Caparian Creek
	Birao Creek
	Inmagus River
	Bolong Creek
	Aloragat River
16. Laoac	Magalong River
	Potol Creek
	Banding Creek
17. Manaoag	Salcedo Creek
	Carrera Creek
	Mabolo-bolo Creek
18. Mapandan	Tulong Creek
	Angalacan River
19. San Fabian	Nilanguyan Creek
20. Urdaneta	Mitura Creek
	Calopasan River
	Labit River

LOCATION/MUNICIPALITY	WATER BODIES
21. Pozorrubio	Banba Creek
	Angalacan River
	Banding Creek
	Tulnac Creek
	Paldit River
	Bobonan River
	Bukol Spring
	Bunod Spring
	Colos Spring
	Cubal Creek
	Maolo River
	Dukot River
	Alban Creek
	Quebuar Creek
	Cablong River
	Aloragat River
	Sobol River
	Salcedo Spring
	Solis Spring
	Sisiw River
	Tulding Creek
	Inuman Creek
	Pugo Creek
	Backer Creek
22. Sison	Caoayan River
	Bued River
	Sta. Maria River
	Abenoleng River
	Barachac River
	Aloragat River
	Sapid Creek
	Alibeng River
	Antong Creek
	Albay Creek
	Pilawan Creek
	Ngalab Creek
	Palina Creek
	Capacuan Creek
23 Umingan	Cabasan Creek
	Poblacion Creek
	Banila River
	Calitlitan River
	Cayatyatan Creek
	Carayungan River
	Matacdang Creek
	Pajo Creek
	Maputal-putal Creek
	Pemienta Creek
	Umingan River
	Nangalisan Creek
	Padilla Creek
	Nancapian Creek
	Carasacas River
	Colos Barat
	Capsing Creek
	Sicsi Creek
	Pias Creek
	Saguilian Creek

LOCATION/MUNICIPALITY	WATER BODIES
24. Natividad	Viray River
	Limongon Creek
	Cacaasian Creek
	Ananasio Creek
	Magsabar Creek
	Lakab Creek
	Parasapas Creek
	Grande Creek
25. San Quintin	Dipalo River
	Labuan Creek
	Matacdang Creek
	Minosicoan Creek
	Bitong Creek
26. Baungao	Matablang River
	Managus River
	Madilap River
	Banila River
	Cabaliman River
27. Santa Maria	Viray River
	Balloy River
	Bangar Creek
	Lagasit River
28. Villasis	Barraca River
29. San Nicolas	Agno River
	Ambayaoan River
	Paraspas Creek
	Catabongan Creek
	Cabalisian River
	Sabangan River
30. Rosales	Bued River
31. San Manuel	Boboaya River
	Chico River
	Toboy River
	Agno River
32. Asingan	Chico River
	Agno River
	Mitura River
	Calobang Creek
33. Tayug	Bitong Creek
34. Mangaldan	Polong Creek

National Irrigation System in Pangasinan Province

(1/1)

Name of NIS	Service Area (ha)	Irrigated Area (ha) Wet	Irrigated Area (ha) Dry	No. of IAs	Coverage Area (ha)	No. of Farmers	Remarks
1. Agno	17,173	2,109	3,101	12	2,452	1,961	
2. Sinocalan	3,000	163	648	6	814	524	
3. San Fabian	2,684	1,742	1,506	8	1,762	1,433	
4. Dumoloc	1,458	1,098	198	2	563	340	
5. Lower Agno	7,623	4,644	2,630	5	979	547	
6. Ambayoan	4,339	3,230	995	11	2,532	2,901	Including Ambayoan Extension
7. Dipalo	1,963	1,508	179	3	938	926	
TOTAL	38,240	14,494	9,257	47	10,041	8,632	

Communal Irrigation System in Pangasinan Province

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category: Amortizing P	Category: Amortizing NP	Category: Non-Amorti-zing	Remarks
AGNO								
1. Cayungan CIS	Gravity	55	50	No data			*	Operational
2. Gayonggayong CIS	Gravity	35	30	No data			*	Operational
3. Pandan CIS	Gravity	20	15	No data			*	Operational
4. Pau-tupa CIS	Gravity	25	25	32	*			Operational
5. Payong CIS	Gravity	70	65	No data			*	Operational
6. San Juan CIS	Gravity	50	97	No data			*	Operational
7. Telek CIS	Gravity	25	20	No data			*	Operational
8. Vega CIS	Gravity	25	20	No data			*	Operational
9. Casao CIS	Gravity	30	30	-			*	Operational
ALAMINOS								
1. Alos-Conconing CIS	Gravity	430	430	No data			*	Operational
2. Alos Paed CIS	Gravity	350	350	No data			*	Operational
3. Amandigo CIS	Gravity	295	0	No data			*	Not operational
4. Amangbangan CIS	Gravity	40	35	No data			*	Operational
5. Balangobong CIS	Gravity	180	180	No data			*	Operational
6. Bugarin CIS	Gravity	179	30	60		*		Operational
7. Cabatuan CIS	Gravity	100	80	No data			*	Operational
8. Dulacac CIS	Gravity	50	30	No data			*	Operational
9. Lower Tawin-Tawin CIS	Gravity	190	0	No data			*	Operational
10. Tancarang CIS	Gravity	125	80	No data			*	Operational
11. Tocok-Palamis CIS	Gravity	180	100	No data			*	Operational
12. Upper Tawin-Tawin CIS	Gravity	270	0	No data			*	Not operational
BANI								
1. Ambabaay CIS	Gravity	60	0	No data			*	Not operational
2. Gorita CIS	Gravity	55	50	No data			*	Operational
3. Macabit CIS	Gravity	60	60	No data			*	Operational
4. Masidem CIS	Gravity	345.28	50	120		*		
BOLINAO								
1. Cabasan CIS	Gravity	25	25	No data			*	Operational
2. Manlumanat CIS	Gravity	40	40	No data			*	Operational
3. San Roque CIS	Gravity	50	50	No data			*	Operational
4. Tanobong CIS	Gravity	40	0	25		*		Not operational
5. Zaragoza CIS	Gravity	60	-	No data			*	Not operational
BURGOS								
1. Anapao CIS	Gravity	35	35	No data			*	Operational
2. Mabolitoc CIS	Gravity	60	60	No data			*	Operational
3. Papallasen CIS	Gravity	62.4	20	50		*		Operational
4. San Lorenzo CIS	Gravity	80	80				*	Partially operational
5. Sangbay CIS	Gravity	30	30				*	Partially operational
DASOL								
1. Alilao-Dosoc CIS	Gravity	79	5	55		*		Partially operational
2. Eguia CIS	Gravity	90	-	No data			*	Not operational
3. Macalang CIS	Gravity	52	52	95	*			Operational
4. Magsaysay-Bobonot CIS	Gravity	68	68	52	*			Operational
5. San Vincente CIS	Gravity	20.87	10	15		*		Partially operational
INFANTA								
1. Bamban CIS	Gravity	177	177	135	*			Operational
2. Baracbac CIS	Gravity	30	30	No data			*	Operational
3. Botang-Atel CIS	Gravity	40	40	No data			*	Operational
4. Fontelera CIS	Gravity	15	15	No data			*	Operational
5. San Felipe CIS	Gravity	140	120	No data			*	Operational
6. Upper San Felipe CIS	Gravity	75	75	No data			*	Operational
7. Bayambang CIS	Gravity	54	54	96	*			Operational
LABRADOR								
1. Anawang CIS	Gravity	130	130	No data			*	Operational
2. Apallang CIS	Gravity	90	90	No data			*	Operational
3. Bolosan CIS	Gravity	30	30	No data			*	Operational
4. Casupling CIS	Gravity	75	75	No data			*	Operational
5. Colingat CIS	Gravity	15	15	No data			*	Operational
6. Pantol CIS	Gravity	120	120	No data			*	Operational
7. San Gonzalo CIS	Gravity	20	20	No data			*	Operational
8. Silag-Lawis CIS	Gravity	85	45	135	*			Operational
9. Tobuan CIS	Gravity	21	11	No data			*	Partially operational
10. Uyong CIS	Gravity	-	-	No data			*	Not operational
MABINI								
1. Cabinuangan CIS	Gravity	38	38	No data			*	Operational
2. Calzada CIS	Gravity	125	120	No data			*	Operational
3. Dacoc CIS	Gravity	38	35	No data			*	Operational
4. De Guzman CIS	Gravity	30	-	No data			*	Not operational
5. Pajam CIS	Gravity	95	95	No data			*	Operational
6. Magalong CIS	Gravity	60	-	No data			*	Not operational
7. San Pedro CIS	Gravity	90	-	No data			*	Not operational

Communal Irrigation System in Pangasinan Province

(2/6)

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category: Amortizing P	Category: Amortizing NP	Category: Non-Amortizing	Remarks
SUAL								
1. Bolaoen CIS	Gravity	100	-	No data			*	Not operational
2. Cabuenlag CIS	Gravity	30	50	No data			*	Operational
3. Camagsese CIS	Gravity	600	432	315		*		Operational
4. Caoayan CIS	Gravity	25	25	No data			*	Operational
5. Macaycayaoan CIS	Gravity	30	30	No data			*	Operational
6. Madangla CIS	Gravity	20	20	24		*		Operational
7. Padua CIS	Gravity	20	20	No data			*	Operational
8. Paitan CIS	Gravity	40	30	No data			*	Operational
9. Siwasiw CIS	Gravity	25	25	No data			*	Operational
10. Sto. Domingo CIS	Gravity	38	38	No data			*	Operational
11. Victoria CIS	Gravity	84	65	79		*		Operational
12. Capantolan CIS	Gravity	52	40	36	*			Operational
13. Matico CIS	Gravity	14	14	No data			*	Operational
14. Maurang CIS	Gravity	16	15	No data			*	Operational
AGUILAR								
1. Acbat CIS	Gravity	208	208	No data			*	Operational
2. Caguioa CIS	Gravity	22	22	No data			*	Operational
3. Calsib CIS	Gravity	180	150	210		*		Operational
4. Dalimot CIS	Gravity	115	115	No data			*	Operational
5. Dona Rufina CIS	Gravity	48	48	40	*			Operational
6. Don Quiron CIS	Gravity	180	180	No data			*	Operational
7. Manlocboc CIS	Gravity	145	145	No data			*	Operational
8. Nancompapeyan CIS	Gravity	145	145	No data			*	Operational
9. Parlan CIS	Gravity	221	221	No data			*	Operational
10. Pila CIS	Gravity	115.15	65	80	*			Operational
11. Pogomboa CIS	Gravity	92	92	No data			*	Operational
12. Pogonali CIS	Gravity	420	420	No data			*	Operational
13. Sobol Concepcion CIS	Gravity	110	60	89		*		Operational
14. Tangal Acapatey CIS	Gravity	141	90	87		*		Operational
15. Tangal Baley CIS	Gravity	72	72	42	*			Operational
16. Tangal Masiken CIS	Gravity	180	180	No data			*	Operational
17. Tangal Paco CIS	Gravity	18	18	No data			*	Operational
18. Vargas CIS	Gravity	145	145	No data			*	Operational
BUGALON								
1. Bolaoen CIS	Gravity	192	192	No data			*	Operational
2. Laguit-Padilla CIS	Gravity	119.95	119.95	No data			*	Operational
3. Magtaking-Guesset CIS	Gravity	118.5	118.5	No data			*	Operational
4. Pantol-Guesset CIS	Gravity	67	0	No data		*		Operational
5. Salomague Sur CIS	Gravity	112.7	112.7	No data			*	Operational
MALASIQUI								
1. Dona Rosa CIS	Gravity	261	71	200	*			Operational
2. Engelero CIS	Gravity	687.73	680	No data			*	Operational
3. Langis CIS	Gravity	150	145	No data			*	Operational
4. Popoguelan-Mag. CIS	Gravity	55	55	No data			*	Operational
5. Lipa CIS	Gravity	182.34	164.24	No data			*	Operational
6. Pocuan-Co CIS	Gravity	56.36	50	No data			*	Operational
7. Pamaranum CIS	Gravity	80	74	No data			*	Operational
8. Umagao CIS	Gravity	129.89	117	No data			*	Operational
MANGATAREM								
1. Abuya CIS	Gravity	50	50	No data			*	Operational
2. Andangin CIS	Gravity	120	92	No data			*	Operational
3. Balococ CIS	Gravity	60	60	No data			*	Operational
4. Baracbac CIS	Gravity	88.55	80	No data			*	Operational
5. Bogton-Silag CIS	Gravity	140	129	No data			*	Operational
6. Bueno Historia CIS	Gravity	492	442	No data			*	Operational
7. Baracbac East CIS	Gravity	105	95	No data			*	Operational
8. Bulalacao CIS	Gravity	525	499	No data			*	Operational
9. Cabulayan I CIS	Gravity	47.15	47.15	No data			*	Operational
10. Cabulayan II CIS	Gravity	82.46	82.46	No data			*	Operational
11. Nancasalan CIS	Gravity	150	150	111	*			Operational
12. Cabaruan-Bogtong CIS	Gravity	2000	2000	No data			*	Operational
13. Calomboyan CIS	Gravity	137	124	No data			*	Operational
14. Cacamposan CIS	Gravity	Integrated with Nagalisan-Cagarlitan					*	Operational
15. Cacawitan CIS	Gravity	50.29	50.29	No data			*	Operational
16. Casilagan CIS	Gravity	137.07	125	No data			*	Operational
17. Caviernesan CIS	Gravity	274.5	244	No data			*	Operational
18. Cervantes CIS	Gravity	407.55	366	No data			*	Operational
19. Lawak-Langka CIS	Gravity	117.11	106	No data			*	Operational
20. Dalayan-Muelang CIS	Gravity	242	218	No data			*	Operational
21. Macarang CIS	Gravity	151.76	136	No data			*	Operational
22. Malabobo CIS	Gravity	90.02	81	No data			*	Operational
23. Naguilayan East CIS	Gravity	275	248	No data			*	Operational

