BOREHOLE LOG

PROJECT	ILOCOS NORTE IRRIGATION PROJECT					SITE	PAPA DAMSITE		
HOLE NO. DDH - 2	ELEVATION		ANGLE	VERTICAL	MACHINE		BEGUN		SITE ENGINEER	
	DEPTH	14.10 m	BIT		PUMP		COMPLETED		FOREMAN	
	DIAMETER		GW LEVEL		ENGINE		DAYS REQUIRED		DRILLER	

DATE	ELEVAT'N	DEPTH	THICK'S	LOG	TERMINO'Y	COLOR	MAX. CORE: 20 40 60 80 / NO. OF CORE 10 20 30 40	RECOVERY (%) 20 40 60 80	DRILL SPEED (h/m) 1 2 3	PERMEABILITY K in CGS/ LUGEON 10 1	DESCRIPTIONS
		0.00	0.00								
					OVERBURDEN						
		1.30	1.30			white blue					
		5.00			DIORITE	milk white					
		10.00									
		14.10				white blue					

0.00 - 1.30 M
OVERBURDEN
(River deposite)

1.30 - 3.55 M
Rock itself is hard
Core recovered is brocken and under gravel - like.

3.55 - 13.00 M
Core recovered is soft.
Some sections are study recovery.

13.00 - 14.10 M
Rock itself is hard.
Core recovered is under gravel - like.

BOREHOLE LOG

PROJECT	ILOCOS NORTE IRRIGATION PROJECT			SITE	PAPA DAMSITE		
HOLE NO.	DDH - 3	ELEVATION		ANGLE		MACHINE	
		DEPTH	14.30 m	BIT		PUMP	
		DIAMETER		GW LEVEL		ENGINE	

BEGUN		SITE ENGINEER	
COMPLETED		FOREMAN	
DAYS REQUIRED		DRILLER	

DATE	ELEVAT'N	DEPTH	THICK'S	LOG	TERMINO'Y	COLOR	MAX. CORE: 20 40 60 80 / NO. OF CORE 10 20 30 40	RECOVERY (%) 20 40 60 80	DRILL SPEED (h/m) 1 2 3	PERMEABILITY K in CGS/ LUGEON 10 10	DESCRIPTIONS
		0.00	0.00								
					OVERBURDEN						00-05M Gravel and Sand
		2.50	2.50								05 2.5M Gravel
						milk white blue white					2.5 4.9M Rock itself is hard and fresh Core recovered is broken
											4.9 5.9M Rock itself is moderately soft Milk white in color.
					DIORITE						5.9 - 14.30M Rock itself is hard and fresh But crack surfaces have been polluted by iron oxide.
						white blue					
		14.30									

Technical Supporting

1. Geology of Diversion Dams

a) General Geology

The foundations of the five proposed diversion dam sites are composed of marine effusive rock and diorite. The diorite intruding into the andesitic basement is also the main constituent of the basement of the Project Area, and of the cordillera central mountain.

The foundations of Labugaon and Papa diversion dam sites consist of diorite having granodioritic rock facies while the foundations of Solsona and Madongan diversion dam sites consist of andesite. The foundation of Nueva Era diversion dam site consists of agglomerate. The river deposit of about three meters thick overlies the above-mentioned basement.

There is no problem in constructing diversion dam at the proposed sites from a view point of geology.

b) Geology of Dam Sites

(1) Labugaon Dam Site

The geological survey conducted by NIA is core boring at one point. So, core boring has been additionally conducted with a total depth of 40 m. According to this study resault, the rock foundation consists of diorite having granodioritic rock facies. The outcrops of this diorite are observed on the left abutment and have joints of a high angle. As a result of the boring, it is recognized that the boring core recovered is under gravel-like condition, that the rock itself is hard and dense. It has no problems in constructing diversion dams. The river deposit of an averaged width of about 2.0 m overlines the rock foundation. This deposit is mainly composed of gravel or sand/gravel layer. So the bearing capacity is sufficient.

(2) Solsona Dam Site

The geological survey conducted by NIA is core boring at five points with a total depth of 44.4 m. Result of this is as shown in Figure 4D-3. According to this study result, the rock foundation consists of slightly metamorfic andesite. The outcrops of this andesite are observed on the both abutments. The outcrops have cracks caused by the intrusion of diorite. Pyrite is also observed. Vein of quartz and calcite have also well developed. The rock itself is hard and dense. It has no problems in constructing diversion dams. The river deposit of an averaged width of about 2.5 m overlies the rock foundation. The right abutment has terrace deposit. These deposits are mainly composed of gravel or sand/gravel layers, and no soft deposit such as clayey one etc. is not seen. So the bearing capacity is sufficient. Care should be paid only to the piping. Two or three small faults seem to run from the north to the east about 400 m upstream of the dam axis, but bring about no problem in constructing the head works.

(3) Madongan Dam Site

The geological survey conducted by NIA is core boring at five points with a total depth of 276 meters on the dam axis. Result of this is as shown Figure 4F-5. The foundation of Madongan diversion site mainly consists of andesite, diorite, terrace deposit and alluvial deposit. The alluvial deposit is composed of gravel of andesite and diorite, and the soft soil such as clay layer etc. is not observed. The terrace deposit is distrubuted on the right bank of the downstream of the damsite.

The rock foundation consists of andesite and diorite, and the dam axis portion is of metamortic andesite. As a result of the boring and field investigation, it is recognized that this andesite has joints of a high angle, that the open crack surfaces have been polluted by oxide of iron and weathered to a great extent.

Based on the boring data regarding the dam site, the andesite is classified into four layers as follows.

No. 1 layer: The layer extremely weathered.

No. 2 layer: The rock itself is hard, but it has many cracks. The boring core recovered is under gravel-like condition.

No. 3 layer: The layer has open cracks. The open crack surface have been polluted by oxide of iron and of red color. However, it has sufficient bearing capacity for dam construction.

No. 4 layer: Fresh and favorable rock foundation though partially it has cracks.

The rock foundation of the river bed is composed of the above-stated No. 3 layer. So the bearing capacity is sufficient.

(4) Papa Dam Site

Core boring at three points with a total depth of 47.40 m has been conducted by NIA for the proposed dam axis. The result is shown in Figure 4D-7, According to the field investigation and core boring, the rock foundation of this place is composed of diorite. This diorite has deep cracks, so the core recovered is broken. It is found that some portion of this rock covering the left side of the river bed and bank has been softened to a degree. But no problem in construction.

Outcrops of the above-mentioned rock is observed on the both abutments, but the river bed is covered by deposit of 1.30 to 2.50 m thick. This river deposit mainly consists of hard andesitic and dioritic sand/gravel layers. No soft layer can been recognized. The bearing capacity is sufficient.

(5) Nueva Era Dam Site

The geological survey of this place is not conducted by NIA. According to the field investigation, the foundation of the proposed diversion dam site is mainly composed of agglomerate. Partially narrow stripes of shale are observed. The upper layer of this agglomerate can be continueously seen on the excavated surfaces along the right bank road. Rock facies have been weathered to a great extent. The weathering condition of them is peculiar. Gravel has been onion-stricturely weathered. The matrixes have a red color. The lower layer of the agglomerate is continueously seen on the river bed. The lower agglomerate is very hard, dense, massive and favorable. The river bed is covered by deposit of 3.0 to 4.0 meters thick. This river deposit mainly consists of sand/gravel layers. So the bearing capacity is sufficient. Care should be paid only to the piping.

B. Irrigation Canals

1. Design Criteria for Irrigation Canal

a) Intensity of Canal

The intensity of main and lateral canals should be more than about 13 m for one hectare or one kilometer for 75 ha of service area.

b) Water Requirement

Depending on the irrigation water requirement, the maximum water requirement is estimated at 2.33 Lit/sec/ha including necessary losses.

c) Canal Capacity

Canal capacity will be determined to satisfy the water demand which is computed from the maximum water requirement, and total discharge for every canal is reflected in the schematic diagram as shwon in Figure 4D-8 to 4D-11.

d) Flow Formula

Manning's open channel formula will be applied to determine the canal elements. It is expressed in the metric system by the following:

$$V = 1/n \cdot R^{2/3} \cdot I^{1/2}$$

where; V: velocity in meter per second

n: coefficient of roughness
(0.025 for each canal with ordinary soil material)

R: hydraulic radius in meter

D: slope of canal

The coefficient of roughness "n: and slope "S" are usually fixed values, this leaving the hydraulic radius "R" is the only variable. The hydraulic radius is depending on the cross sectional area of the water and wetted perimeter. The formula for steady and uniform flow is;

FIGURE 4D-8 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM (LABUGAON AREA)

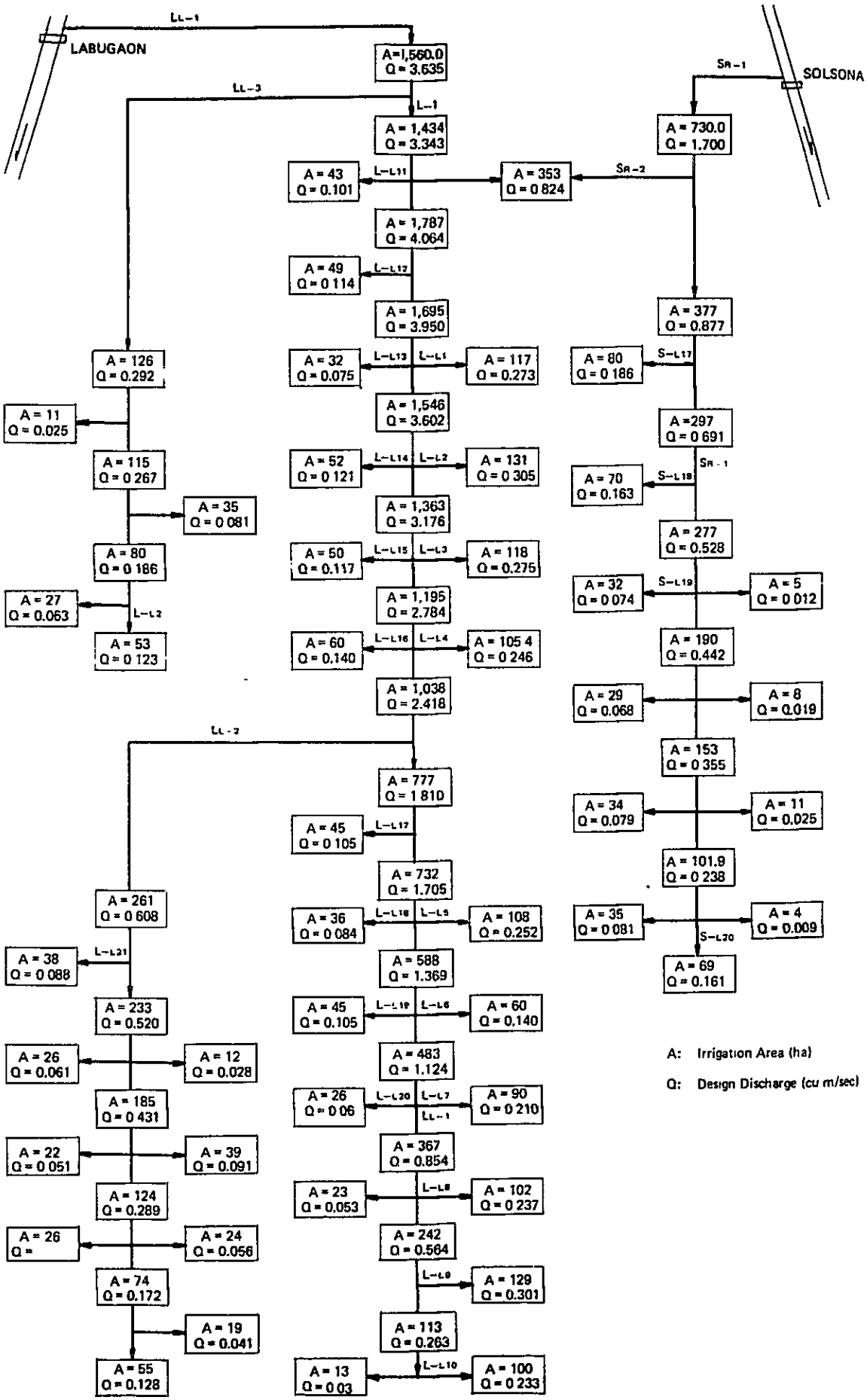


FIGURE 4D-9 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM (SOLSONA AREA)

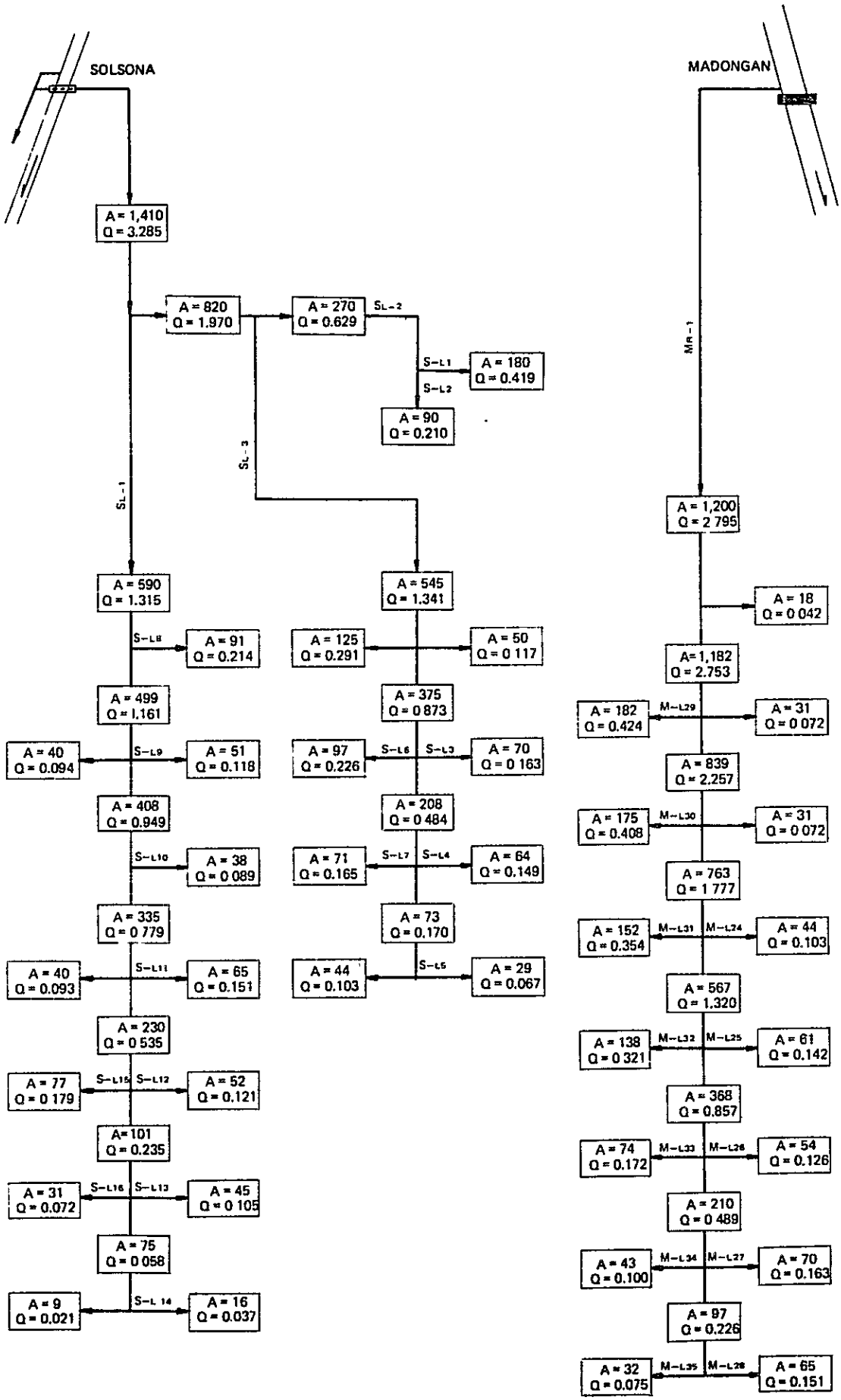
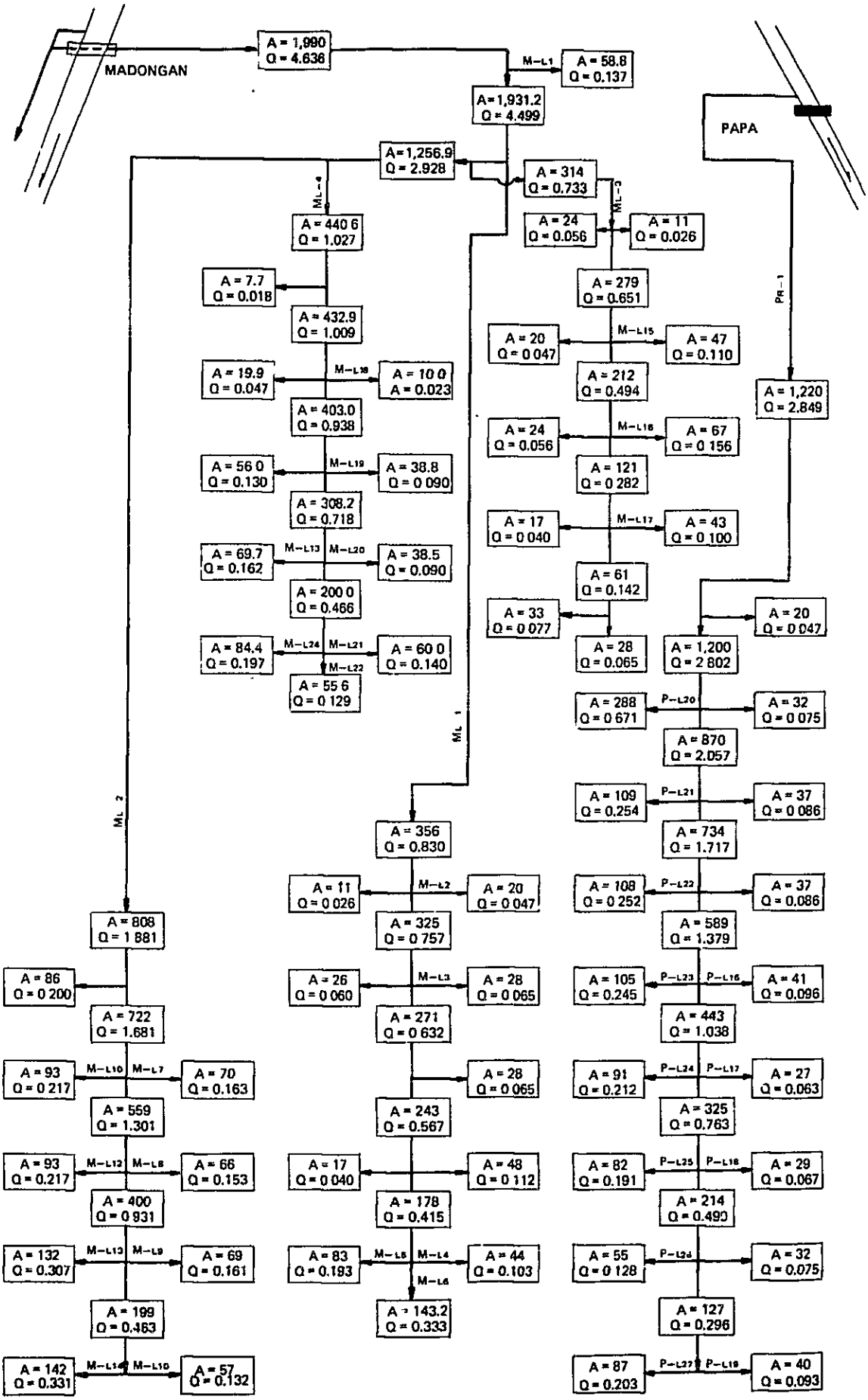