Communal Irrigation System in Pangasinan Province

(3/6)

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category Amortizing P	Amortizing NP	Non-Amorti-zing	Remarks
24. Niog CIS	Gravity	160	135	No data			*	Operational
25. Pacalat-Cadanglaan CIS	Gravity	128	126	No data			*	Operational
26. Parian CIS	Gravity	400.37	360	No data			*	Operational
27. Pacalat-Olo CIS	Gravity	250	240	No data			*	Operational
28. Pias Cabaluyan CIS	Gravity	12.09	12.09	No data			*	Operational
29. Pias Maravilla CIS	Gravity	54.8	45	65	*			Operational
30. Ramos Dorongnan CIS	Gravity	241	217	No data			*	Operational
31. Ramones CIS	Gravity	249.41	224	No data			*	Operational
32. Sagpat-Sacneb CIS	Gravity	86.5	86.5	No data			*	Operational
33. Sapang CIS	Gravity	69	69	No data			*	Operational
34. Tocok Protacio CIS	Gravity	46	46	No data			*	Operational
35. Tocok Bariker CIS	Gravity	58.17	58.17	No data			*	Operational
36. Torre Pagon Lomboy CIS	Gravity	414	372	No data			*	Operational
37. Torre-Martinez CIS	Gravity	109.4	108	No data			*	Operational
38. Tagak-Suaco CIS	Gravity	150	150	No data			*	Operational
39. Bogtong-Potot CIS	Gravity	428	428	No data			*	Operational
40. Potot Kiling CIS	Gravity	80	80	No data			*	Operational
41. Takipan CIS	Gravity	272	272	No data			*	Operational
42. Kapuritan CIS	Gravity	91	80	No data			*	Operational
43. Nangalisan-Cagarlitan CIS	Gravity	363	200	48	*			Operational
44. Bangao CIS	Gravity	100	100	No data			*	Operational
45. Bantay CIS	Gravity	129	110	No data			*	Operational
46. Sanchez CIS	Gravity	38.99	38.99	No data			*	Operational
47. Olo CIS	Gravity	250	225	No data			*	Operational
48. Cabyugan CIS	Gravity	120	-	No data			*	Not operational
BINALONAN								
1. Binmortor CIS	Gravity	262	262	No data			*	Operational
2. Bogayong-Casubituan CIS	Gravity	148	128	No data			*	Operational
3. Catemelan CIS	Gravity	36	36	No data			*	Operational
4. Cili CIS	Gravity	75.39	60	36		*		Operational
5. Cili-Bugayong CIS	Gravity	70	70	No data			*	Operational
6. Cili Duplas Orno CIS	Gravity	150	150	No data			*	Operational
7. Dumayat CIS	Gravity	147	147	No data			*	Operational
8. Inmagus CIS	Gravity	146	146	No data			*	Operational
9. Moreno CIS Part I	Gravity	168	168	No data			*	Operational
10. Moreno CIS Part II	Gravity	110	110	No data			*	Operational
11. Sta. Catalina CIS	Gravity	177	177	No data			*	Operational
12. Vacante Aloragat CIS	Gravity	213	213	No data			*	Operational
13. Poro Orno Cili CIS	Gravity	627	500	No data			*	Operational
LAOAC								
1. Barobar CIS	Gravity	138	138	No data			*	Operational
2. Caldona CIS	Gravity	160	160	No data			*	Operational
3. Casaestebanan CIS	Gravity	101	101	No data			*	Operational
4. Lebueg CIS	Gravity	80	80	No data			*	Operational
5. Mabolobolo CIS	Gravity	286	286	No data			*	Operational
MANAOAG								
1. Carrera CIS	Gravity	301	301	No data			*	Operational
MAPANDAN								
1. Apaya CIS	Gravity	70	70	No data			*	Operational
2. Kapandan-Mangaldan CIS	Gravity	833	250	No data			*	Operational
SAN FABIAN								
1. Balaoen CIS	Gravity	32	32				*	Operational
URDANETA								
1. Anonas Cayambanan CIS	Gravity	216	216	No data			*	Operational
2. Betor CIS	Gravity	149	149	No data			*	Operational
3. Labit CIS	Gravity	228	228	No data			*	Operational
4. Tangal-Americano CIS	Gravity	2000	2000	1300		*		Operational
5. San Vicente CIS	Gravity	151	151	No data			*	Operational
POZORRUBIO								
1. Anolaguid CIS	Gravity	70	70	No data			*	Operational
2. Angalacan CIS	Gravity	0	0	0		*		Not operational
3. Banding CIS	Gravity	225	225	No data			*	Operational
4. Banding I CIS	Gravity	15	15	No data			*	Operational
5. Banding II CIS	Gravity	11	11	No data			*	Operational
6. Bantugan CIS	Gravity	42	0	38	*			Not operational
7. Bato-Batakil CIS	Gravity	55	55	No data			*	Operational
8. Bobonan CIS	Gravity	124	124	No data			*	Operational
9. Bukol CIS	Gravity	32	30	No data			*	Operational
10. Casebacon CIS	Gravity	200	135	No data			*	Operational
11. Calobasa CIS	Gravity	35	35	No data			*	Operational
12. Combenta CIS	Gravity	23	23	No data			*	Operational
13. Cubal CIS	Gravity	50	-	No data			*	Not operational
14. Don Benito CIS	Gravity	75	75	No data			*	Operational

Communal Irrigation System in Pangasinan Province

(4/6)

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category: Amortizing P	Category: Amortizing NP	Category: Non-Amortizing	Remarks
15. Dukot CIS	Gravity	66	66	No data			*	Operational
16. Don Victorio CIS	Gravity	24	24	No data			*	Operational
17. Jimenez CIS	Gravity	61	25	28		*		Operational
18. Laoac CIS	Gravity	101	101	85	*			Operational
19. Lucban CIS	Gravity	68	68	No data			*	Operational
20. Mabeldat CIS	Gravity	34	34	No data			*	Operational
21. Malukiat CIS	Gravity	42.66	22	32		*		Operational
22. Mislang CIS	Gravity	15	15	No data			*	Operational
23. Nama-Inuman CIS	Gravity	640	411	No data			*	Operational
24. Tocok-Baleg CIS	Gravity	100	100	No data			*	Operational
25. Salcedo CIS	Gravity	36	36	No data			*	Operational
26. Solis CIS	Gravity	58	55	No data			*	Operational
27. Villegas CIS	Gravity	180	87	No data			*	Operational
28. Saldivar Dam I CIS	Gravity	75	75	No data			*	Operational
29. Saldiver II CIS	Gravity	49	49	No data			*	Operational
30. Imbalbalatong CIS	Gravity	47	35	No data			*	Operational
31. Dapan CIS	Gravity	59	59	No data			*	Operational
32. Abalos CIS	Gravity	70	50	No data			*	Operational
33. Pugo CIS	Gravity	59	59	No data			*	Operational
34. Sagat CIS	Gravity	100	100	No data			*	Operational
SISON								
1. Alibeng CIS	Gravity	180	180	187		*		Operational
2. Amagbagan CIS	Gravity	316	310	No data			*	Operational
3. Asan CIS	Gravity	189	189	96	*			Operational
4. Asan Norte CIS	Gravity	36	33	No data			*	Operational
5. Binmeckeg CIS	Gravity	789	520	No data			*	Operational
6. Bolaoen Turod CIS	Gravity	20	20	No data			*	Operational
7. Calunetan CIS	Gravity	39	39	No data			*	Operational
8. Bolaoen CIS	Gravity	40	40	No data			*	Operational
9. Bangatan CIS	Gravity	10	10	No data			*	Operational
10. Esperanza CIS	Gravity	200	200	No data			*	Operational
11. Labayug CIS	Gravity	106	42	No data			*	Operational
12. Macao CIS	Gravity	141.32	130	116		*		Operational
13. Ngayao-ngaoan CIS	Gravity	104	104	No data			*	Operational
14. Pindangan CIS	Gravity	70	70	No data			*	Operational
15. Pinmilapil CIS	Gravity	99	90	No data			*	Operational
16. Pinalpal CIS	Gravity	20	20	No data			*	Operational
17. Pacok-Nagtangan CIS	Gravity	117	117	No data			*	Operational
18. Sagunto CIS	Gravity	41	41	No data			*	Operational
19. Tangal Ngalab CIS	Gravity	15	15	No data			*	Operational
20. Bila CIS	Gravity	34	34	No data			*	Operational
21. Macao CIS	Gravity	70	10	No data			*	Operational
22. Anton CIS	Gravity	25	20	No data			*	Operational
23. Ngaab CIS	Gravity	10	10	No data			*	Operational
24. Sapid CIS	Gravity	42	425	No data			*	Operational
25. Bautista CIS	Gravity	110	25	39	*			
BALUNGAO								
1. Matablang CIS	Gravity	222.5	222.5	No data			*	Operational
2. Managus CIS	Gravity	73	73	52	*			Operational
3. Madilap CIS	Gravity	128	128	No data			*	Operational
4. Banila CIS	Gravity	418	418	415	*			Operational
5. Don Joaquin CIS	Gravity	196	196	No data			*	Operational
6. Santos CIS	Gravity	43	43	No data			*	Operational
7. Colas-Pias CIS	Gravity	84	-	No data			*	Not operational
8. Don Isidro CIS	Gravity	64	64	No data			*	Operational
9. Agbayani CIS	Gravity	182	128	No data			*	Operational
10. Sab Joaquin CIS	Gravity	286	286	No data			*	Operational
11. Tamayo CIS	Gravity	40	-	No data			*	Operational
SANTA MARIA								
1. San Vincent CIS	Gravity	54	54	No data			*	Operational
2. Balloy CIS	Gravity	350	350	No data			*	Operational
3. Bangar CIS	Gravity	64	64	No data			*	Operational
4. Pugot-Tantero CIS	Gravity	62	62	No data			*	Operational
5. Don Anejo CIS	Gravity	150	150	No data			*	Operational
6. Mabolo CIS	Gravity	127	127	No data			*	Operational
7. Magsabatan CIS	Gravity	200	200	No data			*	Operational
VILLASIS								
1. Barraca CIS	Gravity	112	112	No data			*	Operational
ROSALES								
1. San Luis CIS	Gravity	124.11	69	69		*		Operational