FIGURE 4D-10 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM (MADONGAN AREA)



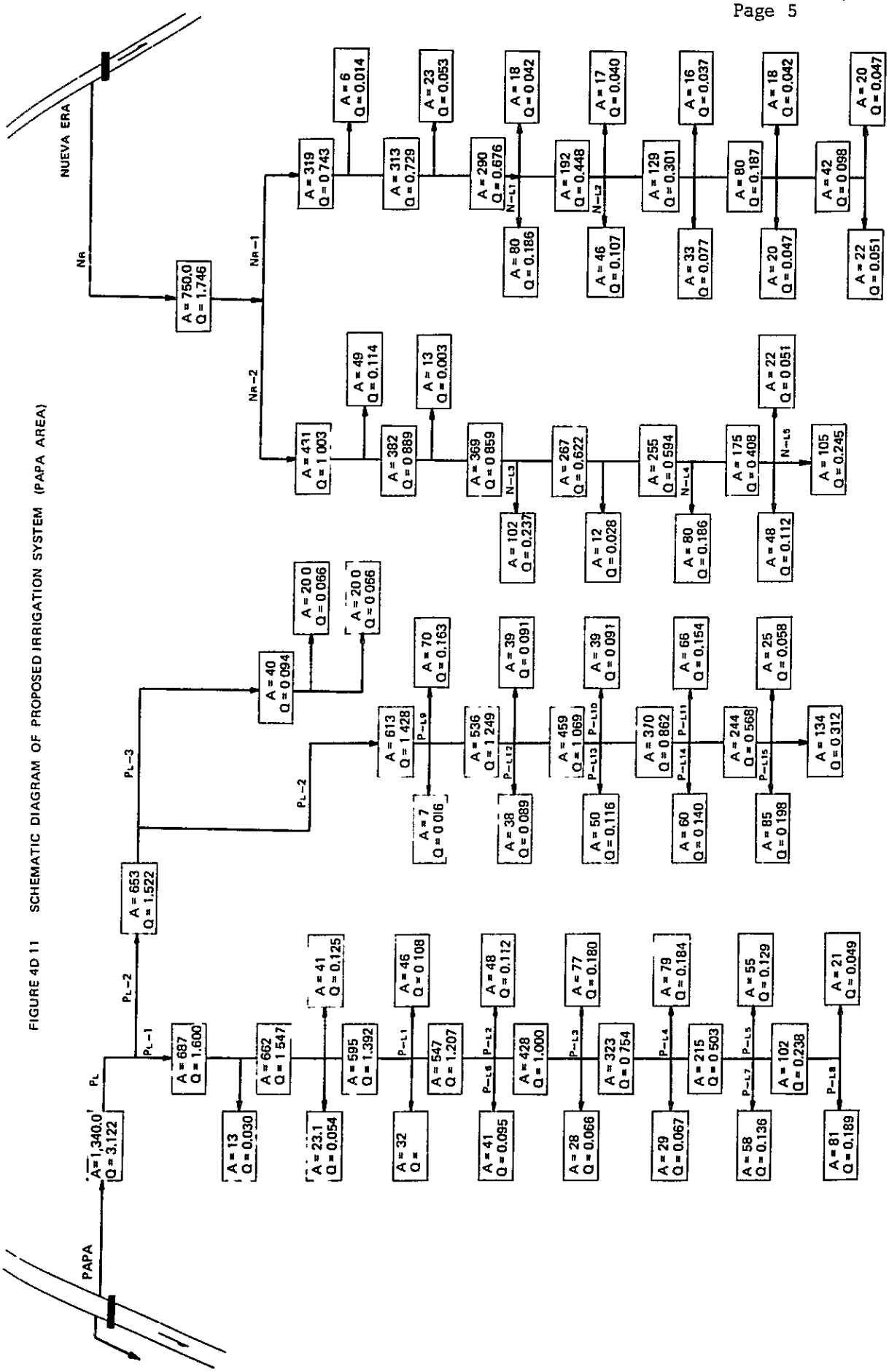


FIGURE 4D 11 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM (PAPA AREA)

$$Q = A \cdot V,$$

Thus, following equetion is producted;

$$A = 1/n \cdot A \cdot R^{2/3} \cdot I^{1/2}$$

where; Q: discharge in cubic meter per second
A; cross sectional area of the water in square meter

e) Coefficient of Roughness

Manning's coefficient of roughness "n" depends largely on canal condition; however, the value of 0.025 is usually applied for ordinary earth main and lateral canals. For various kinds of canal materials, the following values of "n" are applied;

Coefficient of Roughness "n"

Canal material	"n" Value
Main and lateral earth canals	0.025
Concrete lined canal	0.015
Concrete pipe	0.014
Steel or metal pipe	0.012
Farm ditch	0.030

f) Allowable Velocity

For the unlined canals, the maximum allowable velocity of flow should be determined as to prevent scouring, and the minimum allowable velocity should be decided so as to prevent deposition of silt or growth of aquatic plants and moss. If the velocity is not within this requirements, the slope should be revised accordingly. Velocity in unlined canals ordinarily vary from a minimum of 0.25 m/sec to a maximum of 1.0 m/sec.

On the other hand, Kannedy's formula is used to determine the

maximum non-scouring velocity from points of soil conditions of canals. The Kennedy's formula is expressed as follows;

$$Va = CD^{0.64}$$

where; Va: velocity for non-scours of critical velocity in meter per second

C : coefficient for various type of soil

D : depth of water in meter

Value of coefficient C are as follows:

for fine, light, sandy soil	0.64
for coarse, light sandy soil	0.51
for sandy, loamy silt	0.56
for coarse, silt or hardy soil debris	0.60

A suggested modification of Kennedy's formula for clear water is as follows:

$$Vs = C \cdot D^{0 \cdot 5}$$

g) Canal Slope

The Proejct Area is characterized by alluvial fan, so that slope of topography is relatively steep with 0.0125 to 0.008. In case of such steep slope area, the slope of canal to be provided should be determined so as to prevent scouring of the canal. From view point, an allowable velocity (Va) has correlation with depth of water (D) which is determined by a discharge of canal, and the design slope of canal would be computed to satisfy the value of a disign velocity.

The result of computation is as follows:

Q < 0.7 cu.m/sec	Limiting Slope:	0.001
Q: 0.7 to 1.0 cu.m/sec	" :	0.0008
Q; 1.0 to o.3 cu.m/sec	" :	0.0007
Q > 1.3 cu.m/sec	" :	0.0006

These limiting slopes are applicable to canals on soil of the average loam.

h) Canal Section

The section of the canal as previously determined should be satisfy the relationship between depth of water and bottom-width, side slope, free board and width of bank top.

Waterdepth and Bottom-width

The depth of water should not exceed two meters except in uncommonly large canals. A bottom-width and depth ratio of 2.5 has been adopted as standard for canals located on cut and fill on a relatively level ground. From experience, this proportion is the most economy under the such conditions.

Inside Slope

The stability of construction materials for canal is the determining factor in deciding the side slope of canal. Usually, the side slope adopted for unlined earth canal is 1 : 1.5 (vertical versus horizontal) which is approximately the angle of stability of ordinary earth.

Outside Slope

When water satulates in the fill embankments, the satulation line tends to bend downward from the water surface through the embankment material. The rate of bend is a variable slope of the satulation lines, depend mainly on the quality and relative placement of the different type of embankment materials. The empirical slope of the satulation line is 1 : 4.0, commonly under ordinary conditions.

In view of above-mentioned, the outside slope of 1 : 1.5 (vertical versus horizontal) is derived for ordinary earth and height embankemnt lower than four meters.

For the embankment higher than four meters, the following treatment should be considered for proper maintenance;

(1) to use good embankment materials
(2) to change the side slope to a gentler slope
(3) to adopt toe-drain or flat-drain
(4) to construct enough transvers structure
(5) to use slope protection either by sodding or rip-raping

Bank Top Width

The width of the bank top is also based on the depth of water. However, if one side of the bank top would be utilized as a roadway, a width of six meter for the main canal and four meter for the lateral canal would be adopted.

Free Board

Free board of canals will normally be governed by condition of the canal size, location, storm water, inflow, water-surface fluctuation caused by checks, wind action, soil charactaristics, percolation gradients, operating road requirements, and availability of excavated material. U.S Bureau of Reclamation recommended that preliminary estimated of the free board required under ordinary conditions may be calculated by following formula:

$$Fb = \sqrt{cd}$$

where; Fb: free board in meter
c : coefficient
d : depth of water in meter

The coefficient "C" varies from 1.5 for a canal capacity of 0.5 cu.m/sec to 2.5 for a canal capacity of 30 cu.m/sec or more. Generally, it will be over estimated if the above formula will be used for deep canal. According to the Hand Book of Applied hydraulics, the free board in the unlined canal, i.e., height of bank above water surface, varies

from 30 cm for a small canal with a shallow depth to 120 cm for big capacity canal of 30 cu.m/sec or more. Consequently, the formula for function of water depth can be explained as follows:

$$Fb = 0.3 + d/4$$

It is considered that the above formula is most applicable for earth canal with a depth of one to three meters. However, for deepness less tha two meters, the usual practice is to make the height of the dike 1.4 times the depth of water or Fb = 0.4d, but a minimum of 30 cm.

2. Proposed Canal Length

The following table shows the proposed length of canals.

Table 4D-2 List of Canal Length and Service Area

a) Main Canals

Name	Length (m)
L_L- 1	13,790
L_L- 2	4,300
L_L- 3	2,650
Sub total	20,740
S_R - 1	4,350
S_R - 2	1,200
S_L - 1	8,880
S_L - 2	6,950
S_L - 3	5,070
Sub total	26,450
M_R - 1	9,370
M_L - 1	7,300
M_L - 2	7,720
M_L - 3	4,500
M_L - 4	4,850
Sub total	33,740
P_R - 1	8,610
P_L - 1	7,510
P_L - 2	5,450
Sub total	21,570

Remarks

L_L: Left bank of the Labugaon River
S_R: Right bank of the Solsona River
S_L: Left bank of the Solsona River
M_R: Right bank of the Madongan River
M_L: Left bank of the Madongan River
P_R: Right bank of the Papa River
P_L: Left bank of the Papa River
N_R: Right bank of the Nueva Era

Name	Length (m)	Remarks
N_R - 1	8.080	
N_R - 2	5,900	
Sub total	13,980	
Total	116,480	

b) Lateral Canals

Name	Length (m)	Remarks
L - L_1	15,880	L - L_1: No. 1 lateral of the Labugaon River
L - L_2	350	
L - L_3	250	
Sub total	16,480	S - L_1: No. 1 lateral of the Solsona River
S - L_1	1,370	
S - L_2	4,780	M - L_1: No. 1 lateral of the Madongan River
S - L_3	4,650	
S - L_4	2,100	P - L_1: No. 1 lateral of the Papa River
Sub total	12,900	
M - L_1	16,000	N - L_1: No. 1 lateral of the Nueva Era
M - L_2	5,120	
M - L_3	7,460	
M - L_4	900	
M - L_5	2,800	
Sub total	32,280	
P - L_1	10,490	
P - L_2	2,980	
P - L_3	8,770	
Sub total	22,240	
N - L_1	2,100	
N - L_2	6,050	
Sub total	8,150	
Total	92,050	

3. Related Structures

Canal Lining

The reaches of canal where excess seapages or serious slope sliding occur shall be lined with concrete or rip-rap. Drawing No. 013 shows the typical drawing of linging canal sections.

Road Crossing

Where hydraulic head is available and the discharge is less than three cubic meter per second, a road crossing of reinforced concrete pipe with concrete transition will be used instead of a bridge. The pipe shall be set on a minimum slope of 0.005, and provided with a minimum of 0.9 meter of earth cover except for farm roads which will have a minimum cover of 0.6 meter. Drawing No. 014 shows a typical road crossing with check and Drawing No. 015 shows a typical pipe crossing.

Siphon

precast reinforced concrete pipes will be used for siphones of discharge less than three cubic meter per second, but concrete box section for siphons of above three cubic meter per second. The velocity of siphon should not exceed 1.5 meter per second. Pipe slopes should not be steeper than 2 to 1 and flatter than a slope of 0.005. A typical box siphon or a pipe siphon are shown in Drawing No. 016 to No. 017.

Check

Checks shall be builted where needed to regulate the canal water surface of upstream of the structure and to control the downstream flow. Checks would be conbined, where posible, with the inlets and other structures such as siphon or drop. An interval of checks will be determined based on the canal slopes and canal properties. Use of stop logs shall be limited according to velocity, discharge and depth of water passing through a check structure.

Overflow walls should be provided on both side of the gates or stop logs, and the top of these walls will be set up slightly above the control water surface.

Head gate

Turnout should be placed, avioding places of high embankment or

deep excavation in canal reaches, according to the following conditions; 1) nearest to the command area as much as practicable, 2) where flow is steady, and 3) operation and maintenance of the structure is convenient. The maximum velocity in the pipe should be about one meter per second more or less. In order to check the amount of flow a parshall flume will be installed at the down stream of the headgate.

Wasteway

Wasteways, if necessary, shall be placed at the immediate downstream of a reach of a canal where 1) the storm water or irrigation water entering into a canal is more than 120 percent of the design inflow of the canal, 2) the point where a natural drainage-channal of adequate capacity exists, 3) the upstream of a long reach of high-embankment, 4) the inlet of a long and large siphon and terminals of main canals and laterals.

Drainage Culvert

Drainage culverts would be required to drain strom run-off under canals. Design capacities for the culvert shall be computed by estimating run-off from the drainage area. Drawing No. 023 are typical drainage culverts.

Drain Inlet

Drain inlets will be used to carry relatively small amount of storm run-off or drainage water into the canal when an economical means of crossing the canal is not available. But the maximum drainage inlet capacity at any point should not exceed 10 percent of the capacity of the canal overflow wasteway facility is provided for a reach of canal which is inlet is located. Drawing No. 024 shows a typical drain inlet structure.

The numbers of proposed related structures mentioned above are estimated on the topographic map with scale of 1 : 10,000 and the profile prepared from topo-map. The following table is the list of structures.

Table 4D-3 List of Related Structures

	Name of Structures	Numbers Main Canal	Lateral	Total
1.	Siphon	3	2	5
2.	Siphon and thresher crossing	2	6	8
3.	Drop with Check	135	274	409
4.	Drop with thresher crossing	218	100	318
5.	Drop with check and headgate	101	122	223
6.	End check	18	170	188
7.	Parshall Flume	10	170	180
8.	Drainage Culvert (pipe)	10	27	37
	- do - (culvert)	4	29	33
9.	Turnout	101	-	101
	Total			1,502

C. Drainage Canal

1. Design Criteria of Drainage Canal

a) Design Discharge of Canal

The design discharge of drainage canal is estimated by multiplying the drainage area by the design discharge as shown below;

Discharge Criteria for Drainage

	Description	Drainage Modulus (lit/sec/ha)
1.	Paddy field	
	Drainage area:	
	0 - 400 ha	8.72
	400 - 1,000	8.37
	1,000 - 3,000	7.63
	3,000 - 5,000	7.15
	5,000 -10,000	6.71
2.	Mountainous area	27.5

Figure 4D-12 to Figure 4D-15 indicates the schematic diagram of drainage system and its canal capacity.

b) Determination of Side Slope

The side slope of earth canals should be stabulized without a slip, scour or erosion against the water in the canal and natural conditions. Generally, the side slope is determined based on the soil in the Project Area. The soil is ranged clay or sandy-loam in the Project Area according to the field survey. Therefore, the side slope is decided at 1 : 1. This side slope is the same as NIA's criteria.

c) Base-depth Ratio

Generally, when a bigger base-depth ratio will be chosen for the design of canals, a cross-section will hydraulically stabilize. However, the quantity of earth works and right-of-way will become large.

Therefore, the base-depth ratio has been determined in consideration of the hydraulic most effective cross-section to minimize the construction cost. The section has the minimum wetted perimeter to a cross-sectional area, i.e., its section has the maximum hydraulic radius.

The rectangular and trapezoidal canal have the following equestion about the base-depth ratio.

$$b = 2H(\sqrt{1+m^2} - m)$$

where; m: side slope
H: depth (m)
b: Base width (m)

In case the side slope (m) is 1.0, the above equetion is modified as follows:

$$b = 0.84H$$

FIGURE 4D-12 SCHEMATIC DIAGRAM OF PROPOSED DRAINAGE SYSTEM (LABUGAON AREA)

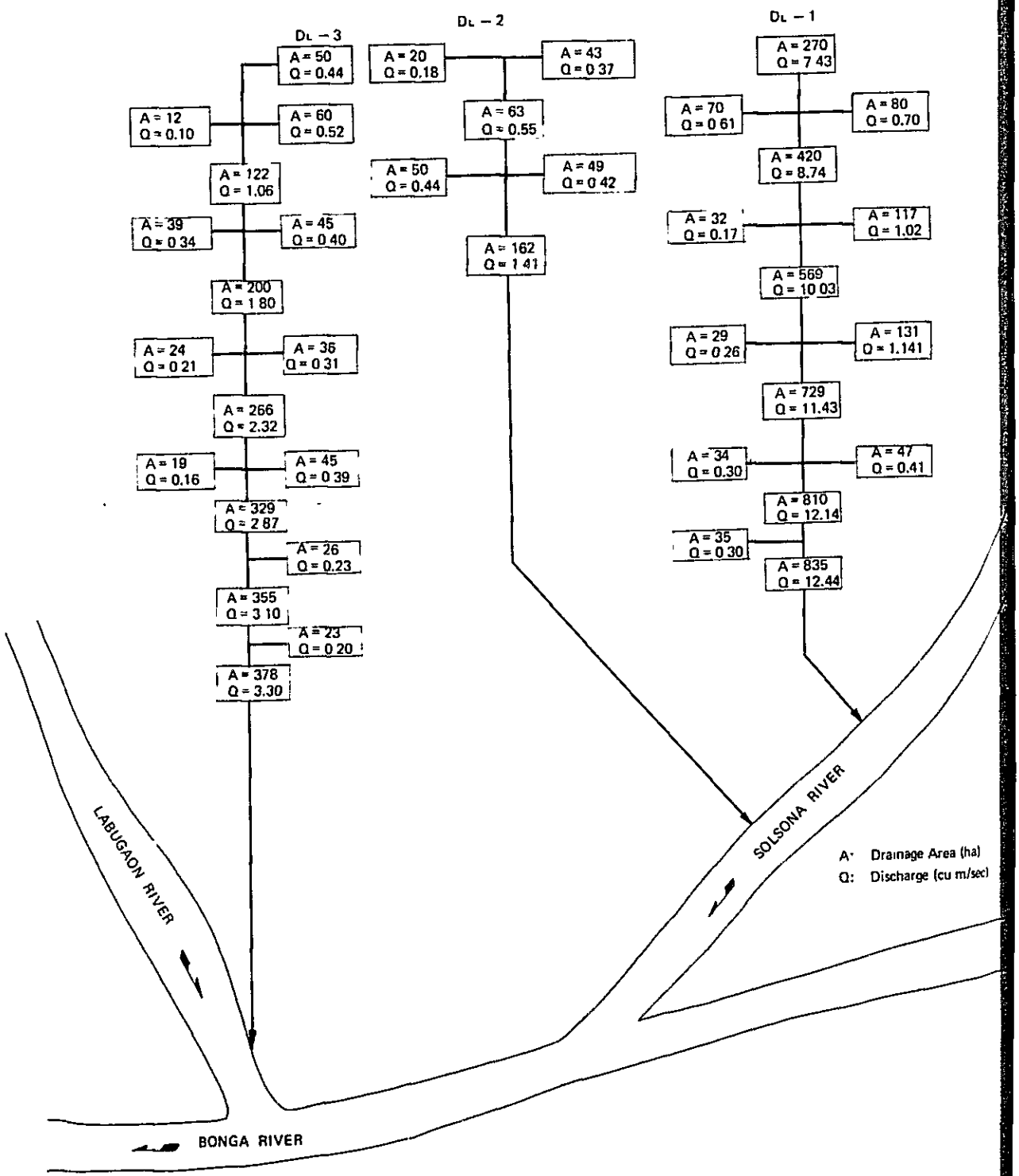


FIGURE 4D-13 SCHEMATIC DIAGRAM OF PROPOSED DRAINAGE SYSTEM (SOLSONA AREA)

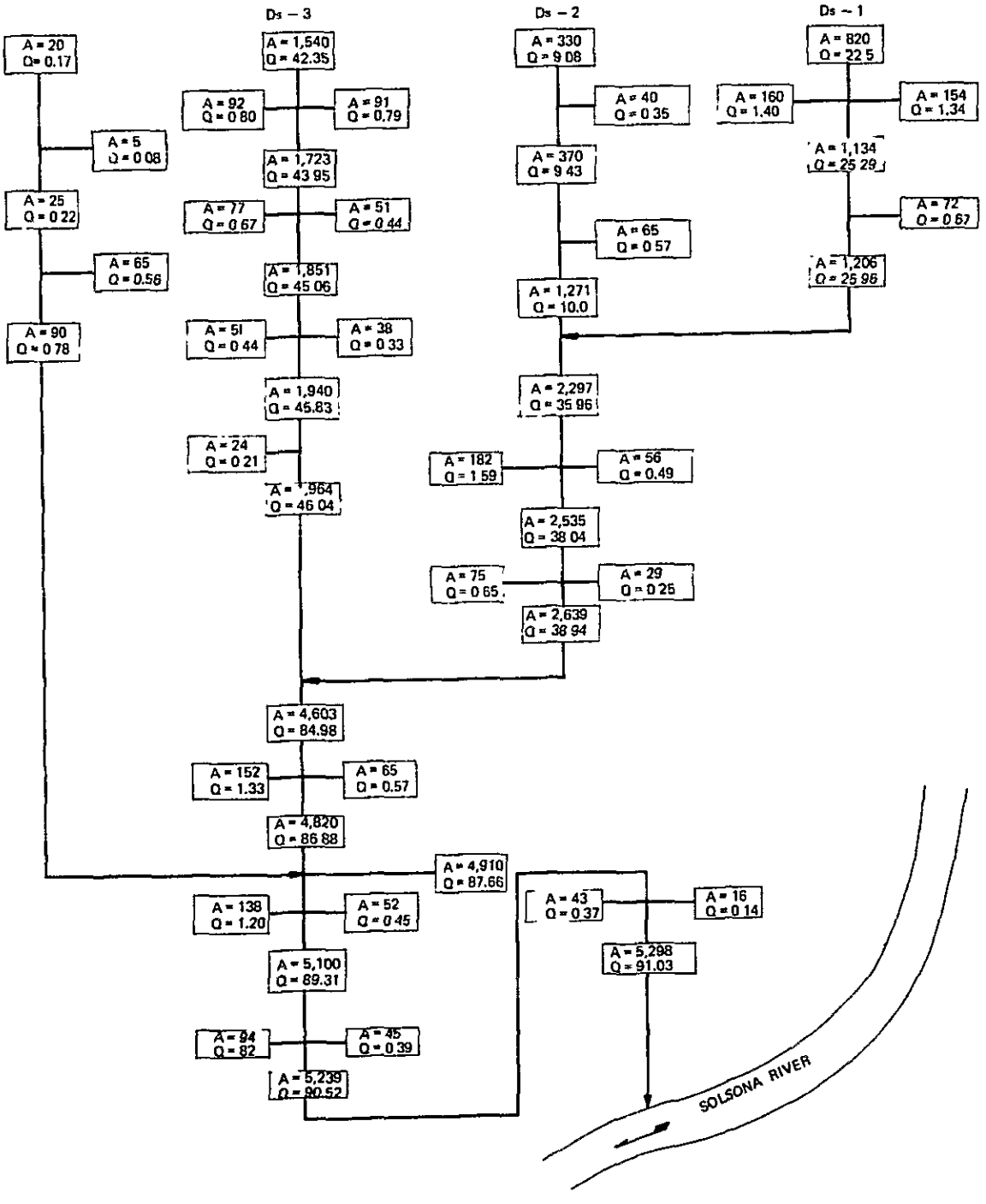


FIGURE 4D-14 SCHEMATIC DIAGRAM OF PROPOSED DRAINAGE SYSTEM (MADONGAN AREA)

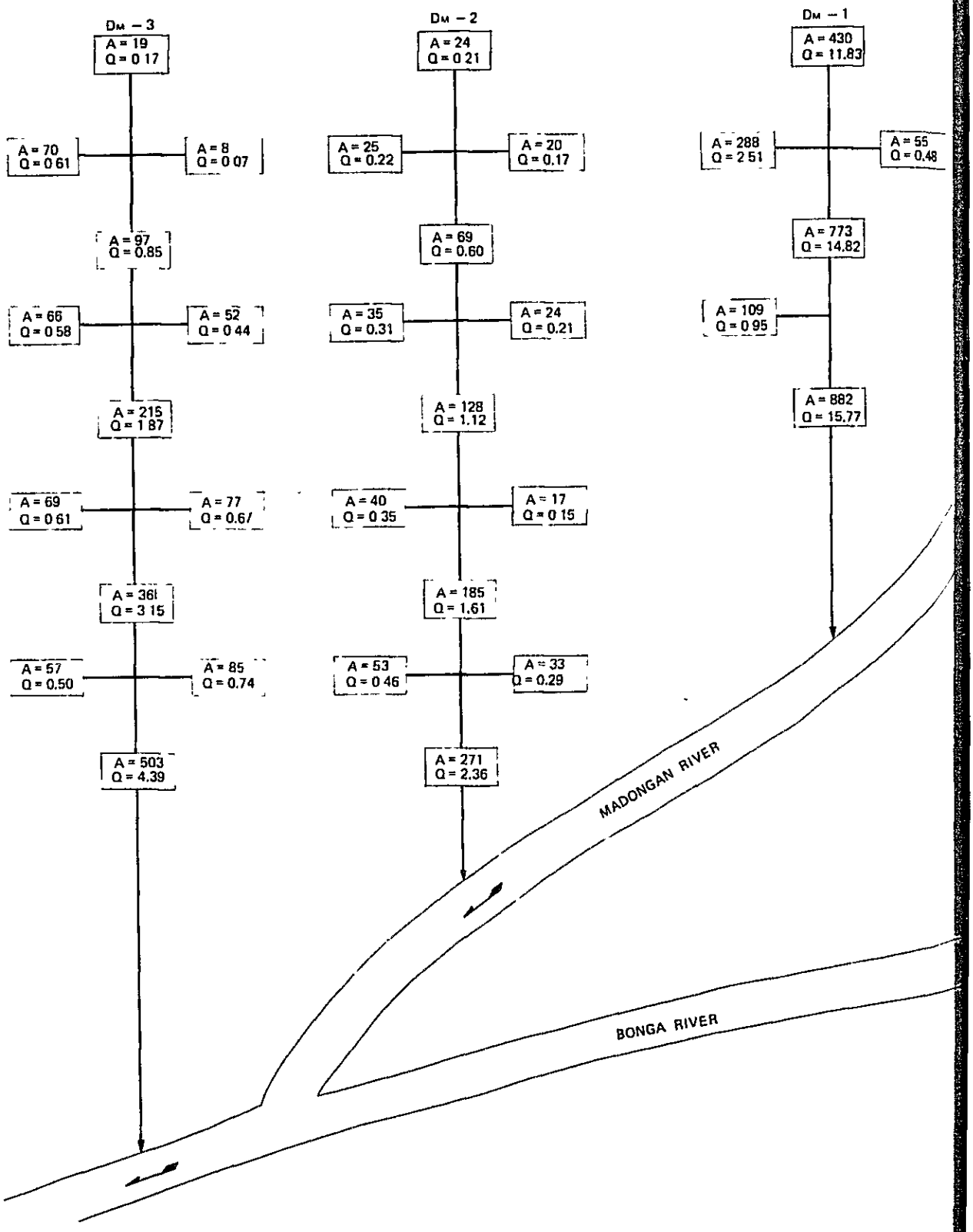
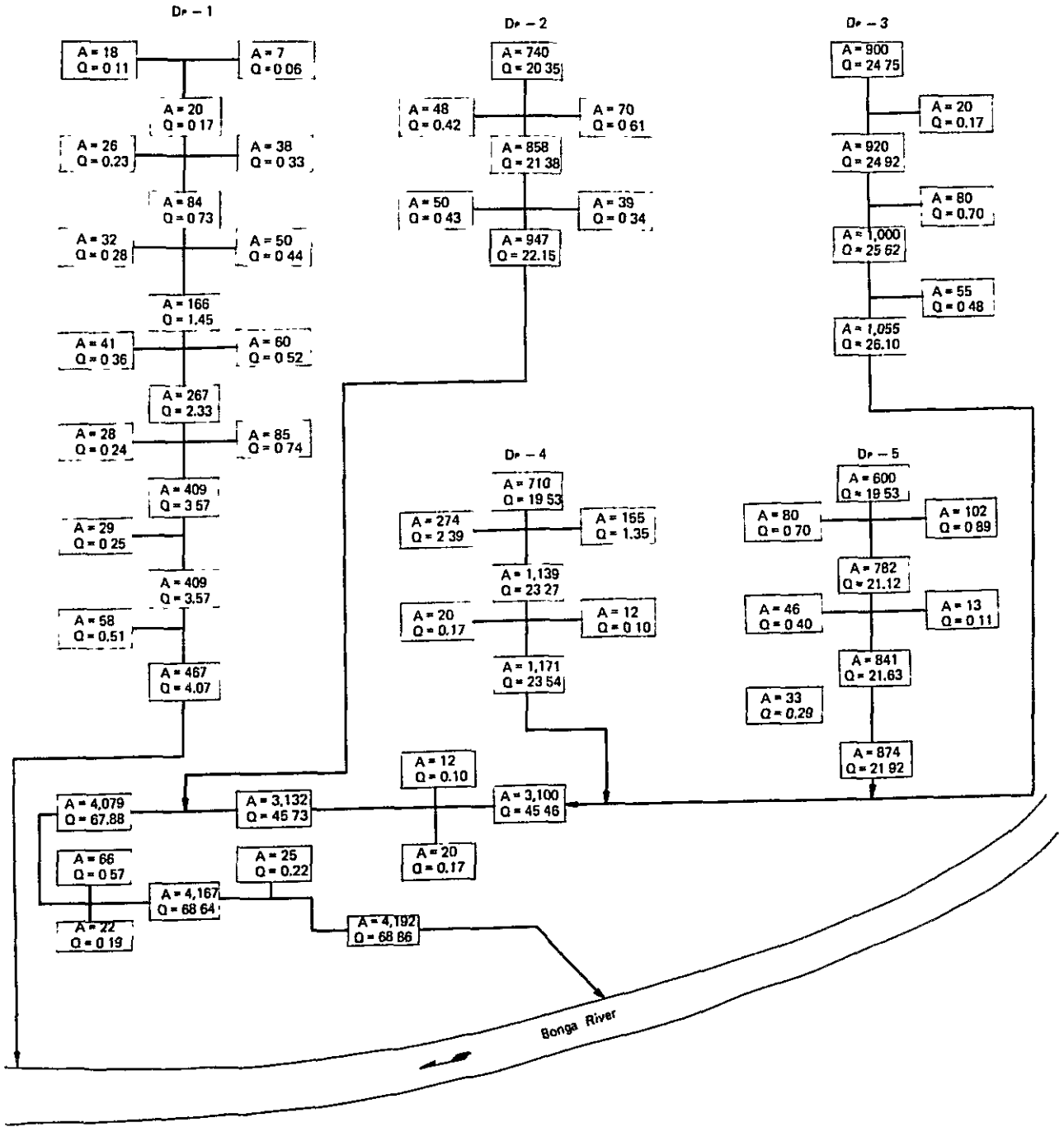


FIGURE 4D-15 SCHEMATIC DIAGRAM OF PROPOSED DRAINAGE SYSTEM (PAPA AREA)



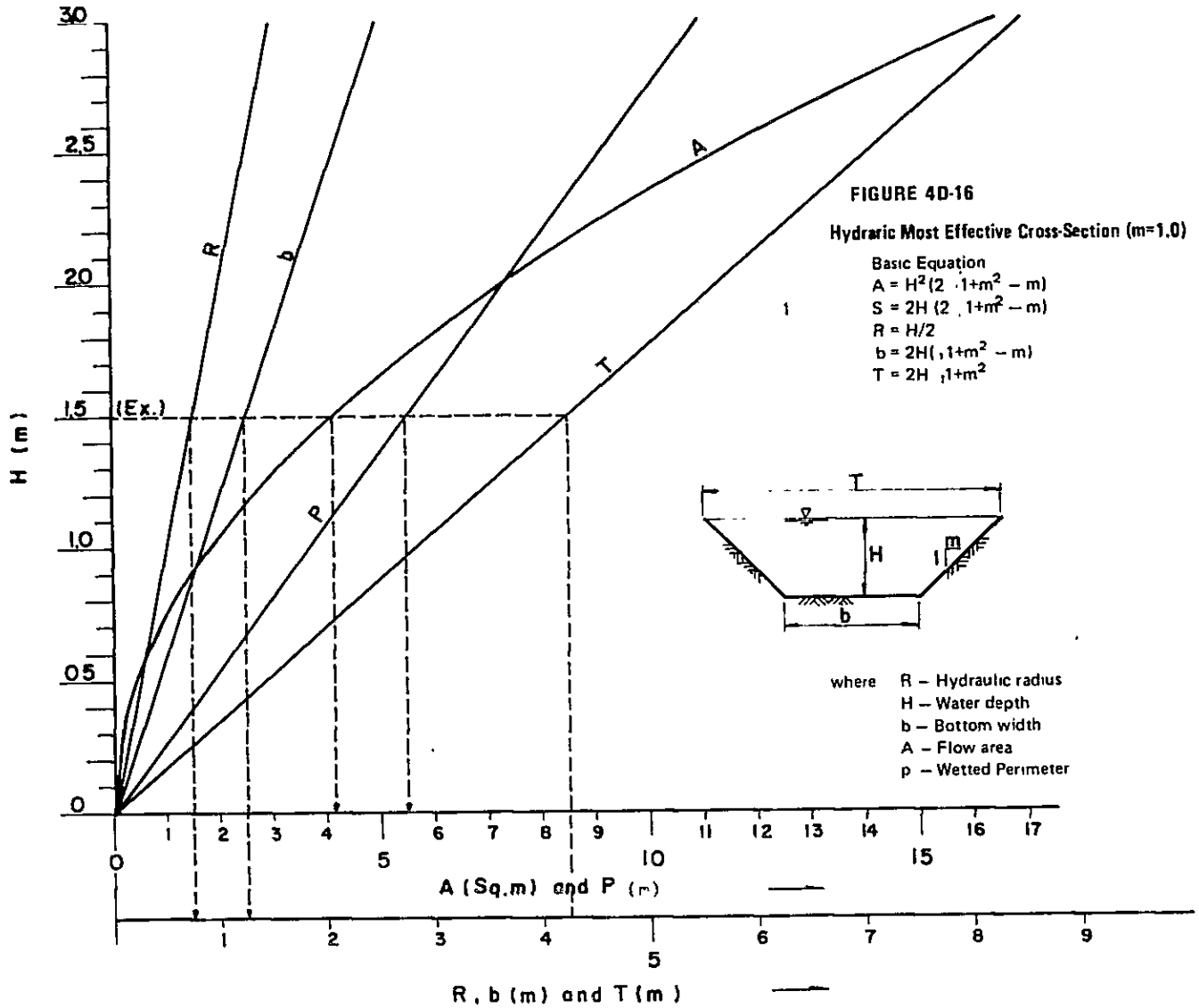


FIGURE 4D-16

Hydraric Most Effective Cross-Section (m=1.0)

Basic Equation

$A = H^2(2\sqrt{1+m^2} - m)$

$S = 2H(2\sqrt{1+m^2} - m)$

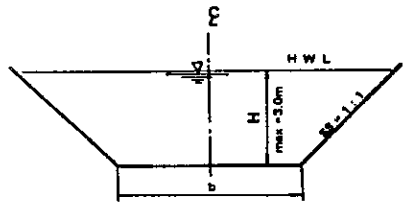
$R = H/2$

$b = 2H(\sqrt{1+m^2} - m)$

$T = 2H\sqrt{1+m^2}$

where R – Hydraulic radius
H – Water depth
b – Bottom width
A – Flow area
p – Wetted Perimeter

FIGURE 4D-17 DISCHARGE CURVE OF PROPOSED DRAINAGE CANAL



DIMENSION OF DRAINAGE CANAL

Type	H	b	Type	H	b
A	3.0 m	9.3 m	J	2.1 m	1.7 m
B	3.0	8.0	K	1.9	1.8
C	3.0	6.5	L	1.7	1.4
D	3.0	3.6	M	1.5	1.2
E	3.0	3.0	N	1.3	1.1
F	3.0	2.5	O	1.1	0.9
G	3.0	2.4	P	0.9	0.7
H	2.5	2.1	F. Drain	0.5	0.4
I	2.3	1.9			

Manning Formula n = 0.025

Therefore, the base-depth ratio is decided at 0.8H also the basic dimensions by depth such as hydraulic radius, wetted perimeter, etc. are shown in Figure 4D-16, and 4D-17.

2. Proposed Canal Length.

Table 4D-4 shows the proposed length of canals.

3. Related Structures

a) Drainage Drop

The earth canal type is recommended to minimize the construction cost. However, the present slope in the Project Area is steep. The average slope along the canal is ranged with about 0.01 on an average. On the other hand, the proposed slope of drainage canal will be less than 0.002 based on the non-securing velocity in the flood period.