Communal Irrigation System in Pangasinan Province

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category: Amortizing P	Category: Amortizing NP	Category: Non-Amortizing	Remarks
SAN NICOLAS								
1. Cabarucor-Darangidong CIS	Gravity	60	40	No data			*	Operational
2. Carunungan CIS	Gravity	25	25	No data			*	Operational
3. Calunitan CIS	Gravity	320	320	No data			*	Operational
4. Balungot CIS	Gravity	93	93	No data			*	Operational
5. Siblot CIS	Gravity	49	49	No data			*	Operational
6. Takip CIS	Gravity	600	600	No data			*	Operational
7. Payao CIS	Gravity	12	12	No data			*	Operational
8. Ubol CIS	Gravity	41.78	41.78	No data			*	Operational
9. Capacpacuan CIS	Gravity	61.66	61.66	No data			*	Operational
10. Tangal Martin CIS	Gravity	34.4	34.4	No data			*	Operational
11. Casapangan CIS	Gravity	520	520	No data			*	Operational
12. Marintek CIS	Gravity	510	510	No data			*	Operational
13. Paraspas CIS	Gravity	172.05	172.5	No data			*	Operational
14. Catabongaoan CIS	Gravity	47	47	No data			*	Operational
15. Don Felipe CIS	Gravity	130.92	130.92	No data			*	Operational
16. Don Simon CIS	Gravity	9	9	No data			*	Operational
17. Cabaruan CIS	Gravity	77	77	No data			*	Operational
18. Cadaanan CIS	Gravity	63.41	63.41	No data			*	Operational
19. Pias CIS	Gravity	20	20	No data			*	Operational
20. Tangal Mayor CIS	Gravity	181	160	175	*			Operational
21. Segunda CIS	Gravity	253	200	No data			*	Operational
22. Cameing CIS	Gravity	69.3	69.3	No data			*	Operational
23. Sabangan CIS	Gravity	453	453	No data			*	Operational
24. Alimotong CIS	Gravity	113	113	No data			*	Operational
25. Nangalisa CIS	Gravity	187	187	No data			*	Operational
26. San Bastian CIS	Gravity	64	64	No data			*	Operational
27. Agpay CIS	Gravity	35.44	35.44	17		*		Operational
28. Ventar CIS	Gravity	20	20	No data			*	Operational
SAN MANUEL								
1. Ambuetel CIS	Gravity	7	7	No data			*	Operational
2. Boboaya CIS	Gravity	75	75	No data			*	Operational
3. Cabulandayan I CIS	Gravity	88.4	88.4	No data			*	Operational
4. Cabulandayan II CIS	Gravity	24	24	No data			*	Operational
5. Casilagan CIS	Gravity	31	31	No data			*	Operational
6. Anonas Norte CIS	Gravity	512	512	No data			*	Operational
7. Anonas Sur CIS	Gravity	200	200	No data			*	Operational
8. Anonas Cadaanan Pao CIS	Gravity	34	34	No data			*	Operational
9. Lubas Santa Catalina CIS	Gravity	136	136	No data			*	Operational
10. Mag-sa-da-lem CIS	Gravity	204	204	No data			*	Operational
11. Lapalo CIS	Gravity	461	461	No data			*	Operational
12. Sison Casabar CIS	Gravity	212	212	No data			*	Operational
13. Tacnien Pidpid CIS	Gravity	205	140	No data			*	Partly operational
14. Comering CIS	Gravity	150	150	No data			*	Operational
ASINGAN								
1. Arban CIS	Gravity	998	998	No data			*	Operational
2. Aribar CIS	Gravity	187	187	No data			*	Operational
3. Binituang CIS	Gravity	50	50	No data			*	Operational
4. Capampangan CIS	Gravity	319	319	No data			*	Operational
5. Sinapog CIS	Gravity	414	414	335		*		Operational
6. Sobol Mitura CIS	Gravity	395	395	No data			*	Operational
7. Santa Maria CIS	Gravity	134	134	No data			*	Operational
8. Tangal Pita CIS	Gravity	100	100	No data			*	Operational
9. Toboy-Anchieta CIS	Gravity	88	88	No data			*	Operational
NATIVIDAD								
1. Anglat CIS	Gravity	291	291	No data			*	Operational
2. Arciaga Dam CIS	Gravity	67	67	No data			*	Operational
3. Capulaan CIS	Gravity	52	52	No data			*	Operational
4. Cacasian CIS	Gravity	77	77	No data			*	Operational
5. Cacadongan CIS	Gravity	85	85	No data			*	Operational
6. Cadamortisan CIS	Gravity	88	88	No data			*	Operational
7. Lecud CIS	Gravity	44	44	No data			*	Operational
8. Milagrosa CIS	Gravity	100	100	112	*			Operational
9. Magsabar CIS	Gravity	108	108	No data			*	Operational
10. Palali-Lacab CIS	Gravity	83	83	No data			*	Operational
11. Paronapew CIS	Gravity	39	39	No data			*	Operational
12. Principal CIS	Gravity	477	471	685	*			Operational
13. San Macaris CIS	Gravity	49	49	No data			*	Operational
14. Darat-Grande CIS	Gravity	33	33	No data			*	Operational

Communal Irrigation System in Pangasinan Province

(6/6)

Name of CIS by Municipality	Tyoe of Irrigation	Service Area (ha)	Actual Irrigated Area (ha)	Number of Farmers	Category: Amortizing P	Category: Amortizing NP	Category: Non-Amortizing	Remarks
SAN QUINTIN								
1. Labuan CIS	Gravity	214	214	No data			*	Operational
2. Matacdang CIS	Gravity	85	85	No data			*	Operational
3. Minesicean CIS	Gravity	169	169	No data			*	Operational
4. Baligayan I & II CIS	Gravity	136	136	No data			*	Operational
5. Parasapas CIS	Gravity	49	16	No data			*	Operational
6. Tocson CIS	Gravity	44	44	No data			*	Operational
TAYUNG								
1. Cabaruan-Cacamposan CIS	Gravity	182	182	No data			*	Operational
2. Agno CIS	Gravity	62	62	68	*			Operational
3. Putno CIS	Gravity	214	214	No data			*	Operational
UMINGAN								
1. Borobor CIS	Gravity	25	25	No data			*	Operational
2. Bucasas CIS	Gravity	44	44	No data			*	Operational
3. Cabalitian CIS	Gravity	157	157	No data			*	Operational
4. Calilitan CIS	Gravity	80	80	No data			*	Operational
5. Caloocan CIS	Gravity	90	90	No data			*	Operational
6. Carayungan CIS	Gravity	75	63	42	*			Operational
7. Carosalisan CIS	Gravity	80	80	No data			*	Operational
8. Casilagan CIS	Gravity	63	63	No data			*	Operational
9. Don Justo CIS	Gravity	57	57	No data			*	Operational
10. Kagaoan CIS	Gravity	53	53	No data			*	Operational
11. Lipit CIS	Gravity	48	84	No data			*	Operational
12. Macaina CIS	Gravity	240	240	No data			*	Operational
13. Minesicean CIS	Gravity	74	74	No data			*	Operational
14. Nampalcan CIS	Gravity	67	67	No data			*	Operational
15. Nancalobasaan CIS	Gravity	66	66	No data			*	Operational
16. Nangalisan CIS	Gravity	44	44	No data			*	Operational
17. Nangoltongan CIS	Gravity	82	82	No data			*	Operational
18. Padilla CIS	Gravity	160	160	No data			*	Operational
19. T. Padua CIS	Gravity	167	96	69	*			Operational
20. Polpuguen CIS	Gravity	215	215	No data			*	Operational
21. Papallasen CIS	Gravity	498	498	310	*			Operational
22. Pedring CIS	Gravity	265	265	No data			*	Operational
23. Pemienta CIS	Gravity	303	303	No data			*	Operational
24. Pongwa CIS	Gravity	170	24	153		*		Operational
25. Poblacion CIS	Gravity	88	88	No data			*	Operational
26. San Juan CIS	Gravity	110	97	151	*			Operational
27. Santol CIS	Gravity	105	105	No data			*	Operational
28. Santa Barbara CIS	Gravity	78	78	No data			*	Operational
29. Sinabaan CIS	Gravity	294	294	No data			*	Operational
30. Tangal Boro CIS	Gravity	56	56	No data			*	Operational
31. Tangal-Molina CIS	Gravity	364	364	No data			*	Operational
32. Upper Banila CIS	Gravity	801	801	No data			*	Operational
33. Diket CIS	Gravity	77	40	54	*			Operational
34. Boboaya CIS	Gravity	521	400	350	*			Operational
35. Sicsi CIS	Gravity	150	150	No data			*	Operational
MANGALDAN								
1. David	Gravity	230	70	No data			*	Operational

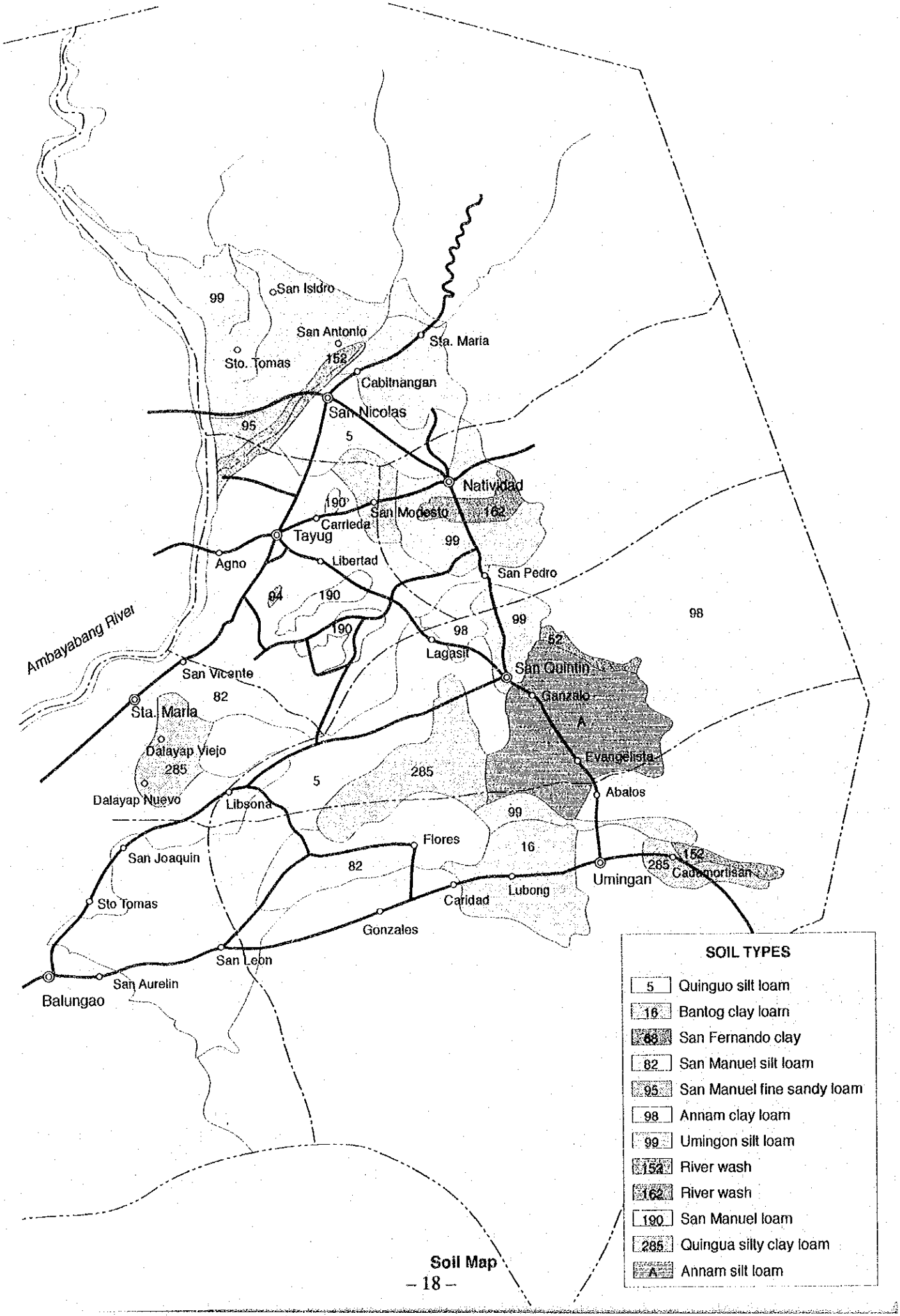
Ambayoan - Dipalo River Irrigation System

(1/1)

	Ambayoan RIS	Dipalo RIS
General Information		
Area		
Service area	4,050 ha	1,963 ha
Actual area irrigated before the earthquake	3,090 ha	1,544 ha
Actual area irrigated after the earthquake	2,986 ha	772 ha
Land and irrigators association		
Total number of lots	6,351	2,139
Total number of landowners	5,491	1,502
Total number of irrigators associations	10	3
Area covered by irrigators association	1,889 ha	1,963 ha
O&M cost per ha		
CY 1990 (before eathquake)	302.26 Pesos	306.33 Pesos
CY 1991 (after earthquake)	246.85 Pesos	842.14 Pesos
Irrigation Activity		
CY 1990 (before eathquake)		
Wet season service area	3,160 ha	1,550 ha
Actual area irrigated	2,986 ha	772 ha
Dry season service area	860 ha	300 ha
Actual area irrigated	495 ha	175 ha
Rice	375 ha	67 ha
Others	320 ha	108 ha
CY 1991 (after earthquake)		
Wet season service area	3,160 ha	750 ha
Dry season service area	860 ha	300 ha
Actual area irrigated	794 ha	117 ha
Rice	254 ha	46 ha
Others	546 ha	71 ha

Population and Number of Household of Barangays Concerned

Municipality	Barangay	Population	Household	Family Size
San Quintin	Alac	2,736	506	5.41
	Bantog	653	110	5.94
	Bolintanguen	1,174	226	5.19
	Cabalaongan	2,109	368	5.73
	Cabangaran	1,024	185	5.54
	Calomboyan	1,686	307	5.49
	Carayacan	1,273	211	6.03
	Casantamarian	1,361	253	5.38
	Gonzalo	1,423	271	5.25
	Lagasit	2,330	450	5.18
	Lumayao	822	149	5.52
	Mabini	839	151	5.56
	Nagapugan	1,086	216	5.03
	San Pedro	971	195	4.98
	Ungib	779	143	5.45
Umingan	Amaronan	904	176	5.14
	Evangelesta	395	81	4.88
Total (Dipalo RIS)		21,565	3,998	5.39
Natividad	Batchelor East	1,097	200	5.49
	Batchelor West	1,005	187	5.37
	Cacandungan	948	179	5.30
	Poblacion East	1,563	297	5.26
	Salud	1,225	241	5.08
Total (Principal CIS)		5,838	1,104	5.29
Grand Total		27,403	5,102	5.37


San Isidro
San Antonio
Sto. Tomas
Sta. Maria
Cabitnangan
San Nicolas
Natividad
San Modesto
Carrieda
Tayug
Agno
Libertad
San Pedro
Ambayabang River
San Vicente
Lagasit
San Quintin
Ganzalo
Sta. Maria
Dalayap Viejo
Evangelista
Dalayap Nuevo
Libsong
Abalos
Flores
San Joaquin
Umingan
Cadormotisan
Sto Tomas
Caridad
Lubong
Gonzales
San Leon
San Aurelin
Balungao
99
152
95
5
190
162
98
94
82
285
16
68
A
SOIL TYPES
5 Quinguo silt loam
16 Bantog clay loam
68 San Fernando clay
82 San Manuel silt loam
95 San Manuel fine sandy loam
98 Annam clay loam
99 Umingon silt loam
152 River wash
162 River wash
190 San Manuel loam
285 Quingua silty clay loam
A Annam silt loam

Soil Map

Monthly Rainfall

Name of station: SANROQUE
Station location: SAN MANUEL, PANGASINAN

unit: mm

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1957	6.6	1.3	64.5	2.5	32.8	497.8	328.8	386.1	673.6	109.0	79.2	3.6	2,185.8
1958	0.3	4.1	0.3	16.8	94.2	592.3	494.0	383.0	629.2	230.1	3.0	1.8	2,449.1
1959	4.6	0.0	8.1	3.6	147.1	90.2	245.6	341.9	168.9	92.5	126.7	5.8	1,235.0
1960	6.1	38.4	30.5	74.2	132.7	294.4	97.8	1,279.4	303.8	125.7	16.5	0.0	2,399.5
1961	0.0	0.0	9.9	7.9	109.7	287.8	433.3	321.3	245.6	191.5	29.0	0.0	1,636.0
1962	0.0	3.0	16.5	59.9	134.6	135.4	1,104.6	399.5	593.1	25.4	33.8	0.0	2,505.8
1963	0.0	0.0	7.6	21.6	35.3	1,147.8	368.8	439.4	644.9	79.2	63.5	46.2	2,854.3
1964	5.1	0.0	7.1	66.5	137.4	280.2	128.5	974.1	250.9	353.3	164.3	82.6	2,450.0
1965	0.0	0.0	0.0	113.0	304.3	249.7	498.9	311.9	541.5	27.4	57.4	0.0	2,104.1
1966	0.0	9.4	5.8	57.1	245.5	202.6	267.4	581.2	744.8	64.5	161.7	17.8	2,357.8
1967	0.0	0.0	0.0	0.0	0.0	-	453.1	476.8	331.8	335.9	0.0	20.3	-
1968	0.0	0.0	1.3	50.8	83.5	18.3	113.1	754.8	424.2	12.8	55.9	0.0	1,514.7
1969	0.0	0.0	0.0	7.6	80.3	287.5	589.4	401.5	437.0	67.1	8.9	5.1	1,884.4
1970	2.5	0.0	8.9	32.8	156.9	197.9	278.0	103.1	347.1	224.7	103.6	23.4	1,478.9
1971	0.0	0.0	0.0	0.0	226.8	293.6	498.3	365.1	384.5	452.6	0.0	18.4	2,239.3
1972	15.6	7.9	14.4	31.7	62.5	207.6	2,990.2	847.7	157.1	45.1	63.5	4.8	4,448.1
1973	0.0	0.0	0.0	0.0	55.0	243.8	158.9	652.3	205.0	440.2	57.1	0.8	1,813.1
1974	1.8	0.0	0.0	119.7	-	-	-	-	43.2	717.8	150.1	36.5	-
1975	0.0	0.0	14.5	56.5	118.4	241.8	141.6	336.5	394.3	170.6	-	26.2	-
1976	0.0	5.1	38.1	50.9	958.5	588.0	202.0	400.8	577.7	80.9	6.1	0.0	2,908.1
1977	1.8	0.0	-	22.9	116.7	185.1	261.4	523.7	515.2	47.8		-	-
1978	0.0	1.5	8.4	9.3	5.6	-	-	-	-	-	-	-	-
MEAN	2.0	3.2	11.2	36.6	154.2	318.0	482.7	514.0	410.2	185.4	62.1	14.7	2,262.6
S.D.	3.74	8.32	15.87	35.42	199.49	249.68	633.70	271.43	193.52	181.96	55.54	21.01	737.34
C.V.	1.86	2.59	1.41	0.97	1.29	0.79	1.31	0.53	0.47	0.98	0.89	1.43	0.33
SKEW	2.597	3.949	2.304	0.978	3.561	2.252	3.611	1.439	-0.040	1.550	0.693	2.081	1.514
C.S													
N	22	22	21	22	21	19	20	20	21	21	19	20	17