Table 4D-4 Total Length of Drainage Canal

a) Rivers, Creek and New Main Canal (with Improvement)

Name of Canal	Length (m)	Remarks
P - 1	8,910	P: Papa area
P - 2	1,870	
P - 3	4,700	M: Madongan area
P - 5	2,500	S: Solsona area
P - 6	1,850	
P - 7	3,450	L: Labugaon area
Sub total	32,280	
M - 1	3,300	
M - 2	2,540	
M - 3	1,980	
Sub-total	7,820	
S - 3	1,900	
S - 5	1,600	
S - 6	2,300	
S - 7	3,500	
Sub total	9,300	

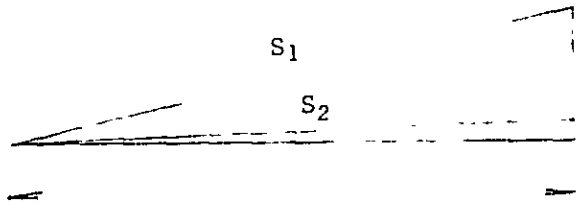
Name of Canal	Length (m)	Remarks
L - 1	6,280	
L - 2	4,100	
L - 3	4,200	
Sub total	14,580	
Total	54,980	

b) Lateral Drainage Canal

Name of Canal	Length (m)	Remarks
N_R - 1	2,100	N_R L_L: See Irrigation Canal
N_R - 2	6,050	
P_L - 1	2,980	
P_L - 2	8,770	
Sub total	19,900	
P_R - 1	10,490	
M_L - 1	5,120	
M_L - 2	7,460	
M_L - 3	900	
M_L - 4	2,800	
Sub total	26,770	
M_R - 1	16,000	
S_L - 1	4,780	
S_L - 2	4,605	
S_L -3	2,100	
Sub total	27,530	
S_R - 1	1,370	
L_L - 1	15,880	
L_L - 2	350	
L_L - 3	250	
Sub-total	17,850	
Total	92,110	

b) Number of Drop

The number of drops has been estimated in consideration of the present and proposed slope based on the topo-map (1 : 10,000). The standard drop head is 1.0 meter.



S_1: Present Slope
S_2: Proposed Slope

$$No. = 1 \times (S_1 - S_2)/1.0$$ No.: Number of drop

c) Design of Drainage Drop

(1) Type of Drainage Drop

There are many type of drainage drop. These drops should be designed in consideration of the non-secoring and non-erosion of approach canals because of the earth type of drainage canals.

The type of drops will be decided by the topographical condition, economic construction cost, drop head and the drainage discharge in the canals, etc. Most of the discharge are ranged with less than two cubic meter per second, and the standard drop head is one meter in the project. In this case, the drop head and discharge are not so large, therefore, the stilling pool type is recommendable. However, in case that the drop head is more than one meter and discharge is less than 0.5 cubic meter per second, the drop with the impact box is adopted. And the inclined drop will be adopted in case both head and discharge are higher.

(2) Length of Approach Canal, L (m)

$$L = 1.2 + 3\sqrt{Q/2}$$ Q: Discharge (cu.m/sec)

(3) Thickness of Base of Approach Canal, t (m)

$$t = 0.2 + 0.1\sqrt{h}$$ h: Depth of uniform flow (m)

(4) Free-board of Approach Canal, h_1 (m)

$$h_1 = 1/3\ h > 0.3\ m$$

(5) Width of Notch, b (m)

$$hc = 2/3\,(h + 1.1\,V^2/2g)$$
$$q = 2.98\ hc^{3/2}$$
$$b = Q/q$$

hc: Critical depth (m)
V : Velocity of uniform flow (m/sec)
h : Depth of uniform flow (m)
q : Unit discharge at notch (cu.m/m)

(6) Length of Stilling Pool, Ls (m)

$$Ls = 3(E \cdot F)^{1/2}$$

F : Drop head (m)
E : $h + \alpha V^2/2g$

(7) Depth of Stilling Pool, D (m)

$$D = 1/2 \cdot (E \cdot F)^{1/2}$$

(8) Thickness of Base of Stilling Pool, Ts (m)

$$Ts = 0.1 + 0.0\sqrt{q \cdot F}$$

(9) Free-board of Stilling Pool, Fb (m)

$$Fb = 0.10 + 0.3\sqrt{Q}$$

d) Number of Related Structure

The numbers of proposed related structures are estimated on the topographic map with scale of 1 : 10,000. The following table shows the list of structures.

Table 4D-5 List of Related Structures

Name	Drop	Culvert	
		Box	Pipe
1. Main Canal	236	9	27
2. Lateral	497	17	65
Total	733	26	92

D. Roads

1. Design Criteria of Road

Paved roads by gravels are to be provided along main and lateral canals for operation and maintenance of canals at the intensity of about 13 meters for each hectare of service area, based on the following criteria.

- In case the proposed canal runs parallel to the existing road within a center to center distance of 40 m, the O & M road may be omitted.
- The width of O & M roads for canals is to be designed six meter for main canals and four meter for laterals.
- Generally, the canal operating roads shall terminated at the furthest turnout of canal. However, when a canal terminates near an existing road or another canal, a connecting road may be provided.
- Bridges are to be provided at parallel with siphons where concrete pipe or box culverts are not econimical. Bridges must commonly used are reinforced concrete deck girder type width 3.5 meter roadway width and 0.45 meter side walk on the both sides.

2. Proposed Road Length

The following table shows the proposed length of roads.

Table 4D-6 List of Road Length

Name	Width (m)	Length (m)
1. Side of Main Canal		
Labugaon	6	20,500
Solsona	6	23,800
Madongan	6	21,700
Papa	6	16,500
Nueva Era	6	11,200
Sub total		93,700
2. Side of Lateral Canal		
Labugaon	4	14,400
Solsona	4	10,400
Madongan	4	24,700
Papa	4	17,500
Nueva Era	4	6,400
Sub total		73,400
Total		167,100

Table 4E-1 Investment Cost of the Project (Financial Cost)

Description	Total		Foreign Currency		Local Currency	
	₱'000	(US$'000)	₱'000	(US$'000)	₱'000	(US$'000)
1. Civil Works[1/]						
1-1 Preparation	1,136	(154)	45	(6)	1,091	(148)
1-2 Diversion Dam	55,562	(7,508)	26,596	(3,594)	28,966	(3,914)
1-3 Irrigation & Drainage Canals	53,068	(7,171)	19,615	(2,651)	33,453	(4,520)
1-4 On-farm	11,577	(1,564)	5,312	(719)	6,265	(845)
1-5 Roads	9,733	(1,315)	3,743	(506)	5,990	(809)
1-6 Pre-Engineering	365	(49)	-	-	365	(49)
Sub-total	131,441	(17,761)	55,311	(7,476)	76,130	(10,285)
2. Land Acquisition & Compensation	13,557	(1,832)	-	-	13,557	(1,832)
3. Construction Equipments	31,447	(4,250)	31,147	(4,209)	300	(41)
4. Agricultural Development	2,000	(270)	-	-	2,000	(270)
5. Operation & Maintenance Cost	5,279	(713)	428	(59)	4,851	(654)
6. Project Facilities	4,502	(608)	702	(95)	3,800	(513)
7. Project Administration (8%)	14,985	(2,025)	7,001	(946)	7,984	(1,079)
8. Consulting Services	6,658	(900)	5,643	(763)	1,015	(137)
Sub-total (1 to 8)	209,869	(28,359)	100,232	(13,548)	109,637	(14,811)
9. Contingency	20,331	(2,748)	9,744	(1,315)	10,587	(1,433)
Sub-total (1 to 9)	230,200	(31,107)	109,976	(14,863)	120,224	(16,244)
10. Price Escalation (8%)	81,073	(10,955)	36,504	(4,931)	44,569	(6,024)
Total	311,273	(42,062)	146,480	(19,794)	164,793	(22,268)

1/ : Exclusive of depreciation cost of construction equipments

1. Civil Works

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (F.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1.	Civil Works										
1-1	Preparation	L.S.			1,260	124	45	169	45	1,046	1,091
1-2	Diversion dam	L.S.			62,540	7,102	26,472	33,574	8,417	20,549	28,966
1-3	Irrigation & Drainage Canals	L.S.			60,685	7,617	19,615	27,232	10,487	22,966	33,453
1-4	On-farm	L.S.			14,796	3,219	5,312	8,531	2,741	3,524	6,265
1-5	Roads	L.S.			15,627	5,894	3,743	9,637	3,749	2,241	5,990
1-6	Pre-Engineering	L.S.			365	-	-	-	-	365	365
	Total				155,273	23,956	55,187	79,143	25,439	50,691	76,130
					(US$20,983 x 10^3)		(US$10,695 x 10^3)			(US$10,288 x 10^3)	

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-1	Preparation										
	Road (Labugaon)	4,000	m		324	32	8	40	8	276	284
	" (Solsona)	1,000	"		24	1	1	2	1	21	22
	" (Madongan)	9,000	"		368	37	9	46	9	313	322
	" (Papa)	8,000	"		344	34	17	51	17	276	293
	" (Nueva Era)	3,000	"		200	20	10	30	10	160	170
	Total				1,260	124	45	169	45	1,046	1,091
					(US$170 x 10^3)			(US$23 x 10^3)			(US$147 x 10^3)

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labour (₱'000)	Total (₱'000)
1-2	Diversion Dam										
	1-2-1 Labugaon	1	place		8,176	819	3,703	4,522	1,227	2,427	3,654
	1-2-2 Solsona	1	"		8,176	734	3,995	4,729	1,076	2,371	3,447
	1-2-3 Madongan	1	"		13,632	1,314	6,556	7,870	1,580	4,182	5,762
	1-2-4 Papa	1	"		15,256	1,280	7,732	9,012	1,916	4,328	6,244
	1-2-5 Nueva Era	1	"		17,300	2,831	4,610	7,441	2,573	7,286	9,859
	Total	5			62,540	6,978	26,596	33,574	8,372	20,594	28,966
					(US$8,451x10^3)			(US$4.573x10^3)			(US$3,878x10^3)

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-2-1	Labugaon Diversion Dam										
	Earth Works										
	Excavation (indurated)	9,000	cu.m	15	135	45	4	49	5	81	86
	Excavation (rock)	2,000	"	35	70	24	3	27	3	40	43
	Foundation										
	Concrete "A"	1,650	cu.m	570	940	156	273	429	241	270	511
	Concrete "B"	2,470	"	490	1,210	227	321	548	262	400	662
	Reinforcement bar	775	ton	4,060	3,146	162	2,372	2,534	604	8	612
	Rubble masonry	170	cu.m	380	65	13	13	26	16	23	39
	Plain rip-rap	-	"	130	-	-	-	-	-	-	-
	Concrete pipe	-	m	580	-	-	-	-	-	-	-
	Gate										
	Roller gate	10.3	ton	38,000	391	-	352	352	-	39	39
	Sluice gate	6.8	"	44,000	299	-	269	269	-	30	30
	Bridge	-	"	24,000	-	-	-	-	-	-	-
	Temporary Works										
	Preparation	1			1,920	192	96	288	96	1,536	1,632
	Sub-total				8,176	819	3,703	4,522	1,227	2,472	3,564

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreci-ation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Mateiral (₱'000)	Labor (₱'000)	Total (₱'000)
1-2-2	Solsona Diversion Dam										
	Earth works										
	Excavation (indurated)	7,000	cu.m	15	105	35	3	38	4	63	67
	Excavation (rock)	2,000	"	35	70	24	3	27	3	40	43
	Foundation										
	Concrete "A"	1,410	cu.m	570	803	133	235	368	205	230	435
	Concrete "B"	2,130	"	490	1,043	196	277	473	225	345	570
	Reinforcement bar	665	ton	4,060	2,699	139	2,035	2,174	59	6	525
	Rubble masonry	160	cu.m	380	60	12	12	24	15	21	36
	Plain rip-rap	-	"	130	-	-	-	-	-	-	-
	Concrete pipe	79	m	580	45	6	20	26	10	9	19
	Gate										
	Roller gate	9.0	ton	38,000	342	-	308	308	-	34	34
	Sluice gate	6.9	"	44,000	303	-	273	273	-	30	30
	Bridge	34.0	ton	24,000	816	-	734	734	-	82	82
	Temporary Works										
	Preparation				1,890	189	95	284	95	1,511	1,606
	Sub-total				8,176	734	3,995	4,729	1,076	2,371	3,447

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-2-3	Madongan Diversion Dam										
	Earth Works										
	Excavation (indurated)	12,000	cu.m	15	180	60	6	66	6	108	114
	Excavation (rock)	2,000	"	35	70	24	3	27	3	40	43
	Foundation										
	Concrete "A"	1,870	cu.m	570	1,065	177	310	487	273	305	578
	Concrete "B"	3,900	"	490	1,911	359	507	866	403	632	1,045
	Reinforcement bar	855	ton	4,060	3,471	180	2,616	2,796	667	8	675
	Rubble masonry	200	cu.m	380	76	15	15	30	19	27	46
	Plain rip-rap	2,700	"	130	351	162	16	178	16	157	173
	Concrete pipe	185	m	580	107	16	47	63	23	21	44
	Gate										
	Roller gate	19.6	ton	38,000	744	-	670	670	-	74	74
	Sluice gate	8.8	"	44,000	387	-	348	348	-	39	39
	Bridge	86.0	"	24,000	2,064	-	1,858	1,858	-	206	206
	Temporary Works										
	Preparation	1			3,206	321	160	481	160	2,565	2,725
	Sub-Total				13,632	1,314	6,556	7,870	1,580	4,182	5,762

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreci-ation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-2-4	Papa Diversion Dam										
	Earth Works										
	Excavation (indurated)	10,000	cu.m	15	150	50	5	55	5	90	95
	Excavation (rock)	3,000	"	35	105	36	5	41	4	60	64
	Foundation										
	Concrete "A"	2,620	cu.m	570	1,493	249	435	684	383	426	809
	Concrete "B"	3,140	"	490	1,538	289	408	697	333	508	841
	Reinforcement bar	1,230	ton	4,060	4,993	258	3,763	4,021	960	12	972
	Rubble masonry	400	cu.m	380	152	30	30	60	38	54	92
	Plain rip-rap	-	"	130	-	-	-	-	-	-	-
	Concrete pipe	182	m	580	105	15	46	61	23	21	44
	Gate										
	Roller gate	12.8	ton	38,000	386	-	347	347	-	39	39
	Sluice gate	19.0	"	44,000	836	-	752	752	-	84	84
	Bridge	82.0	"	24,000	1,968	-	1,771	1,771	-	197	197
	Temporary Works										
	Preparation				3,530	353	170	523	170	2,837	3,007
	Sub-total				15,256	1,280	7,732	9,012	1,916	4,328	6,244

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-2-5	Nueva Era Diversion Dam										
	Earth Works										
	Excavation (indurated)	15,000	cu.m	15	225	75	8	83	7	135	142
	Excavation (rock)	3,000	"	35	105	36	5	41	4	60	64
	Foundation										
	Concrete "A"	650	cu.m	570	370	61	108	169	95	106	201
	Concrete "B"	12,000	"	490	5,880	1,104	1,560	2,664	1,272	1,944	3,256
	Concrete 'C"	12,000	"	300	3,600	948	1,194	2,142	666	792	1,458
	Reinforcement bar	300	ton	4,060	1,218	63	918	981	234	3	237
	Rubble masonry	100	cu.m	380	38	7	8	15	10	13	23
	Plain rip-rap	-	"	130	-	-	-	-	-	-	-
	Concrete pipe	200	m	580	116	17	51	68	25	23	48
	Gate										
	Roller gate	9.0	ton	38,000	342	-	308	308	-	34	34
	Sluice gate	4.8	"	44,000	211	-	190	190	-	21	21
	Bridge	-	"	24,000	-	-	-	-	-	-	-
	Temporary Works										
	Preparation				5,195	520	260	780	260	4,155	4,415
	Sub-total				17,300	2,831	4,610	7,441	2,573	7,286	9,859

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-3	Irrigation & Drainage Canals										
1-3-1	Main Canal										
	Earth Wroks										
	Common excavation	811,000	cu.m	8	6,488	1,297	649	1,947	972	3,569	4,541
	Compaction fill	452,200	"	8.5	3,843	1,058	664	1,722	663	1,458	2,121
	Concrete linning	3,840	"	430	1,651	275	613	888	590	173	763
	Concrete (Class B)	12,100	"	940	11,374	688	3,973	4,661	3,885	2,828	6,713
	Grouted riprap	13,920	"	210	2,923	557	878	1,435	543	945	1,488
	Pipe work ø48'	670	m	580	389	28	194	222	92	75	167
	Check gate & installation	60	ton	34,000	2,040	-	1,836	1,836	-	204	204
	Miscellaneous metal work	12	"	18,000	216	-	194	194	-	22	22
	Sodding	181,700	sq.m	3	546	-	-	-	-	546	546
	Sub-total				29,470	3,904	9,001	12,905	6,745	9,838	16,565

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-3-2	Lateral Canal										
	Earth work										
	Common excavation	159,500	cu.m	8	1,276	32	526	558	82	636	718
	Compaction fill	236,200	"	8.5	2,008	555	349	904	349	755	1,104
	Concrete linning	2,360	"	430	1,015	169	366	535	203	277	480
	Concrete (Class B)	6,720	"	940	6,317	390	2,251	2,641	2,131	1,545	3,676
	Grouted riprap	8,660	"	210	1,819	346	537	883	338	598	936
	Pipe ø36'	2,110	m	430	903	64	449	513	212	178	390
	Check gate & installation	54	ton	34,000	1,836	-	1,652	1,652	-	184	184
	Miscellaneous metal work	11	"	18,000	198	-	178	178	-	20	20
	Sodding	73,700	sq.m	3	221	-	-	-	-	221	221
	Sub-total				15,593	1,556	6,308	7,864	3,315	4,318	7,729

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-3-3	Improvement of Rivers and Creeks										
	Earth work										
	Excavation	276,800	cu.m	8	2,214	443	333	776	332	1,106	1,438
	Compaction fill	59,900	"	8.5	509	141	89	230	89	190	279
	Concrete (class B)	4,700	"	940	4,418	273	1,575	1,848	1,490	1,080	2,570
	Grouted riprap	11,400	"	210	2,394	456	706	1,162	446	786	1,232
	Sodding	15,000	sq.m	3	45	-	-	-	-	45	45
	Sub-total				9,580	1,313	2,703	4,016	2,357	3,207	5,564
1-3-4	Lateral Drainage Canal										
	Earth work										
	Excavation	249,400	cu.m	8	1,995	399	300	699	299	997	1,296
	Compaction fill	27,700	"	8.5	83	-	-	-	-	83	83
	Concrete (Class B)	2,500	"	940	2,350	145	838	983	793	574	1,367
	Grouted riprap	7,500	"	210	1,575	300	465	765	293	517	810
	Sodding	13,000	sq.m	3	39	-	-	-	-	39	39
	Sub-total				6,042	844	1,603	2,447	1,385	2,210	3,595
	Total				60,685 (US$8,201 x 10^3)	7,617	19,615 (US$3,680 x 10^3)	27,232	10,487	22,966 (US$4,521 x 10^3)	33,453

Item	Description	Quantity	Unit	Rate (₱)	Total Cost (₱'000)	Foreign Currency (F.C) Depreciation (₱'000)	Material (₱'000)	Total (₱'000)	Local Currency (L.C) Fuel & Material (₱'000)	Labor (₱'000)	Total (₱'000)
1-4	On-farm										
1-4-1	Gently sloping Area	2,970	ha		3,650	840	1,250	2,090	726	834	1,560
1-4-2	Rugged, rolling area	7,230	ha		10,426	2,213	3,947	6,160	1,901	2,365	4,266
	Sub-total	10,200	ha		14,076	3,053	5,197	8,250	2,627	3,199	5,826
1-4-3	Drainage canal	102,000	m		720	166	115	281	114	325	439
	Total				14,796	3,219	5,312	8,531	2,741	3,524	6,265
					(US$2,000 x 10^3)		(US$1,153 x 10^3)			(US$847 x 10^3)	
1-5	Roads										
	Compaction fill	449,200	cu.m	-	(include in the estimation of irrigation canal)						
	Sodding	174,000	sq.m	3	552	-	-	-	-	552	552
	Paved gravel	266,400	cu.m	55	14,652	5,842	3,605	9,447	3,620	1,585	5,205
	Concrete (Class B)	450	"	940	423	52	138	190	129	104	233
	Total				15,627	5,894	3 743	9,638	3,749	2,241	5,990
					(US$2,112 x 10^3)		(US$1,302 x 10^3)			(US$810 x 10^3)	