Monthly Rainfall

Name of station: DAGUPAN CITY
Station location: DAGUPAN CITY, PANGASINAN

unit: mm

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1947	0.0	0.0	0.8	161.0	72.4	313.7	433.3	468.9	369.1	208.3	340.9	111.0	2,479.4
1948	0.0	6.6	6.9	169.4	87.9	296.9	489.7	991.9	348.2	83.8	6.1	38.1	2,525.5
1949	1.8	6.4	35.8	31.2	117.4	251.7	425.7	332.2	479.3	236.7	47.0	42.4	2,007.6
1950	0.0	8.9	41.2	91.2	97.8	390.9	808.7	780.8	431.8	311.7	9.9	19.8	2,992.7
1951	8.4	15.2	0.0	83.3	159.8	369.8	509.0	738.4	263.1	98.8	16.0	15.2	2,277.0
1952	7.4	13.5	26.9	151.4	169.2	205.0	261.4	527.3	230.1	110.2	38.4	44.4	1,785.2
1953	2.8	1.5	44.4	76.2	197.9	245.9	549.1	600.7	172.2	31.5	176.8	32.5	2,131.5
1954	1.0	33.5	104.6	81.5	116.3	197.6	400.0	424.4	284.5	84.3	180.6	0.0	1,908.3
1955	4.6	0.0	0.0	176.5	141.0	162.6	271.0	288.5	287.8	159.5	37.6	7.1	1,536.2
1956	4.3	41.4	1.0	130.0	214.6	168.9	319.3	317.5	677.9	79.0	172.2	34.3	2,160.4
1957	3.3	0.0	98.3	83.1	82.8	400.8	371.9	355.6	428.2	49.5	31.7	23.4	1,928.6
1958	0.0	3.3	1.5	98.6	20.3	482.3	602.2	260.6	470.4	252.0	6.6	1.0	2,198.8
1959	3.3	0.0	7.6	0.0	279.7	262.9	310.6	430.8	191.0	104.4	31.0	5.6	1,626.9
1960	6.1	51.8	14.0	85.3	394.7	261.4	157.7	1,098.8	240.0	164.6	33.5	1.3	2,509.2
1961	0.0	0.0	2.3	40.1	162.6	652.5	463.5	448.8	347.2	296.7	26.4	0.0	2,440.1
1962	17.8	0.0	9.7	63.0	219.5	124.5	1,223.8	278.9	456.9	31.0	34.5	0.0	2,459.6
1963	0.5	0.3	2.8	1.0	100.3	1,121.9	216.2	243.9	572.8	51.8	54.4	28.4	2,394.3
1964	0.3	0.0	56.2	90.8	235.2	252.7	278.1	886.3	255.4	499.5	99.0	114.6	2,768.1
1965	0.0	0.0	66.1	137.8	352.0	296.3	484.7	339.0	296.2	66.5	16.6	0.0	2,055.2
1966	10.2	1.8	2.3	105.0	687.8	209.3	429.3	344.1	945.9	62.1	118.2	15.0	2,931.0
1967	0.0	0.0	0.0	41.3	78.8	456.1	244.5	677.9	283.8	281.4	69.6	0.0	2,133.4
1968	0.0	0.0	1.0	149.5	131.4	175.2	561.4	1,499.8	373.2	89.0	64.0	0.0	3,044.5
1969	0.0	0.0	0.0	43.8	312.0	260.7	731.8	456.8	336.8	136.1	59.6	5.0	2,342.6
1970	10.2	4.0	9.7	91.9	174.1	534.3	292.5	611.4	292.9	223.3	31.4	16.9	2,292.6
1971	30.3	0.0	0.0	83.7	119.1	447.7	332.7	375.8	179.0	204.2	46.9	31.8	1,851.2
1972	12.5	2.1	29.5	26.4	79.8	295.8	2,659.4	1,273.8	201.4	59.8	2.8	15.7	4,659.0
1973	5.3	12.9	8.7	26.2	250.8	270.9	201.3	494.9	165.6	184.7	36.4	0.0	1,657.7
1974	3.3	0.0	0.0	60.6	256.3	576.2	339.4	1,260.1	125.6	568.5	149.1	9.4	3,348.5
1975	4.7	0.0	33.0	54.6	262.0	173.5	216.1	443.5	279.6	198.3	20.8	10.7	1,696.8
1976	15.5	21.9	19.1	5.6	862.7	630.8	334.0	382.6	498.5	69.0	0.0	0.0	2,839.7
1977	53.0	0.0	11.0	70.0	101.0	194.0	304.0	507.0	543.0	31.0	248.0	0.0	2,062.0
1978	0.0	0.0	0.0	46.0	155.0	308.0	488.0	1,075.0	308.0	204.0	76.0	1.0	2,661.0
1979	0.0	0.0	0.0	70.0	439.0	127.0	236.0	759.0	224.0	216.0	6.0	3.0	2,080.0
1980	1.0	3.3	24.1	5.5	201.1	233.9	703.7	162.2	391.0	56.5	109.8	4.2	1,896.3
1981	0.7	4.4	0.0	40.1	116.4	534.6	417.5	694.2	167.8	133.8	196.4	1.4	2,307.3
1982	0.0	0.8	1.1	163.5	178.4	248.1	690.1	522.9	128.2	86.2	0.2	46.7	2,066.2
1983	13.1	0.2	0.2	0.4	61.3	84.9	114.9	692.0	223.8	111.6	37.2	7.2	1,346.8
1984	8.2	0.0	20.8	91.4	131.7	312.1	222.6	1,067.0	217.4	328.5	7.7	1.0	2,408.4
1985	0.0	3.2	20.2	99.5	136.7	995.2	155.6	678.0	386.4	189.8	39.6	0.8	2,705.0
1986	21.7	28.4	13.0	0.0	202.6	116.5	905.2	646.0	547.5	51.3	64.8	16.3	2,613.3
1987	0.0	0.0	11.0	11.4	61.6	-	319.2	-	-	-	-	-	-
MEAN	6.1	6.5	17.7	74.1	200.5	341.1	475.0	610.9	340.5	160.1	68.6	17.6	2,328.2
S.D.	10.15	12.15	25.37	51.26	161.98	219.64	414.96	319.58	164.81	121.11	75.77	26.34	581.68
C.V.	1.66	1.88	1.43	0.69	0.81	0.64	0.87	0.52	0.48	0.76	1.10	1.49	0.25
SKEW	3.016	2.411	2.097	0.342	2.512	1.931	3.948	1.037	1.493	1.580	1.838	2.535	1.646
C.S													
N	41	41	41	41	41	40	41	40	40	40	40	40	40

Monthly Evaporation

Name of station: SAN MANUEL
Station location: SAN MANUEL, PANGASINAN

unit: mm

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1957	191.4	198.7	241.5	275.2	315.2	164.9	162.6	141.0	151.0	165.8	158.6	190.4	2,356.3
1958	229.9	203.7	293.1	313.4	280.2	140.8	147.3	164.1	123.2	145.3	171.6	207.3	2,419.9
1959	205.5	235.2	291.9	311.9	256.0	233.1	168.2	140.5	155.4	178.6	176.0	203.7	2,556.0
1960	211.8	222.2	264.6	234.4	226.1	155.4	169.4	122.2	129.3	153.7	193.0	186.7	2,268.8
1961	242.6	221.2	257.1	283.7	192.3	144.0	106.7	121.2	108.5	106.2	133.4	147.1	2,064.0
1962	165.1	203.4	224.8	203.5	201.7	155.2	105.7	121.4	96.0	134.6	146.6	174.5	1,932.5
1963	180.1	198.1	179.8	256.5	254.8	114.8	106.4	124.0	97.0	141.2	140.5	145.8	1,939.0
1964	172.0	228.8	253.0	269.0	191.8	121.7	142.5	111.8	112.8	121.2	84.1	120.7	1,929.4
1965	144.5	153.9	204.0	197.0	197.2	145.5	151.4	149.1	128.8	164.6	136.1	171.1	1,943.2
1966	162.9	195.5	282.2	269.9	215.3	128.5	146.1	166.4	114.6	170.1	113.6	137.5	2,102.6
1967	174.2	225.4	286.6	269.4	290.1	135.3	167.1	118.3	142.6	167.6	158.0	199.0	2,333.6
1968	211.5	218.2	290.5	279.3	251.1	156.0	132.2	115.5	122.9	122.6	136.0	128.2	2,164.0
1969	145.4	190.0	236.7	245.6	260.2	145.6	144.9	170.5	106.8	116.6	120.7	136.8	2,019.8
1970	153.9	158.9	197.9	232.8	172.6	131.3	118.6	120.4	106.3	126.8	106.1	108.1	1,733.7
1971	-	-	-	-	-	-	-	-	-	-	-	-	-
MEAN	185.1	203.8	250.3	260.1	236.0	148.0	140.7	134.7	121.1	143.9	141.0	161.2	2,125.9
S.D.	31.11	24.42	37.77	34.81	42.80	28.27	23.34	20.43	18.75	23.17	29.38	33.14	232.59
C.V.	0.17	0.12	0.15	0.13	0.18	0.19	0.17	0.15	0.15	0.16	0.21	0.21	0.11
SKEW	0.433	-0.907	-0.520	-0.334	0.272	2.195	-0.408	0.752	0.537	-0.059	-0.122	-0.032	0.284
C.S													
N	14	14	14	14	14	14	14	14	14	14	14	14	14

Monthly Runoff

Name of station: AMBAYOAN R. B GAUSING STATION
Station location: STA. MARIA, SAN NICOLAS, PANGASINAN
Drainage area: 291 sq.km.

unit: cms

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1958	-	-	-	-	-	21.05	20.22	26.92	37.31	17.06	7.41	6.97	-
1959	5.06	3.98	3.74	3.11	5.15	2.94	9.55	19.14	21.73	13.03	14.05	7.12	9.05
1960	3.34	2.70	2.53	1.87	2.37	5.49	6.99	109.06	26.25	27.02	12.43	7.35	17.28
1961	4.58	3.17	3.64	2.74	3.42	24.12	135.02	26.89	23.54	15.97	6.18	3.24	21.04
1962	3.00	2.92	2.67	2.97	2.84	5.54	82.25	38.14	56.79	26.92	12.19	7.08	20.28
1963	4.68	3.84	3.23	3.28	3.56	56.16	43.54	39.43	60.72	15.15	11.29	6.74	20.97
1964	6.38	5.44	3.66	3.35	6.98	10.70	9.83	72.41	40.86	46.24	23.10	15.93	20.41
1965	7.36	4.03	3.58	3.86	6.28	15.84	53.07	26.88	33.53	19.79	10.06	6.94	15.94
1966	4.32	3.10	2.75	2.31	37.80	32.80	44.50	67.35	92.65	20.85	21.11	12.86	28.53
1967	7.50	7.77	6.60	9.73	6.67	51.41	24.73	82.40	61.47	71.51	26.12	12.51	30.70
1968	8.44	7.00	5.04	3.88	6.62	5.48	19.72	88.65	110.11	34.72	13.04	6.64	25.78
1969	3.51	4.32	3.92	3.31	2.52	4.97	35.54	73.30	57.00	25.18	7.67	3.28	18.71
1970	3.12	2.08	2.16	1.77	2.41	12.66	15.62	34.70	53.76	30.03	13.45	8.26	15.00
1971	5.74	5.07	4.46	3.69	4.64	14.32	36.30	41.96	31.24	56.89	14.13	7.31	18.81
1972	7.07	7.48	5.23	4.26	7.12	12.14	234.33	122.81	30.71	9.20	3.65	3.40	37.28
1973	4.18	2.55	2.52	1.69	3.09	4.92	7.63	14.97	13.53	52.07	11.11	3.49	10.15
1974	2.68	2.40	2.11	3.60	3.02	27.95	23.11	86.19	24.79	94.33	30.07	4.81	25.42
1975	2.66	2.32	2.55	1.45	2.10	2.59	2.39	14.85	15.26	21.28	8.92	2.59	6.58
1976	2.19	1.97	1.90	2.03	-	17.12	-	53.22	63.02	57.12	55.76	24.19	-
1977	18.66	9.87	4.14	2.19	1.77	2.10	23.60	42.84	-	-	-	-	-
MEAN	5.50	4.32	3.50	3.22	6.02	16.52	43.58	54.11	44.96	34.44	15.88	7.93	20.11
S.D.	3.69	2.25	1.22	1.79	8.15	15.48	55.85	31.86	25.77	22.77	11.86	5.29	7.91
C.V.	0.67	0.52	0.35	0.56	1.35	0.94	1.28	0.59	0.57	0.66	0.75	0.67	0.39
SKEW	2.710	1.151	0.921	2.815	3.881	1.505	2.655	0.654	1.094	1.271	2.349	1.871	0.304
C.S													
N	19	19	19	19	18	20	19	20	19	19	19	19	17

Water Requirement by 10 Days

Month	Unit	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	11	11	11	12	12	12	1	1	1	2	2	2	3	3	3
10 days		6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1	9.2	9.3	10.1	10.2	10.3	11.1	11.2	11.3	12.1	12.2	12.3	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3
Overall Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.47	0.47	0.47	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Unit Water Requirement																															
Paddy (wet)	mm/day	0.74	0.80	2.47	0.42	1.86	1.98	3.26	3.63	4.11	3.61	3.50	1.89	0.93																	
Paddy (dry)	mm/day															0.22	3.30	4.19	5.09	4.63	5.68	5.95	7.71	7.84	6.82	6.62	5.32	3.93	2.74	1.30	
Corn	mm/day																1.69	2.18	2.77	3.03	3.49	3.95	5.03	5.33	5.31	5.55	4.59	3.62	2.95	1.87	0.83
Onion	mm/day																1.57	2.01	2.54	2.76	3.27	3.73	4.73	4.95	4.96	5.20	4.27	3.30	2.62	1.64	0.76
Peanut	mm/day																1.95	2.51	3.13	3.49	4.05	4.52	5.60	5.75	5.68	5.94	4.90	3.82	3.05	1.91	0.88