Item	Description	Quantity	Unit	Rate F.C (₱)	Rate L.C (₱)	Amount F.C (₱'000)	Amount L.C (₱'000)
1-6	Pre-Engineering						
1-6-1	Survey works						
1)	Diversion dam						
	Topographical survey (500m x 250m)	13 ha x 5 places = 65	ha		250	-	17
	Cross section	8 lines x 250 m/lines = 2,000 m 2,000 m x 5 places = 10,000	m		1.0		10
	Profile of dam axis	2,000 m x 5 places = 10,000	m		1.5		15
	Sub-total						42
2)	Canal						
	Irrigation and drainage canals Profile	148.0	km		1,000		148
	Topographical survey for major structures	20 places x 0.5 ha = 10	ha		800		8
	Sub-total						156
1-6-2	Geological investigation						
1)	Madongan diversion dam Boring	45 m + 30 m = 75	m	-	1,000	-	75
2)	Papa diversion dam Boring	20 m 20	m		1,000		20
3)	Nueva Era diversion dam Boring	75 m 75	m		1,000		75
	Seismic prospecting	0.73	km		2,500		2
	Sub-total						172
	Total						365
							(US$49 x 10^3)

2. Land Acquisition and Compensation

Item	Description	Quantity	Unit	Rate (₱)	Amount (₱'000)
2-1	Land Acquisition				
(a)	Civil works				
	(1) Diversion Dam	11.5	ha	5,000	58
	(2) Irrigation cannal	236.0	"	20,000	4,720
	(3) Drainage "	60.0	"	"	1,200
	(4) On-farm	367.0	"	"	7,350
	Sub-total				13,328
(b)	Agricultural Development				
	(1) Working station	1.0	ha	20,000	20
(c)	Project Administration and Facilities				
	(1) Main project office	1.0	ha	20,000	20
	(2) Operation office	0.5	"	10,000	10
	(3) Housing	1.0	"	10,000	10
	Sub-total				40
2-2	Land Compensation				
(a)	Diversion dams				
	(1) Land (grassland and forest)	5	ha	600	3
	(2) Building				
	Housing	10	houses	16,000	160
	Housing site	0.3	ha	20,000	6
	Sub-total				166
	Total				13,557
					(US$1,832 x 10^3)

3. Construction Equipment

Equipment	Spec.	Number	Unit Price (₱')	Amount (₱'000)	Remarks
Bulldozer	6 ton	14	230	3,220	
"	11 ton	15	281	4,215	
Cable crane	L.S	1	700	700	
Compressor	5.0m^3/min	5	70	350	
Front end loader	1.2 "	3	333	999	
Leg drill	1.9 "	10	4	40	
Back hoe	0.25 "	2	258	516	
"	0.7 "	11	550	6,050	
Dump truck	6 ton	35	120	4,200	
Concrete mixing plants	0.75^m x 2	2	850	1,700	
Tire-roller	8.5 ~20 ton	2	270	540	
Motor-grader	3.6 m	1	300	300	
Vibrator	5 ps	15	3	45	
Pump	100 m/m 5 ps	34	8	272	
Pick up truck	4 ton	4	59	236	
Stake truck	6 "	3	100	300	with crane 1.5 ton
Fuel truck	8,000 ℓ	1	191	191	
Truck-tractor & trailer	25 ton	1	461	461	
Concrete pot mixer	0.3 m^3	8	37	296	
Portable belt conveyer	L = 7m	4	6	24	
Lammer	90 kg	5	7	35	
Lubricating car		1	414	414	
Repair work shop		1	460	460	
Utility jeep		8	90	720	
Station wagon		2	120	240	
Motor cycle		30	11	330	
Weeder cutter		20	3	60	
Laboratory equipment		L.S	300	300	
Generator	30 KVA	1	50	50	
"	75 "	2	100	200	
"	125 "	1	188	188	
Truck crane	20~25 ton	1	603	603	
Welder	20 KVA	3	20	60	
Sup-total				28,315	
Spair parts				2,832	
Transportation				300	
Total				31,447	
				(US$4,250 x 10^3)	

4. Agricultural Development

Item	Discription	Quantity	Unit	Rate	Ammount (₱'000)
4-1	Cadastral survey	L.S			46
4-2	Preparation cost for establishment of FIA				204
4-3	Cost of FIA office building				370
4-4	Management cost of FIA (during 3 years after establishment)				1,380
	Total				2,000

(US$270 x 10^3)

5. Operation and Maintenance Cost

Item	Description	No. of Personnel	Salary Per Annum (₱)	Total Salary Per Annum (₱'000)
5-1.	Salaries and Wages			
(a)	Main Project Office;			
	Irrigation superintendent	1	16,130	16.1
	Asst. irrigation supt.	2	12,360	24.7
	Agriculturist	2	12,360	24.7
	Administrative officer	1	9,410	9.4
	Supervising water management technologists	5	8,270	41.4
	Water management technicians	36	7,190	258.8
	Ditch tender	170	5,110	868.7
	Instrument man	1	7,190	7.2
	Cahser I	1	8,270	8.3
	Accounting clerk I	1	6,320	6.3
	Store keeper II	1	5,910	5.9
	Clerk II	1	5,910	5.9
	Clerk I	1	5,910	5.9
	Bill collector	3	6,320	18.9
	Billing clerk	3	5,910	7.7
	Securing gurd	3	5,910	7.7
	Janitor	1	4,440	4.4
	Driver	10	5,910	59.1
	Heavy equipment operator	4	7,190	28.8
	Auto mechanician	2	5,910	11.8
	Survey aid	2	5,510	11.0
	Sub-total	250		1,452.7
	Incentive allowance	1/12 x 1,452.7 + 1.2	=	122.3

Item	Description	No. of Personnel	Salary Per Annum (₱)	Total Salary Per Annum (₱'000)
(b) Casual employees for repair works (60 days per year)				
a.	Cons't forman	2 days x ₱25	= 50	
b.	Mason foreman	2 " x 25	= 50	
c.	Skilled labor	16 " x 21	= 336	
d.	Laborers	40 " x 18	= 720	
	Sub-total		1,156	1.2
(c) Five Diversion Dam Operation Offices				
a.	Mechanical engineer	1 x 12,360	= 12,360	
b.	Gate keeper	1 x 7,190	= 7,190	
c.	Driver	1 x 5,910	= 5,910	
d.	Water man	1 x 5,910	= 5,910	
	Sub-total	₱31,730 x 5	= 156,850	156.9
	Total			1,733 (US$234)

5-2. Equipment Operations

(a) Depreciation Cost

Machinaries	Quantity	Unit Cost (₱)	Total Cost (₱'000)	Depreciation Cost (₱'000)
Main Project Office				
Dump truck, 8 ton	3	180,000	540	54
Truck flated, 6 ton	1	120,000	120	12
Front end loader, 1.2 cu.m	1	333,000	120	35
Motor grader, =3.6 m	1	300,000	350	35
Tractor crawler, 16 ton	1	540,000	540	54
25 "	1	603,000		
Station wagon, 4x4	1	120,000	120	12
Jeep, utility vehicle, 4x4	6	90,000	540	54
Motorcycle, 90 cc	50	11,000	550	124
Concrete mixer, 0.3 cu.m	2	37,000	74	8
Water pump, 2" - 4"	2	8,000	16	2
Weed cutter	35	3,000	105	32
Radio transciever	6	65,000	390	39
Wireless telephone	1	230,000	230	35
Meteorological station	2	15,000	30	3
Leveling instlement with staff and steel tape	2	12,000	24	3
Transit with staff and tape	2	12,000	24	3
Current meter	1	4,000	4	1
Miscellaneous tools and equipment	L.S	-	158	24
Spare part (10%)	L.S			53
Sub-total				578
(b) Five-Diversion Dam Operation Office				
Jeep, utility vehicle, 4x4	5	90,000	450	45
Motorcycle, 90 cc	5	11,000	55	12
Sub-total				57

(c) Fuel and Oil Cost

10,200 ha x ₱35/ha = ₱357,000	357
Total	992
	(US$134,000)

5-3. Materials and Supplies

(a) Irrigation, Drainage and Road System

Excavation of irrigation and drainage canals,	
2.0 m x 0.1 m x 355,600 m x ₱5.0/m^3 = ₱355,620	357
Gravel pavement of raods	
4.00 x 0.02 m x 177,100 m x ₱19.0/m^3 = ₱269,192	269
Sub-total	626

(b) Building

Main project office	
2,000 m^2 x ₱650/m^2 x 4 % = ₱52,000	52.0
Operation office	
200 m^2 x ₱550/m^2 x 4 % = ₱4,400	4.4
Housing	
Government staff, 750 m^2 x ₱650 x 4 % = ₱19,500	19.5
Guest house, 200 m^2 x ₱650 x 4 % = ₱5,200	5.2
Consultants, 350 m^2 x ₱850 x 4 % = ₱11,900	11.9
Equipment shed, 3,000 m^2 x ₱250 x 4 % = ₱30,000	30.0
Sub-total	123.0

(c) Others

₱749,000 x 40 % = ₱299,600	300
Sub-total	300
Total	1,049

5-4. Administration and General Expenditures

₱2,079,600 x 30 % = ₱623,900	624
Grand-total	4,399
4,399 x 1.2[1/]	5,279
	(US$713x$10^3$)

1/: Coefficient of the operation and maintenance cost from 1982 to 1984.

6. Project Facility

Item	Description	Quantity	Unit	Rate (₱)	Amount (₱'000)
6-1.	Building and Faniture				
(a)	Building				
	Main project office	2,000	m^2	650	1,300
	Operation "	1,000	"	550	550
(b)	Housing				
	Government staff	750	m^2	650	487
	Guest house	200	"	"	130
	Consultants staff	350	"	850	298
	Equipment shed	3,000	"	250	750
(c)	Faniture	L.S			285
	Sub-total				3,800
6-2.	Equipment				
	Radio tranciever	6		65,000	390
	Wireless telephone	1		230,000	230
	Meteorological station	2		15,000	30
	Leveling instalument with staff and steel tape	2		12,000	24
	Transit with staff and tape	2		12,000	24
	Current meter	1		4,000	4
	Sub-total				702
	Total				4,502
					(US$608 x 10^3)

8. Consulting Service

Item	Description	Quantity	Unit	Rate (₱)	Amount (₱'000)
8-1.	Foreign Exchange Cost				
(a)	Final Design				
	Consultants remuneration	30	man-month	59,200	1,776
	International travel expense	10	trip	5,700	57
	Miscellaneous & communication	L.S			30
	Sub-total				1,863
(b)	construction Supervision				
	Consultants remuneration	60	man-month	59,200	3,552
	International travel expense	20	trip	5,700	114
	Miscellaneous & communication	L.S			114
	Sub-total				3,780
8-2.	Local Currency Cost				
(a)	Final Design				
	Local transportation	30	trip	650	20
	Consultants perdiem	900	day	250	225
	Sub-total				245
(b)	Construction Supervision				
	Local transportation	50	trip	650	33
	Consultants perdiem	1,800	day	250	450
	Housing and furniture	L.S			287
	Sub-total				770
	Total				6,658
					(US$900 x 10^3)

Table 4E-2 Labor Cost

Labor	Unit	Cost (₱)
Worker	day	15.62
Forman (Common)	"	23.89
Forman (Construction)	"	23.89
Chief Worker	"	24.87
Operator of Vehicle	"	21.28
Assistant of Vehicle	"	20.07
Operator of Heavy Equipment	"	15.62
Assistant of Heavy Equipment	"	23.89
Mason	"	21.28
Carpenter	"	21.28
Smith	"	21.28
Painter	"	21.28
Welder	"	23.89
Asphalt Worker	"	15.62
Watcher	"	20.07
Head Carpenter	"	23.89
Head Smith	"	23.89
Head Welder	"	24.87

Table 4E-3 Disbursement Schedule of Investment Cost

Description	Total			1st Year (Jan.'79 - Dec.'79)			2nd Year (Jan.'80 - Dec. '80)			3rd Year (Jan.'81 - Dec.'81)			4th Year (Jan.'82 - Dec.'82)			5th Year (Jan.'83 - Dec.'83)			6th Year (Jan.'84 - Dec.'84)		
	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total
1. Civil Works[1/]																					
1-1 Preparation	45	1,091	1,136	-	-	-	45	1,091	1,136	-	-	-	-	-	-	-	-	-	-	-	-
1-2 Diversion Dams	26,596	28,966	55,562	-	-	-	-	-	-	2,014	1,006	3,020	7,932	8,986	16,918	10,599	11,220	21,819	6,051	7,754	13,805
1-3 Irrigation & Drainage Canals	19,615	33,453	53,068	-	-	-	-	-	-	2,460	4,485	6,945	5,526	10,028	15,554	5,660	10,591	16,251	5,969	8,349	14,318
1-4 On-farm	5,312	6,265	11,577	-	-	-	-	-	-	531	626	1,157	1,592	1,883	3,475	1,592	1,883	3,475	1,597	1,873	3,470
1-5 Roads	3,743	5,990	9,733	-	-	-	-	-	-	479	767	1,246	1,078	1,724	2,802	1,078	1,724	2,802	1,108	1,775	2,883
1-6 Pre-Engineering	-	365	365	-	35	35	-	330	330	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	55,311	76,130	131,441	-	35	35	45	1,421	1,466	5,484	6,884	12,368	16,128	22,621	38,749	18,929	25,418	44,347	14,725	19,751	34,476
2. Land Acquisition & Compensation			13,557	-	-	-	-	-	-	-	4,519	4,519	-	4,519	4,519	-	4,519	4,519	-	-	-
3. Construction Equipment	31,147	300	31,447	-	-	-	-	-	-	31,147	300	31,447	-	-	-	-	-	-	-	-	-
4. Agricultural Development		2,000	2,000	-	-	-	-	-	-	-	620	620	-	460	460	-	460	460	-	460	460
5. Operation & Maintenance Cost	428	4,851	5,279	-	-	-	-	-	-	-	-	-	33	407	440	120	1,640	1,760	275	2,804	3,079
6. Project Facilities	702	3,800	4,502	-	1,140	1,140	702	2,660	3,362	-	-	-	-	-	-	-	-	-	-	-	-
7. Project Administration	7,001	7,984	14,985	-	91	91	56	330	386	2,930	986	3,916	1,290	2,302	3,592	1,514	2,560	4,074	1,211	1,715	2,926
8. Consulting Services	5,643	1,015	6,658	-	-	-	1,980	350	2,330	257	46	303	920	162	1,082	926	164	1,090	1,575	278	1,853
Sub-total (1 to 8)	100,232	109,637	209,869	-	1,266	1,266	2,783	4,761	7,544	39,818	13,355	53,173	18,371	30,471	48,842	21,489	34,761	56,250	17,782	25,012	42,794
9. Contingency	9,744	10,587	20,331	-	7	7	8	252	260	1,672	1,116	2,788	2,613	3,264	5,877	3,066	3,518	6,584	2,385	2,430	4,815
Sub-total (1 to 9)	109,976	120,224	230,200	-	1,273	1,273	2,791	5,013	7,804	41,490	14,471	55,961	20,984	33,735	54,719	24,555	38,279	62,834	20,167	27,442	47,609
10. Price Escalation (8%)	36,504	44,569	81,073	-	51	51	344	617	961	8,841	3,084	11,925	6,505	10,457	16,962	10,183	15,893	26,076	10,631	14,467	25,098
Total (1 to 10)	146,480	164,793	311,273	-	1,324	1,324	3,135	5,630	8,765	50,331	17,555	67,886	27,489	44,192	71,681	34,738	54,172	88,910	30,798	41,909	72,707

1/: Exclusive of depreciation cost of construction equipments.

Additional Investigation (Pre-Engineering Works)

A. Survey and Investigation for Civil Work

1. Diversion Dam

Additional topographical and geological investigations for the proposed five diversion dams will be needed at field in order to obtain sufficient data prior to preparation of the more detailed design works. An outline of the main items of recommendable investigations are shown below:

a) Survey

- Detailed topographic survey with scale of 1 : 500 around the proposed site, 300 m upstream and 200 m downstream from the site, is requested to be carried out and on the surveyed map the following contour line should be indicated: 0.2 m interval for the river course and 1.0 m interval for others.

- Cross-sectional survey of the river of which scale is 1 : 200 at the proposed site is requested to be carried out to the extent of 800 m upstream and 600 m downstream with an interval of 200 m each.

- Longitudinal section survey of stream centerline is requested to be carried out to the extent of about 1,000 m upstream and downstream from the proposed site, respectively, and scale of which is as follows: vertical 1 : 100, horizontal 1 : 1,000.

b) Geological Investigation

- Madongan Diversion Dam

  5 bore-hole drillings

Dam axis	15m x 3 holes = 45.0 m
Right side river bed of downstream	15m x 2 holes = 30.0 m

° Papa Diversion Dam

2 bore-hole drillings

Left side river bed of downstream 10m x 2 holes = 20.0 m

Core boring at three points with a total depth of 47.40 m has been conducted by NIA at the proposed dam axis. It is found that some portions of the rock covering the left side of the river bed and bank has been softened to a degree. So, core boring should be conducted to study the cut-off depth and the necessity of river protection works of the dam body at the proposed end of the apron.

° Nueva Era Diversion Dam

5 bore-hole drillings

Dam axis 15m x 5 holes = 75.0 m

Seismic prospecting

Total length 4 lines 0.73 km

2. Irrigation and Drainage Canals

The profile and cross section surveys for the proposed main, lateral irrigation and drainage canals shall be performed for the detail design of the canals and related structures.

The following table shows the proposed length of survey.

Item	Profile (km)	Related Structures (places)
Irrigation Canal	116.5	20
Drainage Canal	55.0	-

B. Agricultural Survey

1. Soil Survey

The soil profiles in the Project Area were investigated at three test pits, 611 auger boring holes (NIA, 1976) and 78 stick boring holes

(JICA, 1978). In addition, the more detailed survey by digging test pits are requested to be carried out to study.

2. Cadastral Survey

Cadastral survey covering the whole Project Area shall be implemented at the early stage of the construction, and the present status of land tenure shall be clear for smooth execution of organization of compact farming systems to be introduced after the completion of on-farm development.

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION

Construction Planning of Major Civil Works

A. Construction Schedule

1. Workable Days for Construction Works

Workable days for the construction works were enumerated based upon the rainfall data for the periods of 10 years from 1966 to 1976 at Laoag in Ilocos Norte. From this table, the workable months could be considered to be seven months from November to May next year considering rainfall and paddy field conditions.

The daily working hours are decided to eight hours for nomal labor works and seven hours for equipment operation excluding the hours of adjustment of equipments before operation.

2. Construction Schedule

Judging from the above-mentioned workable months, the construction works would be executed with scales and numbers of equipment which are decided economically, and construction schedule was planned based on the production of equipment.

The construction will be started from FY 1981 and completed in FY 1984.

B. Construction Equipment

Necessary equipment for the construction of diversion dams, irrigation and drainage canals and on-farm were estimated based on the expected workable days and construction schedule. The proposed equipment and vehicles will be loaded at San Fernando, and then delivered to the construction sites by trailers or trucks. To transport these equipment and vehicles to the sites, improvement of existing roads together with access roads are to be completed prior to the commencement of construction works.

C. Diversion Dams

Construction periods of the proposed diversion dams, Solsona, Labugaon, Madongan, Papa and Nueva Era, are planned to be about four years, started from October 1981 and finished in December 1984. The construction works of these diversion dams will be conducted during the dry season to prevent from floods. (See Figure 5B-1)

Prior to the construction of major works, the access roads to proceed the construction site would be provided by newly construction or improvement of the existing roads, and these roads would be utilized for operation and maintenance roads of the project facilities after completion of works.

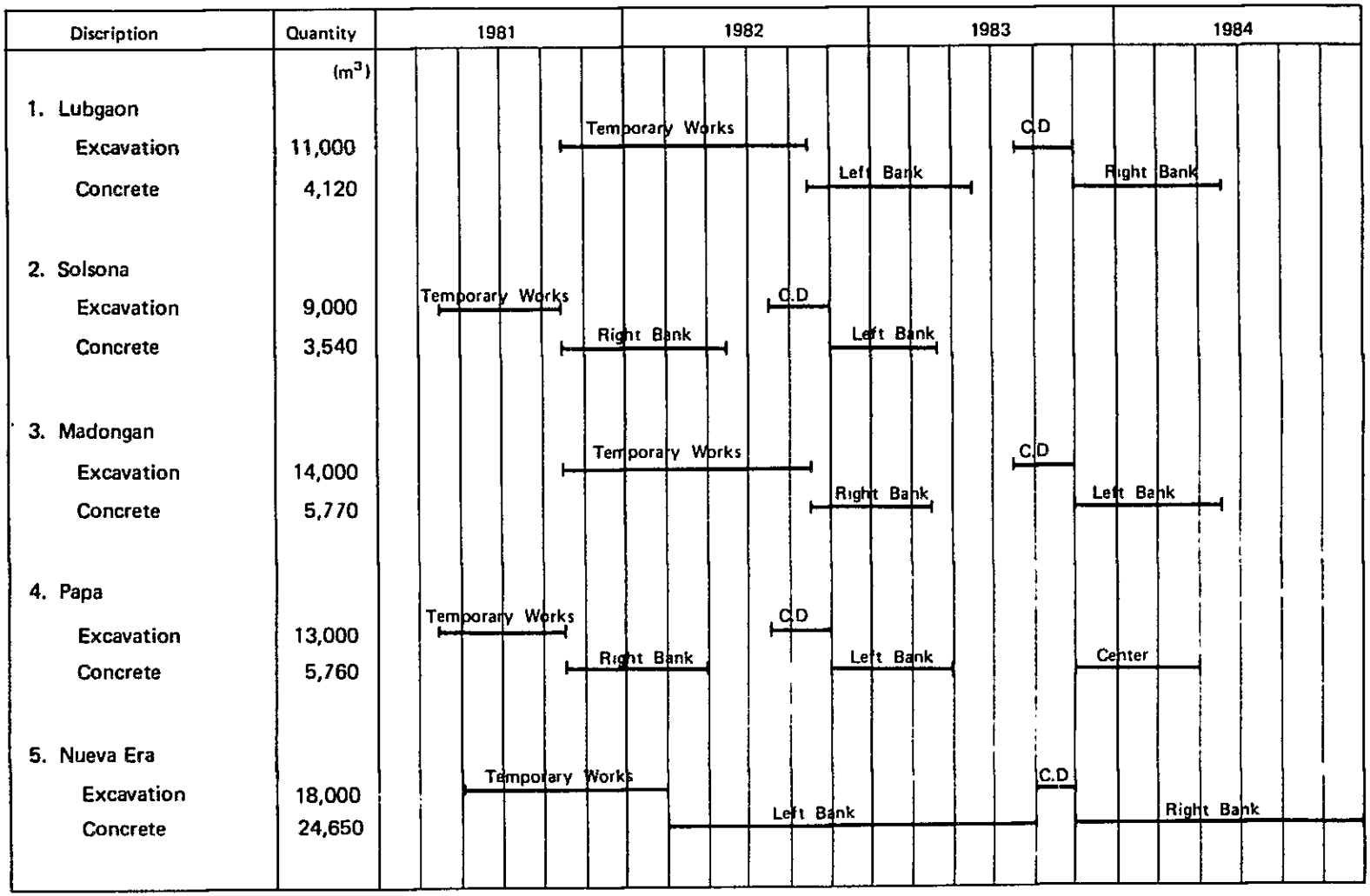
For the excavation of foundation of each diversion dam, bulldozer of 11 ton, back hoe shovel of 0.6 cubic meter and dump truck of 6 ton, are to be utilized. Concrete would be produced by concrete plants installed at the vicinity of the proposed diversion dam sites and transported by a bucket of 1.0 cubic meter and placed in the forms by a truck crane of 10 ton. For diversion dam at Nueva Era the concrete would be placed by a cable crane for a high dam. Gates and maintenance bridges would be installed using a track crane of 10 ton.

Table 5B-1 indicates the required construction equipment for diversion works.

Table 5B-1 List of Required Construction Equipment

Equipment	Specification	Quantity
Dump truck	6 ton	21
Leg drill	1.9 m^3/min	10
Compressor	5.0 m^3/min	5
Drainage Pump	ø100 m/m 5 ps	30
Concrete plant	0.75 m^3 x 2 sets	2
"	0.75 m^3 x 1 set	2
Backhoe shovel	0.7 m^3	7
Bulldozer	11 ton	8

FIGURE 5B-1 CONSTRUCTION SCHEDULE OF DIVERSION DAMS



Note : C.D : Coffer dam

D. Irrigation and Drainage Canals

The construction of irrigation and drainage canal
ed from FY 1981 on the same schedule of on-farm development, and will be completed in FY 1984. Yearly construciton of irrigation and drainage canals are as shown below;

Table 5B-2 Construction Schedule of Irrigation and Drainage Canal

Year	Irrigation Canal		Drainage Canal	
	Main (m)	Lateral (m)	Existing River & Creak (m)	Lateral (m)
1981	19,900	-	14,300	-
1982	48,600	-	25,800	-
1983	40,260	17,050	14,880	32,350
1984	-	75,000	-	59,700
Total	108,760	92,050	54,980	92,050

The following table shows the required construction equipment for the works.

Table 5B-3 List of Required Construction Equipment

Equipment	Specification	Quantity
Bull dozer	6 ton	3
"	11 ton	2
Front end loader	1.2 ton	2
"	0.7 ton	8
Dump truck	6 ton	14
Tire-roller	20 ton	2
Motor grader	3.6 ton	1
Vibrator	5 ps	4
Pump	100 m/m	4
Fuel tank	8000 ℓ	1
Track trailer	25 ton	1
Concrete pot mixer	0.3 m^3	3
Portable Belt conveyer	7 m	4
Lammer	90 kg	4

F. Roads

Table 5B-4 Construction Schedule of O & M Roads

Year	Length	Remarks
1981	23,700	Road width for main canal
1982	54,400	W = 6.0 m
1983	55,800	Road width for lateral canal
1984	51,400	W = 4.0 m
Total	185,300	

Table 5B-5 List of Required Construction Equipment

Equipment	Specification	Quantity
Bulldozer	11 ton	2
Front end Roader	1.2 m^3	2
Dump truck	6.0 ton	14

G. On-farm Development

1. Construction Schedule

On-farm development of the service area will be started from FY 1981, half a year late from starting of construction works of diversion dam. Construction work of on-farm development will be done within five months from November to May next year. Yearly on-farm development areas is summarized as follws; based on the study on expectable irrigation water after completion of the diversion dam.

Table 5B-6 On-farm Development Area

Year	Area to be Developed	Cropping Area (ha)	
		Wet Season	Dry Season
1981	1,020	-	-
1982	3,060	1,020	1,020
1983	3,060	4,080	4,080
1984	3,060	7,140	7,140
1985	-	10,200	
Total	10,200		

As is seen in the above table, on-farm development will be completed by the end of 1984 and the whole area of 10,200 ha will be planted from the wet season in 1985. When the construction of Palsiguan dam is completed, the whole cropping areas will be planted in both wet and dry seasons.

Yearly extent of construction area from 1981 to 1984 is shown in Figure 5B-2 and Table 5B-7.

Table 5B-7 Yearly Construction Schedule of On-farm Development

(Unit: ha)

Area	1981	1982	1983	1984	Total
Labugaon	-	560	560	440	1,560
Solsona	1,020	550	-	570	2,140
Madongan	-	1,180	1,100	910	3,190
Papa	-	770	940	850	2,560
Nueva Era	-	-	460	290	750
Total	1,020	3,060	3,060	3,060	10,200

2. Construction Equipment

Construction equipments for the on-farm development are two back hoes, based on the construction schedule and work valumes. Taking into consideration that there is no construction of land terracing and leveling in this project, bulldozers and dump trucks will not be used.

FIGURE 5B-2 ON-FARM DEVELOPMENT SCHEDULE

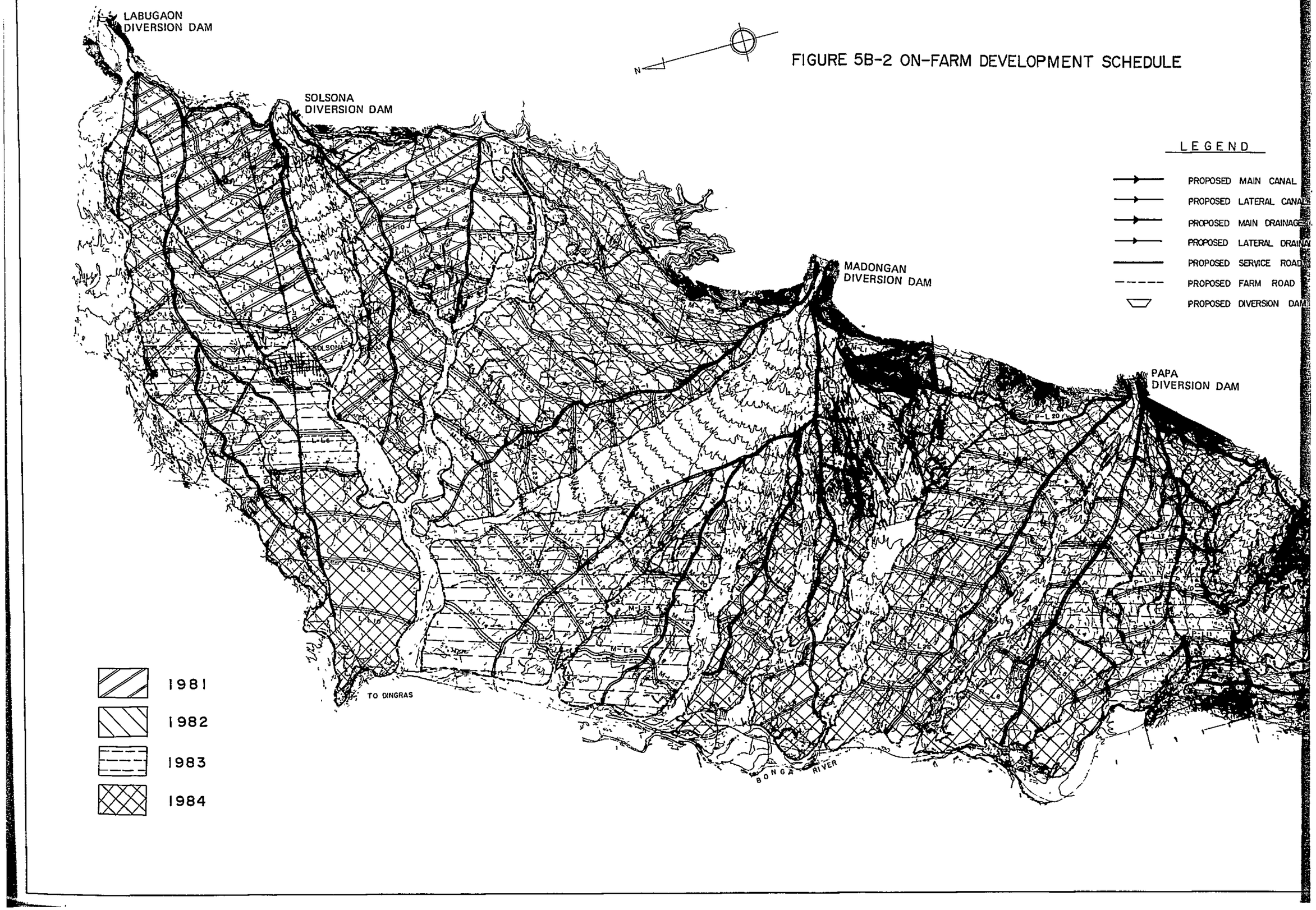
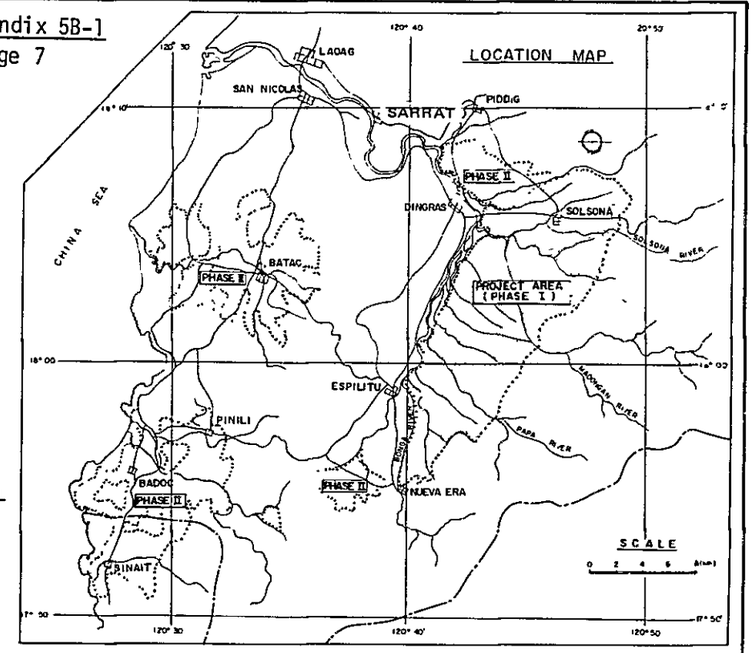


FIGURE 5B-2 ON-FARM DEVELOPMENT SCHEDULE



SCALE

0 1.0 2.0 3.0(KM)

LEGEND

- PROPOSED MAIN CANAL
- PROPOSED LATERAL CANAL
- PROPOSED MAIN DRAINAGE CANAL
- PROPOSED LATERAL DRAINAGE CANAL
- PROPOSED SERVICE ROAD
- PROPOSED FARM ROAD
- PROPOSED DIVERSION DAM

MADONGAN DIVERSION DAM

PAPA DIVERSION DAM

NUEVA ERA DIVERSION DAM

BONGA RIVER

Operation and Maintenance Cost

1. Salaries and Wages

Item	No. of Personnel	Salary per Annum (₱)	Total Salary per Annum (₱'000)
Main Project Office:			
Irrigation superintendent	1	16,130	16.1
Asst. irrigation supt.	2	12,360	24.7
Agriculturist	2	12,360	24.7
Administrative officer	1	9,410	9.4
Supervision water management technologist	5	8,270	41.4
Water management technicians	36	7,190	258.8
Ditch tender	170	5,110	868.7
Instrument man	1	7,190	7.2
Casher I	1	8,270	8.3
Accounting clerk I	1	6,320	6.3
Store keeper II	1	5,910	5.9
Clerk II	1	5,910	5.9
Clerk I	1	5,910	5.9
Bill collector	3	6,320	18.9
Billing clerk	3	5,910	7.7
Security guard	3	5,910	7.7
Junitor	1	4,440	4.4
Driver	10	5,910	59.1
Heavy equipment operator	4	7,190	28.8
Auto mechanician	2	5,910	11.8
Survey aid	2	5,510	11.0
Sub-total	250		1,452.7
Incentive allowance	1/12 x 1,452.7 + 1.2	=	122.3

Casual employees for repair works (60 days per year)				
a. Cons't foreman	2 days	x ₱25	= 50	
b. Masonry foreman	2	x 25	= 50	
c. Skilled labor	16	x 21	= 336	
d. Laborers	40	x 18	= 720	
			1,156	1.2

Five Diversion Dam Operation Offices:

Mechanical engineer	1 x 12,360	= 12,360	
Gate keeper	1 x 7,190	= 7,190	
Driver	1 x 5,910	= 5,910	
Watchman	1 x 5,910	= 5,910	
Sub-total	₱31,370 x 5	= 156,850	156.2
Total			1,733.1
			(US$234,200)

2. Equipment Operations

a) Depreciation Cost

Machinaries	Quantity	Unit Cost (₱)	Total Cost (₱'000)	Depreciation Cost (₱'000)
Main Project Office:				
Dump truck, 8 ton	3	180,000	540	54
Truck flated, 6 ton	1	120,000	120	12
Front end loader, 1.2 cu.m	1	333,000	330	33
Motor grader, ℓ=3.6 m	1	300,000	300	30
Tractor crawler, 16 ton	1	540,000	540	54
Station wagon, 4x4	1	120,000	120	12
Jeep, utility vehicle, 4x4	6	90,000	540	54
Motorcycle, 90 cc	50	11,000	550	124
Concrete mixer, 0.3 cu.m	2	37,000	74	8
Water pump, 2" - 4"	2	8,000	16	2
Weed cutter	35	3,000	105	32
Radio transciever	6	65,000	390	39

Machinaries	Quantity	Unit Cost (₱)	Total Cost (₱'000)	Depreciation Cost (₱'000)
Wireless telephone	1	230,000	230	35
Meteorological station	2	15,000	30	3
Leveling instlement with staff and steel tape	2	12,000	24	3
Transit with staff and tape	2	12,000	24	3
Current meter	1	4,000	4	1
Miscellaneous tools and equipment	L.S	-	158	24
Spare part (10%)	L.S			55
Sub-total				578
Five Diversion Dam Operation Office:				
Jeep, utility vehicle, 4x4	5	90,000	450	45
Motercycle, 90 cc	5	11,000	55	12
Sub-total				57

b) Fuel and Oil Cost

10,200 ha x ₱35/ha = ₱357,000 — 357

Total — 992

(US$134,100)

3. Materials and Supplies

a) Irrigation, drainage and Road System

Excavation of irrigation and drainage canals,

2.0 m x 0.1 m x 355,620 m x ₱5.0/m^3 = ₱355,620 — 356

Gravel pavement of roads

4.00 x 0.02 m x 177,100 m x ₱19.0/m^3 = ₱269,192 — 270

Sub-total — 626

b) Building

Main project office		
2,000 m x ₱650/m^2 x 4% = ₱52,000		52.0
Operation office		
200 m x ₱550/m^2 x 4% = ₱4,400		4.4
Housing		
Government staff,	750 m^2 x ₱650 x 4% = ₱19,500	19.5
Guest house,	200 m^2 x ₱650 x 4% = ₱ 5,200	5.2
Consultants house	350 m^2 x ₱850 x 4% = ₱11,900	11.9
Equipment shed,	3,000 m^2 x ₱250 x 4% = ₱30,000	30.0
Sub-total		123.0

c) Others

₱749,000 x 40% = ₱299,600	300
Sub-total	300
Total	1,049
	(US$141,700)

4. Administration and General Expenditures

₱1,733,100 x 30% = ₱519,930	519.3
	(US$70,180)

Terms of Reference for the Consultant's Services

1. Objectives

The purpose of the Consultsnt's services is to assist the Government in the effective implementation of the Project.