Dipalo RIS

Cropping Area (ha)	
Paddy (wet)	1,548
Paddy (dry)	237
Corn	
Onion	112
Peanut	98

Water Requirement																															
Paddy (wet)	cu.m/s	0.27	0.29	0.89	0.15	0.67	0.71	1.17	1.30	1.47	1.29	1.25	0.68	0.36																	
Paddy (dry)	cu.m/s															0.01	0.21	0.27	0.32	0.30	0.36	0.38	0.49	0.50	0.44	0.42	0.34	0.25	0.17	0.08	
Corn	cu.m/s																														
Onion	cu.m/s																0.05	0.06	0.08	0.08	0.10	0.11	0.14	0.15	0.15	0.16	0.13	0.10	0.08	0.05	0.02
Peanut	cu.m/s																0.05	0.07	0.08	0.09	0.11	0.12	0.15	0.15	0.15	0.16	0.13	0.10	0.08	0.05	0.02
Total-Dipalo	cu.m/s	0.27	0.29	0.89	0.15	0.67	0.71	1.17	1.30	1.47	1.29	1.25	0.68	0.36		0.01	0.31	0.39	0.48	0.47	0.57	0.61	0.78	0.80	0.73	0.74	0.60	0.45	0.33	0.18	0.05

Principal CIS

Cropping Area (ha)	
Paddy (wet)	770
Paddy (dry)	370
Corn	167
Onion	139
Peanut	

Water Requirement																															
Paddy (wet)	cu.m/s	0.13	0.14	0.44	0.07	0.33	0.35	0.58	0.65	0.73	0.64	0.62	0.34	0.18																	
Paddy (dry)	cu.m/s															0.02	0.33	0.42	0.51	0.46	0.57	0.59	0.77	0.78	0.68	0.66	0.53	0.39	0.27	0.13	
Corn	cu.m/s																0.08	0.10	0.12	0.14	0.16	0.18	0.23	0.24	0.24	0.25	0.21	0.16	0.13	0.08	0.04
Onion	cu.m/s																0.06	0.08	0.10	0.10	0.12	0.14	0.18	0.19	0.19	0.19	0.16	0.12	0.10	0.06	0.03
Peanut	cu.m/s																														
Total -Principal	cu.m/s	0.13	0.14	0.44	0.07	0.33	0.35	0.58	0.65	0.73	0.64	0.62	0.34	0.18		0.02	0.46	0.59	0.73	0.70	0.84	0.91	1.17	1.21	1.10	1.10	0.90	0.68	0.50	0.27	0.07

Cropping Area of Paddy in Barangays of Dipalo RIS (1988 - 1992)

Municipality	Barangay	1988		1989		1990		1991		1992	
		Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
San Quintin	Alac	132		132		132		37	95	37	95
	Bantog	100		100		86	14		100		100
	Bolintanguen										
	Cabalaoangan	414		414		407	7	26	388	26	388
	Cabangaran	285		285		273	12		285		285
	Calomboyan										
	Carayacan	371		371		354	17	60	311	60	311
	Casantamarian	349		349		342	7		349		349
	Gonzalo	385		385		340	45	4	381	4	381
	Lagasit										
	Lumayao										
	Mabini										
	Nagapugan	285		285		278	7	7	278	7	278
	San Pedro	442		442		436	6	224	218	224	218
	Ungib										
Umingan	Amaronan										
	Evangelesta										
Total (Dipalo RIS)		2,763		2,763		2,648	115	358	2,405	358	2,405
% to Max.		100%		100%		96%	4%	13%	87%	13%	87%

Cropping Area, Yield and Production of Paddy in Barangays of Principal CIS (1988 - 1992)

Municipality	Barangay	Paddy-Cropping area (ha)					Paddy-Yield (ton/ha)					Paddy-Production (ton)				
		1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
Natividad	Batchelor East	163.0	163.0	80.0	73.0	35.0	3.00	3.50	3.00	2.75	2.20	489.0	570.5	240.0	200.8	77.0
	Batchelor West	78.0	78.0	35.0	27.0	18.0	3.20	3.50	2.80	2.50	2.10	249.6	273.0	98.0	67.5	37.8
	Cacandungan	180.0	180.0	85.0	72.0	60.0	3.25	3.50	3.25	2.80	2.40	585.0	630.0	276.3	201.6	144.0
	Poblacion East	93.0	93.0	45.0	32.0	24.0	3.30	3.40	2.50	2.00	2.00	306.9	316.2	112.5	64.0	48.0
	Salud	188.0	187.0	92.0	71.0	56.0	3.25	3.50	3.00	2.25	2.00	611.0	654.5	276.0	159.8	112.0
Total (Principal CIS)		702.0	701.0	337.0	275.0	193.0	3.19	3.49	2.98	2.52	2.17	2,241.5	2,444.2	1,002.8	693.6	418.8
% to Max.		100%	100%	48%	39%	27%	92%	100%	85%	72%	62%	92%	100%	41%	28%	17%

GEO-RESISTIVITY SURVEY DATA

DIPALO RIS STA. 1+250

NO.	POINT	DISTANCE FROM BASE LINE	EXISTING ELEVATION	DEPTH	ROCK FOUNDATION ELEVATION
1	B.L	0.0	180.10	17.1	163.00
2	R-1	10.0	180.30	18.4	161.90
3	R-2	20.0	180.00	18.3	161.70
4	R-3	30.0	179.50	18.0	161.50
5	R-4	40.0	179.30	17.3	162.00
6	R-5	55.0	179.30	16.3	163.00
7	R-6	70.0	179.80	13.5	166.30
8	R-7	85.0	178.60	5.9	172.70
9	R-8	100.0	179.60	1.1	178.50
10	L-1	10.0	179.60	16.1	163.50
11	L-2	20.0	179.80	16.0	163.80
12	L-3	30.0	179.70	15.9	163.80
13	L-4	45.0	180.60	15.6	165.00
14	L-5	60.0	179.90	11.6	168.30
15	L-6	75.0	181.20	4.7	176.50

NOTE: ALL DISTANCE AND ELEVATION ARE IN METERS

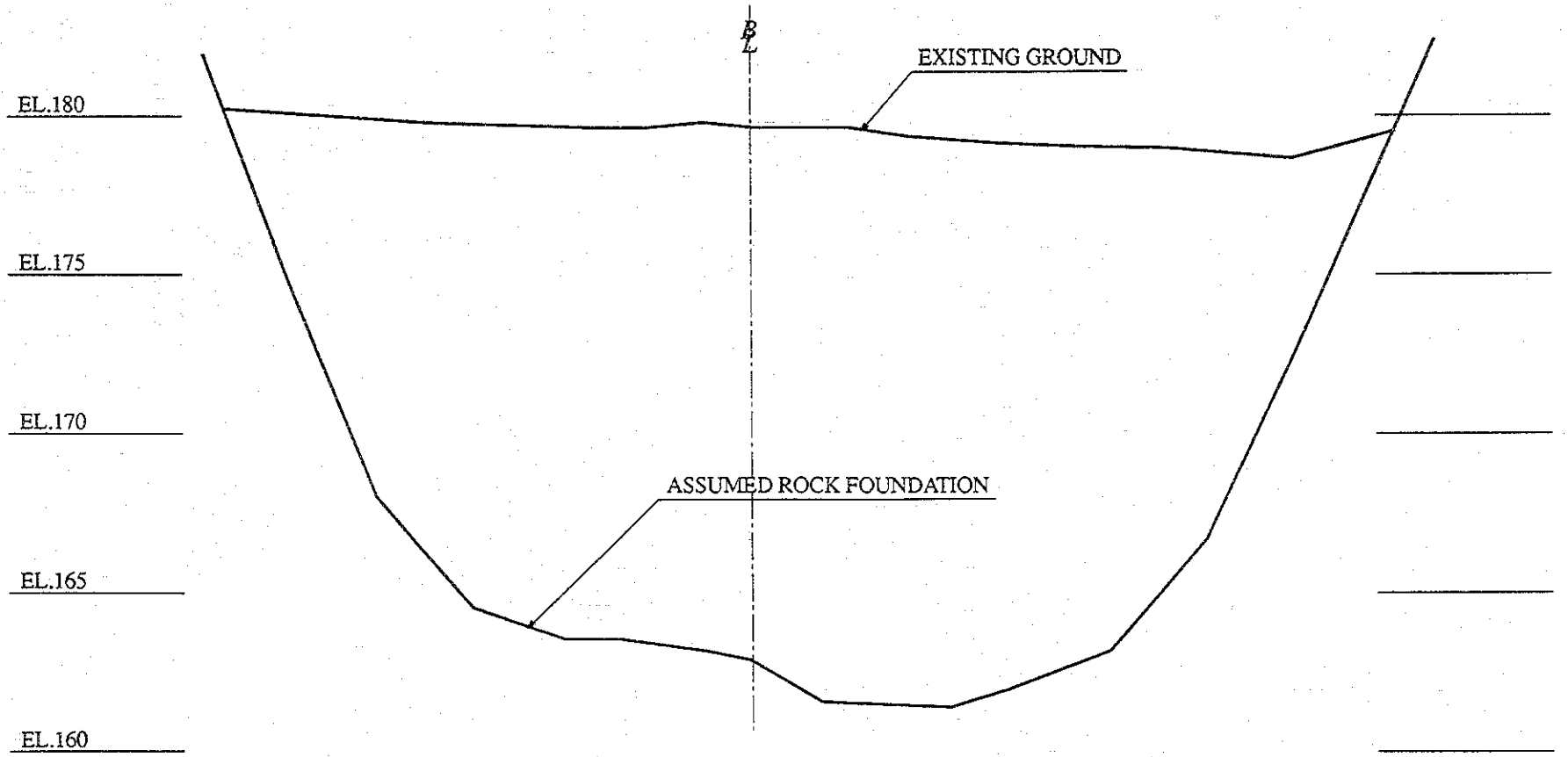
GEO-RESISTIVITY SURVEY DATA

PRINCIPAL CIS STA. 0+900

NO.	POINT	DISTANCE FROM BASE LINE	EXISTING ELEVATION	DEPTH	ROCK FOUNDATION ELEVATION
1	B.L	0.0	118.70	15.4	103.30
2	R-1	15.0	118.90	16.7	102.20
3	R-2	30.0	118.40	16.5	101.90
4	R-3	45.0	117.40	16.0	101.40
5	R-4	60.0	117.70	14.7	103.00
6	R-5	75.0	116.60	10.8	105.80
7	R-6	82.0	116.90	5.9	111.00
8	L-1	5.0	118.40	15.1	103.30
9	L-2	20.0	118.60	15.1	103.50
10	L-3	35.0	118.50	15.0	103.50
11	L-4	50.0	118.50	15.1	103.40
12	L-5	65.0	119.00	15.5	103.50
13	L-6	80.0	118.90	14.3	104.60
14	L-7	95.0	118.40	9.9	108.50
15	L-8	110.0	119.00	6.7	112.30