The Consultant's services are divided into three phases as follows:

(1) The final detailed designs of the Project as well as the preparation of tender documents. It would cover 30 man-months periods starting from January, 1980. Highly qualified experts will be engaged including irrigation engineers, Engineering geolocist, hydrologist, design engineers, and economist.

(2) Construction supervision and training of local counterparts personnel in all phases of project activities. The service periods cover 40 man-months from October 1981 to November 1984. The required experts would be project engineers, and engineering geologist.

(3) Establishment of agricultural institutional development program and training. It would cover 20 man-months. Highly qualified experts will be engaged including a agronomist, agri-institutional expert and water and farm management expert.

2. Specific Terms of Reference

The Consultants will provide a team to undertake the followings of the Consultant's services.

a) To assist the preparation of detailed design, cost estimates, specifications and tender documents for civil works and for procurement of operation and maintenance equipments, construction machineries, construction materials and other goods and instruments necessary for the project;

b) To assist INIP in the supervision of construction works under the project.

c) To assist and advise the Project Manager in preparing monthly construction schedule and work records;

d) To assist the relevant Government agencies to prepare agri-institutional establishment program which will include the provision for:

(i) effective education of farmers in the Project Area through intensive demonstration and other means to enable them to adopt new cropping systems, diversified crops, use improved varieties of crops and improve cultivation practices;

(ii) strengthening of existing farmers' organizations and establishment of new organizations, of local farmers for the effective channelling of agricultural services;

(iii) adequate supply of agricultural credit and production requisites to these farmers as required for the recommended system of intensive cropping; and

e) To train local counterpart personnel in all phases of project activities.

3. Expertise

a) Senior Irrigation Engineer with sufficient experience in the planning, design, and operation and maintenance of irrigation and drainage system and with sufficient seniority to function as team leader.

b) Design Engineer with sufficient experience in the planning, design and construction of diversion dams, canals, and on-farm.

c) Engineering Geologist with sufficient experience in the geological investigation for the major structures such as, diversion dam, canal structures, bridge and etc.

d) Hydrologist with sufficient experience in evaluation the climatical and hydrological data and also analysing run-off discharge and water balance.

e) Agronomist with sufficient experience in the crop and soil management under paddy irrigation and upland crops at the farm level as well as in agricultural supporting services for irrigated agriculture.

f) Agri-institutional Expert with broad experience in the agricultural supporting services for irrigated agriculture.

g) Economist with sufficient experience in the establishment of farm budgets, marketing and credit services and in the evaluation of economic and financial viability of the irrigated agricultural development project.

4. Services to be provided by the Government

The Government will provide the followings for carrying out the Consultant's services.

a) All available documents, drawing, maps, statistics, data and other information related to the Irrigated Agricultural Development Project in the Project Area.

b) Suitable full-time counterparts personnel, including engineers, technicians and professionals, as required for the project; and

c) To exempt the Consultants from (or bear the cost of) any taxes, duties, fees, levies and other impositions imposed under its laws and regulations in the respect of;

(i) any payment made to the Consultants in connection with the carrying out their services;

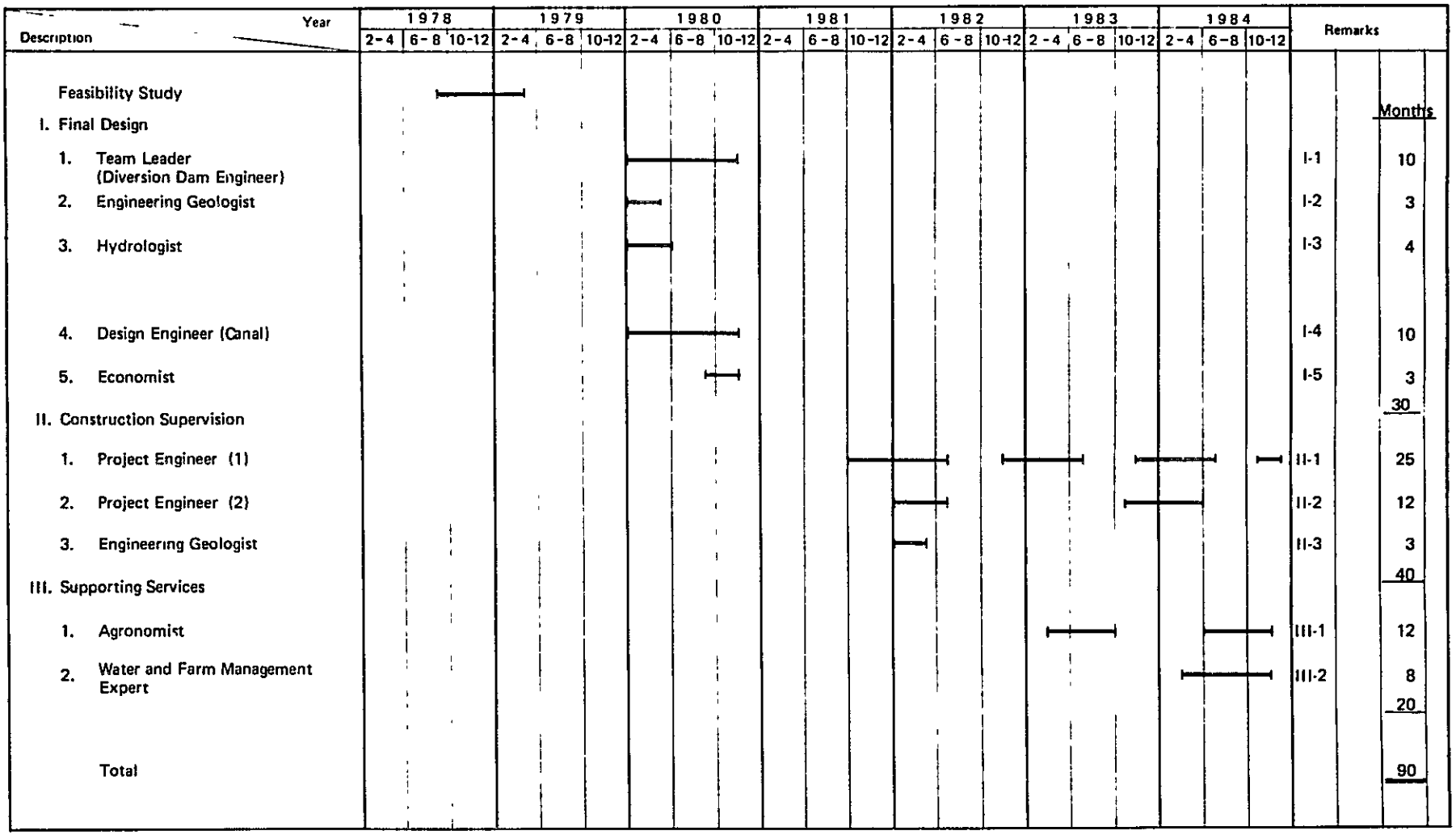
(ii) any equipment and materials and supplies brought into the territories of the Government for the purpose of carrying

out the services; and

(iii) any property brought by the members of the Consultants for their personnel use and consumption.

Figure 5D-1 shows the proposed schedule for the Consultant's services.

FIGURE 5D-1 PROPOSED SCHEDULE FOR CONSULTANT'S SERVICES



CHAPTER VI. PROJECT JUSTIFICATION

Table 6C-1 Price Structure for Rice, 1978 and 1985[1/]

Description	1978 (₱/ton)	1985 (₱/ton)
1) Export Price of Thai 25-35% brokens, F.O.B Bangkok	1,890 ($230)	2.385 ($290)
2) Ocean freight and insurance[2/]	140	140
3) Import price, C.I.F. Philippine port	2,030	2,525
4) Port handling charges	60	60
5) Transport cost from port to selling center[3/]	-75	-75
6) Price of rice ex-mill	2,015	2,510
7) Paddy equivalent price (63% recovery)	1,270	1,580
8) Transport cost from farm to mill[4/]	-40	-40
9) Value of by-products less milling fees	0	0
10) Farm-gate paddy price[5/]	1,230	1,540
11) Financial farm-gate price/cavan	(1,100)	(1,385)[6/]
12) Farm-gate price/cavan	60	75
13) Financial Farm-gate price	(55)	(70)

1/ ₱/ton values at constant middle 1978 prices.
Peso shadow priced at exchange rate of ₱1.00 = ₱8.22.
Peso rounded to nearest ₱5.00.

2/ Philippine port used in this analysis is San Fernando, La Union.

3/ Selling centers used in this analysis is Laoag City esitmated to be 216.9 kms from Philippine port. (San Fernando, La Union)

4/ Transport cost from farm to mill is ₱2 00/bag of 50 kg.

5/ Present financial price is actual.

6/ 1985 financial price is calculated by using the official exchange rate of US$1.00 = ₱7.40.

Basic Data: Milling Costs Less Value of by Products

1) Milling fee per 50 kg of rice ..... ₱8.0 (NGA)

2) Milling Recovery ..... 63 %

3) Milling fee per 50 kg of Palay ..... $8.0 \times \frac{50 \times 0.63}{50} = ₱5.04$

4) Milling fee per 1,000 kg of palay ... ₱100.8

5) Average price of By-products ..... Bran ₱1.11 per kg

6) Output of by-products ..... 9% per one cavan of Palay
50 kg x 0.09 = 4.5 kg

7) Output of by-products per 1,000 kg .. 4.5 kg x 20 = 90 kg

8) Value of by-products per 1,000 kg ... 1.11 x 90 = ₱99.9

9) Milling Cost less value of by products ..... ₱100.8 - ₱99.9 ≒ 0

Table 6C-2 Price Structure for Tobacco, 1978 and 1985[1/]

Description	1978 (₱/ton)	1985 (₱/ton)
1) Export unit value of flue-cured leaf F.O.B India	15,370 (US$1,870)	15,290 (US$1,860)
2) Ocean freight, insurance to Europe	1,350	1,350
3) Inport price, C.I.F. Europe	16,720	16,640
4) 15% mark up for higher quality Phil. leaf	2,510	2,495
5) Import price C.I.F. Europe for Phil. Tobacco	19,230	19,135
6) Ocean freight, insurance Manila to Europe	-2,000	-2,000
7) Manila Handling charges	-400	-400
8) Average transportation cost to Manila	-60	-60
9) Warehouse and dealers expense	-580	-580
10) Transportation cost farm to warehouse	-60	-60
11) Farm-gate tobacco price	16,130	16,035
12) Financial farm-gate price	(7,400)[2/]	(14,435)[3/]

1/ ₱/ton figures are constant June 1978 prices.

Peso shadow priced at US$1.00 = ₱8.22.

Peso figures are rounded to nearest ₱5.00.

2/ 1978 financial prices are actual prices.

3/ 1985 financial prices are calculated by using the official exchange rate of US$1.00 = ₱7.40.

Table 6C-3 Price Structure for Onion, 1978 and 1985

		1978 (₱/ton)	1985 (₱/ton)
1)	Export price, F.O.B San Fernando	1,975 (US$240)	1,975 (US$240)
2)	Port handling charges	-60	-60
3)	Transportation cost from selling center to port	-75	-75
4)	Transport cost from farm to selling center	-40	-40
5)	Farm gate price	1,800	1,800
6)	Financial farm gate price	(1,720)	(1,620)

Table 6C-4 Price of Fertilizers for 1978 and 1985[1/]

(Unit: ₱/ton)

Description	Urea		TSP		Muriate of Potash	
	1978	1985	1978	1985	1978	1985
1) Export price F.O.B.[2/]	₱1,240 (US$151)	₱1,685 (US$205)	₱970 (US$118)	₱1,420 (US$173)	₱470 (US$57)	₱625 (US$76)
2) Ocean freight & insurance	265	270	195	200	175	175
3) Import price C.I.F Phil port[3/]	1,505	1,955	1,165	1,620	645	800
4) Port handling charges	40	40	60	60	60	60
5) Transport cost to Laoag, dist. center[4/]	75	75	75	75	75	75
6) Transport cost from Laoag to farm	45	45	45	45	45	45
7) Farm-gate price	1,665	2,115	1,345	1,800	825	980
(Financial Farm-gate price)[5/]	(2,100)	(1,905)	(1,870)	(1,620)	(1,350)	(880)
	3.70	4.70	2.92	3.00	1.35	1.63
	(4.67/kg)	(4.25)	(4.07)	(4.50)	(2.20/kg)	(1.47)

1/ ₱/ton values at constant mid-1978 prices. Peso shadow priced at US$ = ₱8.22
₱/ton figures are rounded to nearest ₱5.00.

2/ Urea, Europe bagged; TSP Florida bagged & Potash Vancouver bagged.

3/ Philippine port used in this analysis is San Fernando, La Union.

4/ Distribution center is Laoag City, 216.9 km from Phil. port.

5/ Financial price for 1978 is actual, 1985 financial price is estimated using the official exchange rate of US$1.00 = ₱7.40.

Table 6C-5 Petroleum Price Structure, 1978 and 1985

	1977		1985	
	₱/10³ℓ	US$/10³ℓ	₱/10³ℓ	US$/10³ℓ
1) Saudi Arabian light crude oil 340 average realized price F.O.B. Ras Tanura[1/]	937	114	937	114
2) Ocean freight, insurance and ocean loss to Manila Port[2/]	180	24	195	26
3) Price of light crudeoil Cavite refining factory	1,117	138	1,132	140

1/ Based on Office Memoranda, May 17, 1976, IBRD

	1976	1977	1978	1985
in current Dollars	97	106	114	184
in 1976 Constant Dollars	97	97	97	97
in 1977 " "		106		106
in 1978 " "			114	114

2/ Ocean freight value was assumed refering to freight values of other commodities.

Insurance and ocean loss was each computed at 0.2 % and 1.0 % of CIF price.

Table 6C-6 Export of Garlic

Year	Destination	Quantity (kg)	FOB (US$)	Unit Price (US$/kg)	Unit Price (₱/kg)	Domestic Price (₱/kg)
1974	Indonesia	4,000	2,150	0.54	4.05	4.69
1975	Indonesia	8,160	7,050	0.86	6.45	4.59
1976	-	-	-	-	-	10.02
1977	Guam					
	Fish & Chilled	60	27	0.45	3.38	7.93
	Rehydrated or Powdered	100	150	1.50	11.25	

Source: BAEcon.

Note : Domestic price is wholesale price at Laoag City.

Table 6C-7 Garlic: Average Price Received by Farmers (Ilocos Region)

(Unit: ₱/kg)

Month	1973	1974	1976	1977	1978
Jan.	2.67	3.54	9.12	-	6.06
Feb.	2.73	3.71	7.73	5.66	5.86
Mar.	2.43	2.83	7.54	5.07	4.87
Apr.	2.43	4.62	7.12	5.60	6.00
May	2.94	-	7.33	5.65	6.16
Jun.	2.64	4.13	9.14	5.90	5.00
Jul.	4.50	4.38	9.38	6.00	
Aug.	-	4.42	10.42	6.40	
Sep.	-	5.59	10.36	5.64	
Oct.	3.00	6.13	9.00	7.25	
Nov.	-	7.40	10.50	6.95	
Dec.	-	7.16	8.50	-	
Ave.	2.92	4.90	8.85	6.01	(5.66)

Note: March is a harvesting time.
Average per year (1976-1977) ₱7.43/kg (100%)
Average as of March (1976-1977) ₱6.30/kg (85%)
Figure in 1978 indicate wholsale price at Laoag City.

Source: BAECon

Table 6C-8 Garlic: Retail and Wholesale Price

	Laoag City		Vigan City
	Wholesale (₱/kg)	Retail (₱/kg)	Retail (₱/kg)
1974	4.69	5.51	6.01
1975	4.59	6.24	7.72
1976	10.02	13.44	10.95
1977	7.93	10.22	8.80

Table 6C-9 Export of Onion, Fresh or Chilled

	Description	1974 Quantity ('000kg)	1974 FOB Value (US$'000)	1975 Quantity ('000kg)	1975 FOB Value (US$'000)	1976 Quantity ('000kg)	1976 FOB Value (US$'000)	1977 Quantity ('000kg)	1977 FOB Value (US$'000)
1)	United States	-	-	3.1	0.89	-	-	7.0	3.6
2)	Fed of Malaya	-	-	14.0	3.61	-	-	160.0	51.6
3)	Singapore	-	-	636.0	179.23	396.25	136.10	1,573.68	443.92
4)	Hong Kong	76.73	12.95	167.28	23.15	92.34	19.74	127.51	47.31
5)	Japan	1,424.45	383.70	-	-	2,774.5	623.00	4,954.71	1,085.73
6)	Netherland	-	-	175.0	36.03	-	-	-	-
7)	Guam	-	-	0.4	0.09	-	-	-	-
8)	Total	1,501.18	396.65	995.78	243.00	3,263.09	778.84	6,822.9	1,632.16
9)	FOB Price (US$/kg)	0.26		0.24		0.24		0.24	
	(₱/kg)	1.95		1.8		1.8		1.8	
10)	Domestic Price ₱/kg	4.00		2.70		2.15		1.72	

Note: Domestic Price is farm gate Price of Ilocos except that of Philippines in 1977.

Source: BAEcon

Table 6C-10 Garlic Production - Philippines

Year	Area (ha)	Production (ton)	Yield (ton/ha)
1975	4,160	15,973	3.84
1976	4,420	15,182	3.43
1977	4,910	16,026	3.26

Source: BAEcon

Table 6C-11 Onion Production - Philippines

Year	Area (ha)	Production (ton)	Yield(ton/ha)
1975	12,750	52,854	4.15
1976	11,930	54,279	4.55
1977	11,540	75,355	6.53

Source: BAEcon

Table 6C-12 Production of Garlic and Onion - Ilocos
- 1976 -

Crop	Area (ha)	Production (ton)	Value (₱10^6)
Garlic	3,300	11,862 (3.59t/ha)	96.4
Onion			
Green	3,060	13,842 (4.52 t/ha)	30.4
Bulb	1,560	6,159 (3.95 t/ha)	8.7

Table 6C-13 Average Monthly Wholesale Prices of Garlic
Metro Manila, 1975 - 1978

(unit: ₱/kg)

Month	Year			
	1975 - 76	1976 - 77	1977 - 78	1978 - 79
Mar.	6.50	9.33	8.14	6.61
Apr.	6.34	7.58	7.20	6.32
May	6.91	8.20	8.34	6.88
Jun.	7.17	8.72	9.38	
Jul.	8.00	9.40	10.73	
Aug.	8.00	11.45	10.52	
Sep.	8.32	12.50	11.35	
Oct.	9.26	13.14	11.38	
Nov.	10.79	13.16	10.40	
Dec.	10.69	12.93	10.08	
Jan.	11.96	15.07	9.43	
Feb.	12.01	15.07	10.95	

Source: - Garlic Production and Marketing,
Ilocos Region, Aug., 1978

- Special Studies Division, Office of the
Secretary, Department of Agriculture.