NOTE: ALL DISTANCE AND ELEVATION ARE IN METERS

GEO-RESISTIVITY MAP

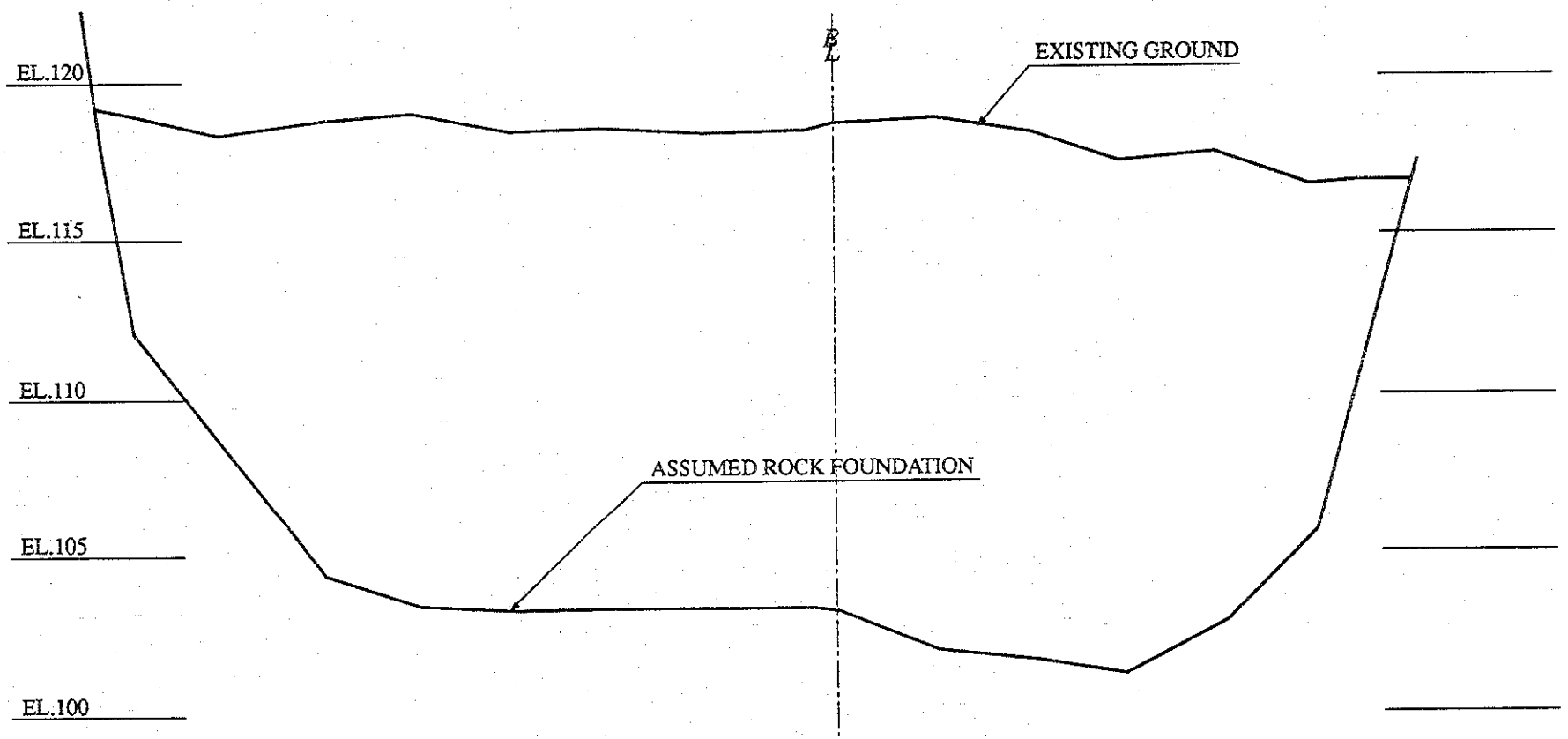


DIPALO RIS

STA. 0 + 250

S= H = 1 : 1,000 / V = 1 : 200

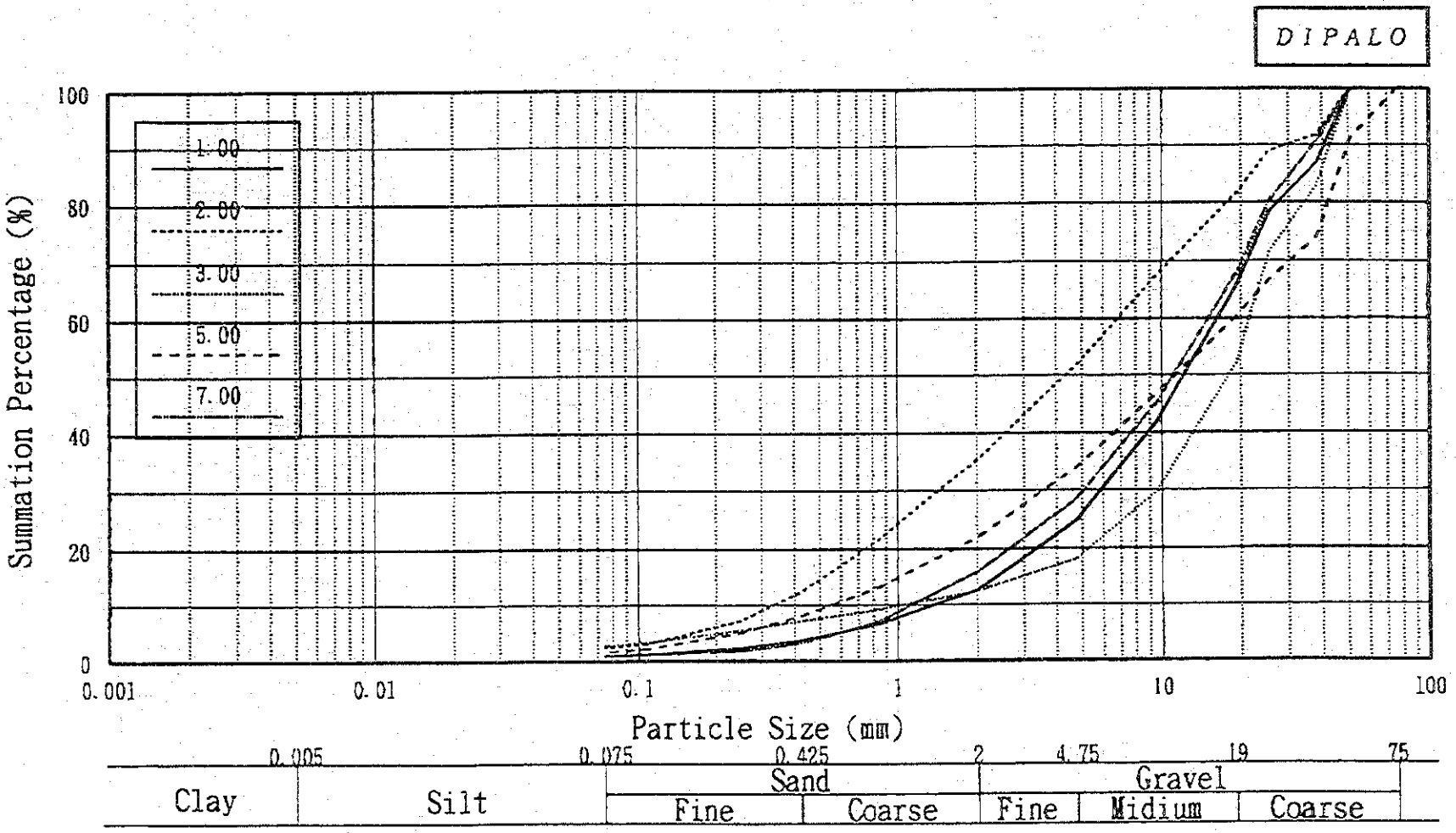
GEO-RESISTIVITY MAP



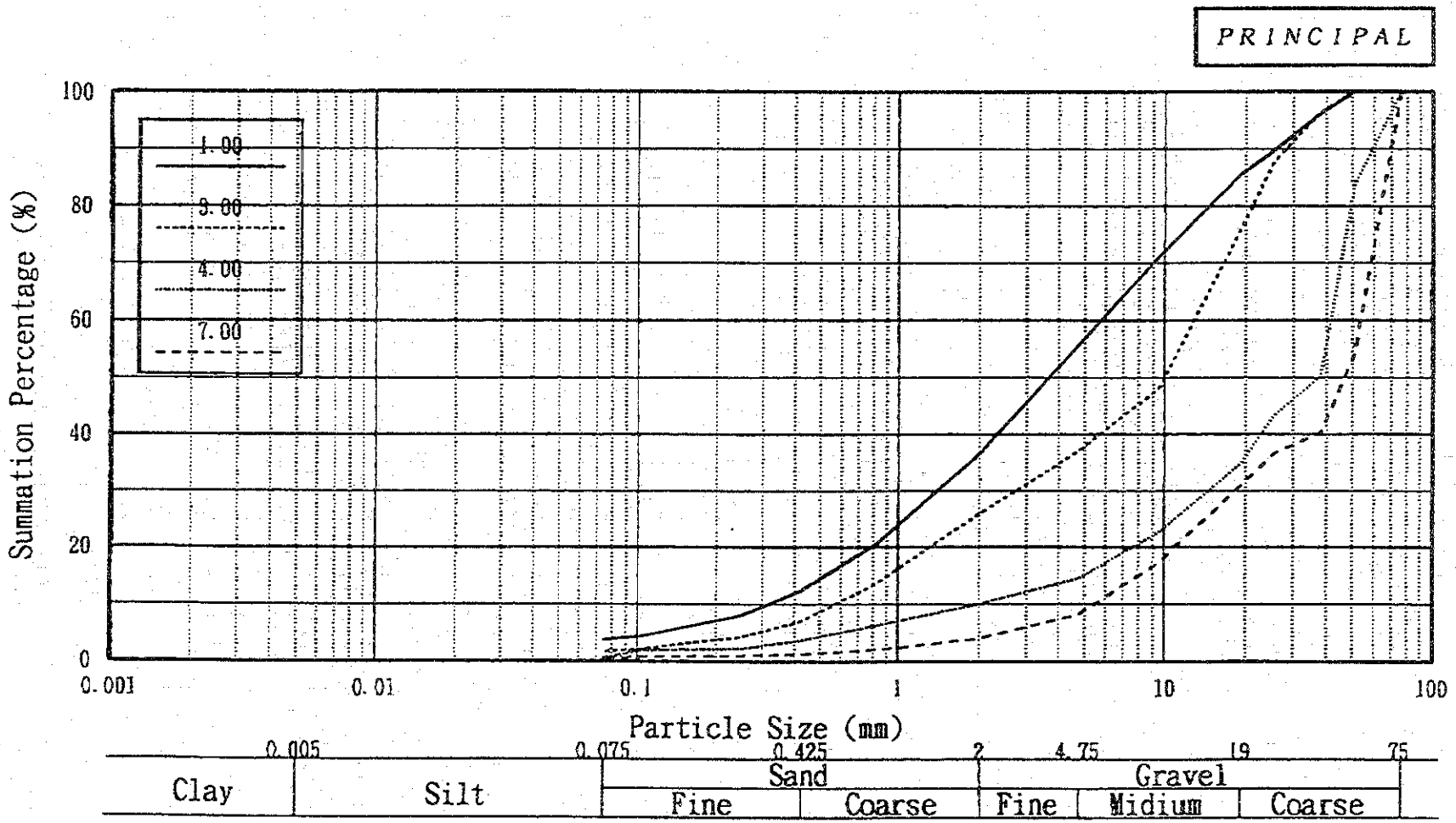
PRINCIPAL CIS

STA. 0 + 900

S= H = 1 : 1,000 / V = 1 : 200



Grain Size Accumulation Curve



Grain Size Accumulation Curve

Crop Production under With- and Without-Project Conditions

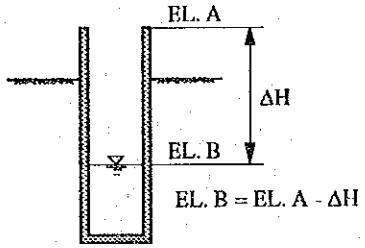
Crop	Status of project	Area (ha)	Yield (t/ha)	Production (ton)
Dipalo RIS				
Wet season				
Rice	without	387	3.20	1,238
	with	1,548	4.15	6,424
Dry season				
Rice	without	5	3.20	16
	with	237	4.15	984
Legume	without	2	0.85	2
(Peanut)	with	98	1.40	137
Onion	without	3	2.50	8
	with	112	3.00	336
Principal CIS				
Wet season				
Rice	without	208	3.20	666
	with	770	4.15	3,196
Dry season				
Rice	without	5	3.20	16
	with	370	4.15	1,536
Corn	without	2	2.85	6
	with	167	3.20	534
Onion	without	2	2.50	5
	with	139	3.00	417
Total Production				
Rice	without	605	3.20	1,936
	with	2,925	4.15	12,140
	Increment	2,320		10,204
Legume	without	2	0.85	2
(Peanut)	with	98	1.40	137
	Increment	96		135
Corn	without	2	2.85	6
	with	167	3.20	534
	Increment	165		528
Onion	without	5	2.50	13
	with	251	3.00	753
	Increment	246		740

Crop Production Value under With- and Without-Project Conditions

Crop	Status of project	Area (ha)	Yield (t/ha)	Unit price (P/ton)		Gross value (P/ha)		Production cost (P/ha)		Net value (P/ha)		Net return (P'000)	
				Financial	Economic	Financial	Economic	Financial	Economic	Financial	Economic	Financial	Economic
Dipalo RIS													
Wet season													
Rice	without	387	3.20	4,235	5,235	13,552	16,752	5,125	5,540	8,427	11,212	3,261	4,339
	with	1,548	4.15	4,235	5,235	17,575	21,725	5,125	5,540	12,450	16,185	19,273	25,055
Dry season													
Rice	without	5	3.20	4,235	5,235	13,552	16,752	5,145	5,560	8,407	11,192	42	56
	with	237	4.15	4,235	5,235	17,575	21,725	5,145	5,560	12,430	16,165	2,946	3,831
Legume (Peanut)	without	2	0.85	10,000	10,000	8,500	8,500	2,810	2,840	5,690	5,660	11	11
	with	98	1.40	10,000	10,000	14,000	14,000	2,810	2,840	11,190	11,160	1,097	1,094
Onion	without	3	2.50	8,000	8,000	20,000	20,000	3,985	4,225	16,015	15,775	48	47
	with	112	3.00	8,000	8,000	24,000	24,000	3,985	4,225	20,015	19,775	2,242	2,215
Sub-total	without	397										3,363	4,454
	with	1,995										25,557	32,194
	Increment	1,598										22,195	27,741
Principal CIS													
Wet season													
Rice	without	208	3.20	4,235	5,240	13,552	16,768	4,000	4,270	9,552	12,498	1,987	2,600
	with	770	4.15	4,235	5,240	17,575	21,746	4,000	4,270	13,575	17,476	10,453	13,457
Dry season													
Rice	without	5	3.20	4,235	5,240	13,552	16,768	3,680	3,915	9,872	12,853	49	64
	with	370	4.15	4,235	5,240	17,575	21,746	3,680	3,915	13,895	17,831	5,141	6,597
Corn	without	2	2.85	3,063	3,063	8,730	8,730	3,095	3,230	5,635	5,500	11	11
	with	167	3.20	3,063	3,063	9,802	9,802	3,095	3,230	6,707	6,572	1,120	1,097
Onion	without	2	2.50	8,000	8,000	20,000	20,000	3,985	4,225	16,015	15,775	32	32
	with	139	3.00	8,000	8,000	24,000	24,000	3,985	4,225	20,015	19,775	2,782	2,749
Sub-total	without	217										2,079	2,706
	with	1,446										19,496	23,900
	Increment	1,229										17,417	21,194
Total	without	614										5,442	7,160
	with	3,441										45,054	56,095
	Increment	2,827										39,611	48,935

Groundwater Level Observation Record
for
Rehabilitation Project for Dipalo RIS and Principal CIS

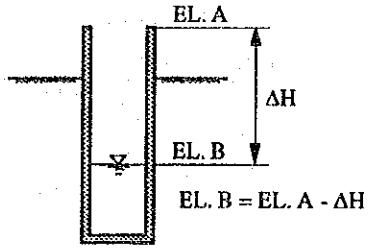
Site:	DIPALO RIVER
Observer:	SOTERO B. PADUA
Year:	1993
Month:	DECEMBER



Date	Time	Weather	Elevation-A (m)	Depth ΔH (m)	Elevation-B (m)	Remarks
1	9:00	Fair	182.471	2.41	180.061	
2	9:02	Fair		2.44	180.031	
3	9:11	Fair		2.44	180.031	
4	8:53	Fair		2.43	180.041	
5	9:00	Fair		2.42	180.051	
6	9:05	Fair		2.40	180.071	
7	9:00	Fair		2.37	180.101	
8	9:15	Fair		2.38	180.091	
9	9:03	Fair		2.40	180.071	
10	8:57	Fair		2.40	180.071	
11	8:51	Fair		2.40	180.071	
12	9:00	Fair		2.43	180.041	
13	9:18	Fair		2.43	180.041	
14	9:04	Fair		2.43	180.041	
15	8:50	Fair		2.43	180.041	
16	9:00	Fair		2.44	180.031	
17	9:05	Fair		2.46	180.011	
18	9:15	Fair		2.48	179.991	
19	9:07	Fair		2.47	180.001	
20	9:10	Fair		2.46	180.011	
21	8:51	Fair		2.45	180.021	
22	8:45	Fair		2.43	180.041	
23	9:13	Fair		2.44	180.031	
24	9:07	w/rain shower		2.47	180.001	
25	9:15	Fair		2.49	179.981	
26	9:10	Fair		2.50	179.971	
27	9:00	Fair		2.49	179.981	
28	9:21	Fair		2.48	179.991	
29	9:24	Fair		2.48	179.991	
30	9:00	w/rain shower		2.48	179.991	
31	9:05	Fair		2.48	179.991	

Groundwater Level Observation Record
for
Rehabilitation Project for Dipalo RIS and Principal CIS

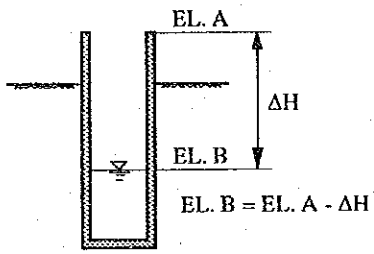
Site:	DIPALO RIVER
Observer:	SOTERO B. PADUA
Year:	1994
Month:	JANUARY



Date	Time	Weather	Elevation-A (m)	Depth ΔH (m)	Elevation-B (m)	Remarks
1	9:35	Fair	182.471	2.48	179.991	
2	9:05	Fair		2.48	179.991	
3	8:50	Fair		2.48	179.991	
4	8:55	Fair		2.48	179.991	
5	9:00	Fair		2.50	179.971	
6	9:11	w/rain shower		2.51	179.961	
7	9:24	- do -		2.53	179.941	
8	9:05	Cloudy		2.55	179.921	
9	9:15	Cloudy		2.45	180.021	
10	9:10	Fair		2.31	180.161	
11	9:00	w/rain shower		2.49	179.981	
12	8:45	Fair		2.39	179.081	
13	8:55	Fair		2.40	179.071	
14	9:00	Fair		2.47	180.001	
15	9:16	Fair		2.51	179.961	
16	9:20	Fair		2.51	179.961	
17	9:05	Fair		2.53	179.941	
18	9:18	Fair		2.54	179.931	
19	9:03	Fair		2.54	179.931	
20	8:55	Fair		2.54	179.931	
21	9:10	Fair		2.55	179.921	
22	9:20	Fair		2.54	179.931	
23	9:30	Fair		2.55	179.921	
24	9:05	Fair		2.55	179.921	
25	9:15	Fair		2.54	179.931	
26	9:00	Cloudy		2.53	179.941	
27	9:07	cloudy w/rain shower		2.40	179.071	
28	8:00	Cloudy		2.43	179.041	
29	9:14	Cloudy		2.45	180.021	
30	9:18	Cloudy		2.50	179.971	
31	9:00	Fair		2.56	179.911	

Groundwater Level Observation Record
for
Rehabilitation Project for Dipalo RIS and Principal CIS

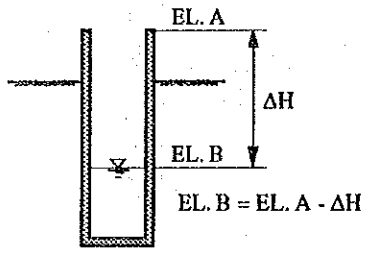
Site:	PRINCIPAL CIS
Observer:	MR. GUILLERMO BARCENA
Year:	1993
Month:	DECEMBER



Date	Time	Weather	Elevation-A (m)	Depth ΔH (m)	Elevation-B (m)	Remarks
1	9:00	Sunny	121.53	3.72	117.81	
2	9:00	- do -		3.72	117.81	
3	9:00	- do -		3.72	117.81	
4	9:00	Cloudy		3.71	117.82	
5	9:00	Sunny		3.71	117.82	
6	9:00	- do -		3.70	117.83	
7	9:00	Cloudy		3.70	117.83	
8	9:00	Sunny		3.68	117.85	
9	9:00	Cloudy		3.67	117.86	
10	9:00	- do -		3.63	117.90	
11	9:00	Rainshower		3.64	117.89	
12	9:00	Rainy		3.60	117.93	
13	9:00	Cloudy		3.62	117.91	
14	9:00	- do -		3.62	117.91	
15	9:00	Rainy		3.62	117.91	
16	9:00	Cloudy		3.67	117.86	
17	9:00	- do -		3.67	117.86	
18	9:00	Sunny		3.67	117.86	
19	9:00	- do -		3.68	117.85	
20	9:00	- do -		3.68	117.85	
21	9:00	- do -		3.68	117.85	
22	9:00	- do -		3.68	117.85	
23	9:00	- do -		3.69	117.84	
24	9:00	- do -		3.70	117.83	
25	9:00	- do -		3.70	117.83	
26	9:00	- do -		3.72	117.81	
27	9:00	Cloudy		3.73	117.80	
28	9:00	Sunny		3.73	117.80	
29	9:00	- do -		3.73	117.80	
30	9:00	- do -		3.73	117.80	
31	9:00	- do -		3.74	117.79	

Groundwater Level Observation Record
for
Rehabilitation Project for Dipalo RIS and Principal CIS

Site:	PRINCIPAL CIS
Observer:	MR. GUILLERMO BARCENA
Year:	1994
Month:	JANUARY



Date	Time	Weather	Elevation-A (m)	Depth ΔH (m)	Elevation-B (m)	Remarks
1	9:00	Sunny	121.53	3.74	117.79	
2	9:00	- do -		3.74	117.79	
3	9:00	- do -		3.75	117.78	
4	9:00	- do -		3.75	117.78	
5	9:00	- do -		3.75	117.78	
6	9:00	- do -		3.76	117.77	
7	9:00	- do -		3.76	117.77	
8	9:00	- do -		3.76	117.77	
9	9:00	Cloudy		3.77	117.76	
10	9:00	Sunny		3.77	117.76	
11	9:00	- do -		3.77	117.76	
12	9:00	- do -		3.77	117.76	
13	9:00	- do -		3.77	117.76	
14	9:00	- do -		3.77	117.76	
15	9:00	- do -		3.77	117.76	
16	9:00	- do -		3.78	117.75	
17	9:00	- do -		3.78	117.75	
18	9:00	- do -		3.78	117.75	
19	9:00	- do -		3.78	117.75	
20	9:00	- do -		3.78	117.75	
21	9:00	- do -		3.78	117.75	
22	9:00	- do -		3.79	117.74	
23	9:00	- do -		3.79	117.74	
24	9:00	- do -		3.79	117.74	
25	9:00	- do -		3.79	117.74	
26	9:00	- do -		3.80	117.73	
27	9:00	- do -		3.80	117.73	
28	9:00	- do -		3.80	117.73	
29	(Not yet submitted by the reader)					
30						
31						