Table 6C-14 Farm Gate Price of Onion

(Unit: ₱/kg)

Month	1972		1973		1974		1975	
	Ilocos	Philippines	Ilocos	Philippines	Ilocos	Philippines	Ilocos	Philippines
Jan.	2.20	1.59	-	1.90	-	-	3.25	4.22
Feb.		1.59	-	2.00	-	-	3.25	4.39
Mar.		1.52	-	2.31	-	-	3.44	3.70
Apr.		1.92	2.10	1.79	-	-	3.20	3.54
May		2.28	-	1.49	-	-	2.90	2.66
Jun.		2.00	1.00	1.19	-	-	2.19	2.59
Jul.		1.50	-	1.31	2.84	3.12	2.00	2.98
Aug.		2.90	-	2.08	3.35	3.45	2.50	2.95
Sep.		2.60	-	3.29	3.88	3.65	1.15	3.02
Oct.		2.96	1.75	2.20	3.81	3.69	3.15	3.11
Nov.		3.80	-	2.85	4.98	5.31	-	3.61
Dec.		1.67	2.50	1.99	5.16	5.49	-	3.70
Ave.	2.20	2.19	1.84	2.03	4.00	4.12	2.70	3.37

Table 6C-15 Farm Gate Prices of Onion (continue)

Month	1976				1977			
	Pesos per Kilos		Pesos per dry bulk		Pesos per Kilos		Pesos per dry bulk	
	Ilocos	Philippines	Ilocos	Philippines	Ilocos	Philippines	Ilocos	Philippines
Jan.	1.37	1.51	0.12	0.19	1.50	1.66	0.14	0.21
Feb.	1.40	1.91	0.15	0.19	-	1.60	0.14	0.23
Mar.	1.24	1.72	0.14	0.19	-	1.62	0.14	0.24
Apr.	2.77	2.01	0.17	0.20	-	1.56	0.12	0.23
May	2.89	2.02	0.18	0.20	-	1.60	0.12	0.23
Jun.	3.56	2.55	0.16	0.19	-	1.79	0.13	0.23
Jul.	3.50	2 68	0.17	0.20	-	1.96	0.14	0.23
Aug.	1.00	2.52	0.14	0.22	-	2.00	0.16	0.23
Sep.	1.00	2.56	0.15	0.22	-	2.00	0.17	0.23
Oct.	-	1.70	0.19	0.22	-	1.16	-	0.25
Nov.	2.50	1.99	0.19	0.22	-	1.16	-	0.27
Dec.	2.50	1.88	0.14	0.21	-	1.55	0.17	0.25
Ave.	2.15	2.09	0.15	0.20	-	1.72	0.14	0.24

Source: BAEcon.

Table 6C-16 Retail Price of Onion -Ilocos Region-

(Unit: ₱/kg)

Month	1973			1974			1975			1976			1977		
	White	Red	Native	W.	R.	Na.	W.	R.	Na.	W.	R.	Na.	W.	R.	Na.
Jan.	-	-	-	3.00	3.50	1.52	5.00	6.71	4.53	3.06	3.97	2.50	3.58	6.00	2.63
Feb.	-	-	-	2.51	3.41	2.16	5.00	4.46	2.85	2.55	3.93	2.66	3.00	4.59	2.54
Mar.	0.80	-	-	1.80	2.69	2.95	1.60	3.04	1.78	2.40	3.34	1.94	3.29	3.50	2.56
Apr.	0.81	-	-	1.74	2.50	2.58	1.46	3.30	2.23	2.00	2 82	2.47	2.44	3.09	2.11
May	-	-	-	1.85	2.35	1.82	1.19	3.67	2.76	2.32	2.93	3.39	2.48	3.00	2.13
Jun.	-	-	-	2.00	2.03	2.33	1.82	3.29	2.77	3.13	2.82	3.34	3.38	3.42	2.23
Jul.	-	1.58	-	3.00	3.57	3.50	2.99	2.97	2.87	3.48	3.08	3.41	3.44	3.06	2.71
Aug.	-	2.08	-	3.00	4.00	3.10	3.00	3.29	2.73	-	4.02	3.52	3.50	3.50	2.76
Sep.	-	2.58	-	-	4.28	3.57	3.79	3.95	3.02	-	3.50	3.56	3.50	3.87	2.98
Oct.	-	3.00	-	-	4.00	3.92	-	3.92	3.68	-	3.64	3.56	3.50	5.06	3.28
Nov.	-	3.00	-	-	4.46	3.15	-	3.77	3.78	-	4.73	2.79	-	4.40	3.26
Dec.	-	3.00	-	-	5.79	3.95	-	4.15	2.23	-	5.78	2.38	-	4.63	3.18
Ave.	0.81	2.54	-	2.36	3.53	2.88	-	3.88	2.94	-	3.70				

Source: BAEcon.

Economic Costs of Farm Labor

1. Methods of Estimation

Pricing of farm labor is the assessment of the opportunity cost. The opportunity costs are estimated in the following criteria.

Point A: The opportunity for off-farm employment

During the "non-pead" period farmers can, and often do, undertake activities like fishing, carpentry, home repairs, wood gathering, cottage industries, construction work and other casual labor. Wage rates of these jobs are unclear. According to the farm labor wage survey by NIA, however, the meal cost for hired labor is 2 pesoes. The value of the incremental caloric intake demanded by changes in labor activity would be considered 2 pesoes.

Point B: The farm work season as usual (non-peak period)

The opportunities for work would compete with the permanent off-farm employment opportunities. The less production off-farm employment is scarce, the more farm labor force is drawn into farm work. The least farm wage without meal, according to the NIA survey, is about 5 pesoes. This rate would be in the marginal rate to compete with the off-farm employment.

Point C: The full employment peak periods

At the employment level corresponding to full employment peak periods, the opportunity cost is equal to the observed market wage rate. Average farm hired labor wage of 8.0 pesoes in the Project area is considered as market wage rate.

Point D: The attractive farm wage rate for outside labor market

Labor would be hired under the more demand than the full employment for farmers themselves. Then wage rate go up. The opportunity cost of alternative labor pool correspond to the highest level of

farm labor wage in the Project area.

It is postulated that the marginal opportunity cost of labor supplied for farm work in the Project area can be represent by an "S shaped" curves which is drawn in Figure 6C-1 and 6C-2 using Point A, B, C and D as mentioned above.

2. Available Farm Labor Force

Farm labor forces to be available in the Project area will be depended upon labor inside and outside the Project area. Farm labor inside the Phase I area consist of permanent and temporary farmer. As the former stay in each village, they are able to work all the year. But the latter transfer from outside area and stay to cultivate during the peak season. Then they are a available labor during the peak season.

Table 6C-17 and 6C-18 indicate the available farm labor force with and without Project inside the Phase I area.

Table 6C-19 explain the unemployment labore force inside and outside the Phase I area which would be assumed to be available as the hired farm labor. Both side labor are summed up Table 6C-20.

3. Total Labor Demand by Month

The labor demand by month which are shown in Table 6C-21 and was calculated based on the data of labor distribution by crops. These man days by month are converted to percentage of potential full employment as shown at Table 6C-25 and 6C-26.

4. Wage Rate by Month

Wage rate, namely, marginal opportunity cost are assumed by application of percentage of potential full employment to "S-shaped" curve.

FIGURE 6C-1 TYPICAL OPPORTUNITY COST CURVE FOR FARM LABOR

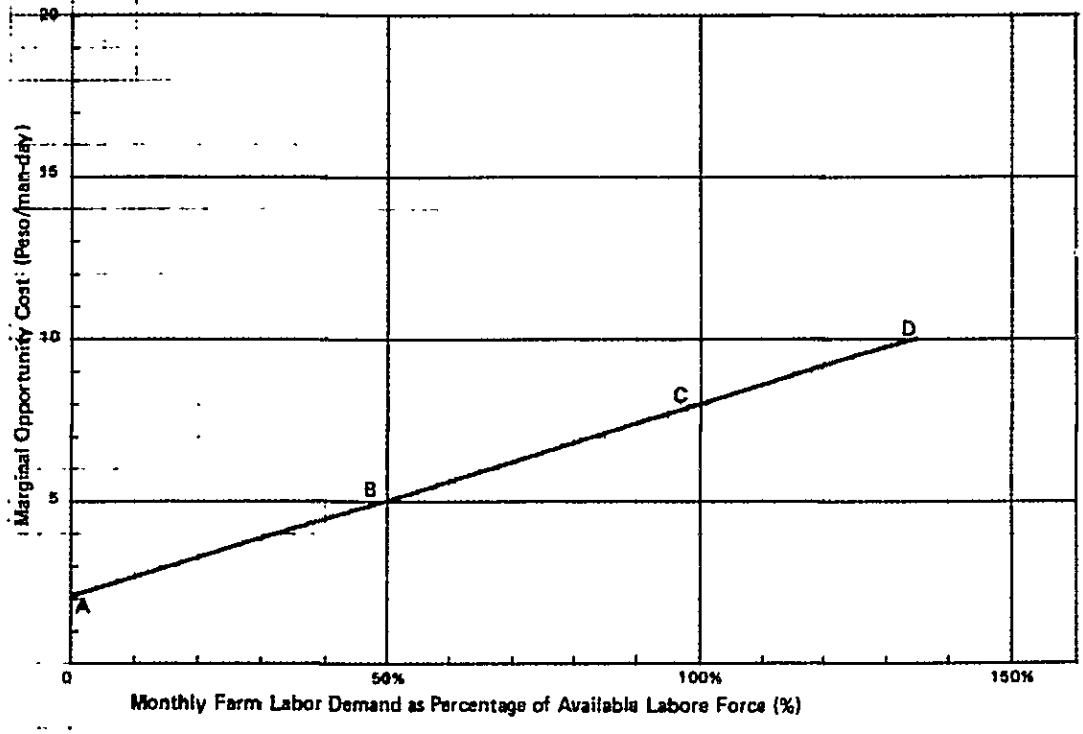


FIGURE 6C-2 OPPORTUNITY COST CURVE FOR FARM LABOR

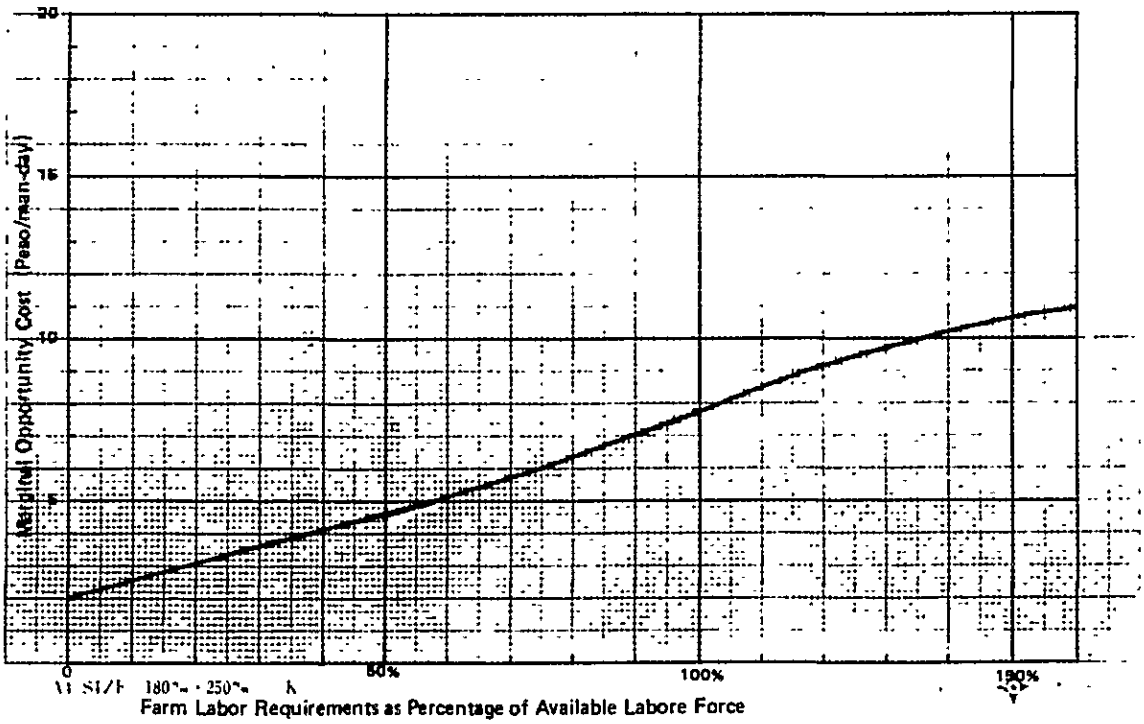


Table 6C-17 Available Farm Labor Force Inside the Project Area

- With Project -

Year	No. of Farm[1/]			Family labor to engaged in farming per permanent farm[2/]		Available labor days per month per permanent farm[3/]			Mandays per Month of permanent farm	Family labor to engage during peak season per temporary farm		Available labor days per month during labor season per temporary farm			Mandays per Month of temporary farm	Total labor per month	
	Permanent	Temporary	Total	Full time	Part time	Full time	Part time	Total		Full time	Part time	Full time	Part time	Total		Peak season[4/]	Non peak season[5/]
	- Household-			- Person -		- Man days -			- 10^3man days -	- Person -		- Man days -			- 10^3man days -	- 10^3man days -	
1978	5,497	1,342	6,839	1.28	1.35	33	9	42	231	1.5	0.5	39	4	43	58	289	231
1979	5,519	1,342	6,861	1,28	1.35	33	9	42	232	1.5	0.5	39	4	43	58	290	232
1980	5,541	1,342	6,883	1.28	1.35	33	9	42	233	1.5	0.5	39	4	43	58	291	233
1981	5,563	1,342	6,905	1.28	1.35	33	9	42	234	1.5	0.5	39	4	43	58	292	234
1982	5,585	1,342	6,927	1.28	1.35	33	9	42	235	1.5	0.5	39	4	43	58	293	235
1983	5,607	1,342	6,949	1.30	1.30	34	9	43	241	1.5	0.5	39	4	43	58	299	241
1984	5,629	1,342	6,971	1.50	1.00	39	7	46	259	1.6	0.4	42	3	45	60	319	259
1985	5,653	1,342	6,225	1.50	1.00	39	7	46	260	1.6	0.4	42	3	45	60	320	260
1986	5,810	1,208	7,018	2.00	0.50	52	4	56	325	1.8	0.2	47	2	49	59	384	325
1987	5,967	1,074	7,041	2.00	0.50	52	4	56	334	1.8	0.2	47	2	49	53	387	334
1988	6,125	939	7,064	2.50	-	65	-	65	398	2.0	-	52	-	52	49	417	398
1989	6,148	939	7,087	2.50	-	65	-	65	400	2.0	-	52	-	52	49	449	400
1990	6.170	939	7,109	2.50	-	65	-	65	401	2 0	-	52	-	52	49	450	401

Note: 1/: Temporary farms would gradually transfer inside the Project area after completion of the project.

2/: Based on Farm Management Survey, NIA, 1978.

3/: It is assumed that full time and part time labor of family are average available to work as 26 days and 7 days per one month, respectively.

4/: Peak season in future are March, June, July, October, November and December. Temporary farm labor would work staying in Barangay during peak season.

Table 6C-18 Available Farm Labor Force Inside the Project Area

- Without Project -

Year	No. of Farm			Family labor to engaged in farming per permanent farm		Available labor days per month per permanent farm			Mandays per Month of permanent farm	Family labor to engage during peak season per temporary farm		Available labor days per months during labor season per temporary farm			Man days per Month of temporary farm	Total labor per month	
	Permanent	Temporary	Total	Full time	Part time	Full time	Part time	Total	permanent farm	Full time	Part time	Full time	Part time	Total	temporary farm	Peak season	Non peak season
	- Household -			- Person -		- Man days -			- 10^3man days -	- Person -		- Man days -			- 10^3man days -	- 10^3man days -	
1978	5,497	1,342	6,839	1.28	1.35	33	9	42	231	1.5	0.5	39	4	43	58	289	231
1979	5.519	1,342	6,861	1.28	1.35	33	9	42	232	1.5	0.5	39	4	43	58	290	232
1980	5,541	1,342	6,883	1.28	1.35	33	9	42	233	1.5	0.5	39	4	43	58	291	233
1981	5,563	1,342	6,905	1.28	1.35	33	9	42	234	1.5	0.5	39	4	43	59	292	234
1982	5,585	1,342	6,927	1.28	1.35	33	9	42	235	1.5	0.5	39	4	43	58	293	235
1983	5,607	1,342	6,949	1.29	1.3	34	9	43	241	1.5	0.5	39	4	43	58	299	241
1984	5,629	1,342	6,971	1.32	1.3	34	9	43	242	1.5	0.5	39	4	43	58	300	242
1985	5,653	1,342	6,995	1.35	1.2	35	8	43	243	1.5	0.5	39	4	43	58	301	243
1986	5,676	1,342	7,018	1.38	1.2	36	8	44	250	1.5	0.5	39	4	43	58	308	250
1987	5,699	1,342	7,041	1.42	1.1	37	8	45	256	1.5	0.5	39	4	43	58	314	256
1988	5,722	1,342	7,064	1.45	1.0	38	7	45	257	1.5	0.5	39	4	43	58	315	257
1989	5,745	1,342	7,087	1.48	1.0	38	7	45	259	1.5	0.5	39	4	43	58	317	259
1990	5,768	1,342	7,109	1.50	1.0	39	7	46	265	1.5	0.5	39	4	43	58	323	265

Table 6C-19 Unemployment Labor Force Inside and Outside the Project Area

Year	Unemployment			Mandays per Month (10^3 man-days)
	Inside	Outside	Total	
1978	1,000	800	1,800	47
1979	1,020	820	1,840	48
1980	1,040	840	1,880	49
1981	1,060	860	1,920	50
1982	1,080	880	1,960	51
1983	1,100	900	2,000	52
1984	1,120	920	2,040	53
1985	1,140	940	2,080	54
1986	1,155	960	2,115	55
1987	1,170	980	2,150	56
1988	1,185	1,000	2,185	57
1989	1,200	1,020	2,220	58
1990	1,215	1,040	2,255	59

Note: According to the Population Census, 1970, the economic active population unemployed amounts to about 1,960 persons in the Phase I area, and about 2,300 persons in Laoag City, San Nicolas and Piddig as the adjacent of Phase I. Ratio of unemployment of 1978 is assumed as half of that in 1970. Then, inside unemployment labor would assumed as about 1,000 persons, and outside labor about 1,200 persons.

About 800 persons of outside 1,200 persons would be assumed to supply into Phase I area.

Annual growth rate are based on "Population Dimension of Planning, 1975, NEDA."

Table 6C-20 Available Farm Labor Force per Month

(Unit: 10^3 man-days)

a) Peak Season

Year	Without Project			With Project		
	Inside	Outside 1/	Total	Inside	Outside	Total
1978	289	47	336	289	47	336
1979	290	48	338	290	48	338
1980	291	49	340	291	49	340
1981	292	50	342	292	50	342
1982	293	51	344	293	51	344
1983	299	52	351	299	52	351
1984	300	53	353	319	53	372
1985	301	54	355	320	54	374
1986	308	55	363	384	55	439
1987	314	56	370	387	56	443
1988	315	57	372	417	57	474
1989	317	58	375	449	58	507
1990	323	59	382	450	59	509

b) Non Peak Season

Year	Without Project			With Project		
	Inside	Outside	Total	Inside	Outside	Total
1978	231	47	278	231	47	278
1979	232	48	280	232	48	280
1980	233	49	282	233	49	282
1981	234	50	284	234	50	284
1982	235	51	286	235	51	286
1983	241	52	293	241	52	293
1934	242	53	295	259	53	312
1985	243	54	297	260	54	314
1986	250	55	305	325	55	380
1987	256	56	312	334	56	390
1988	257	57	314	398	57	455
1989	259	58	317	400	58	458
1990	265	59	324	401	59	460

Note: 1/: Available farm labor force under unemployment situation inside and outside the Project area.

Table 6C-21 Total Labor Demand by Month Without Project

(Unit: 10^3 man-days)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1982-85	25.8	45.3	32.5	8.7	57.2	2331.	127.7	57.0	47.4	201.8	227.2	51.1	1,114.8

Note: It is assumed that the labor demand for farming in the Project area is constant in the conditions of without project.

Table 6C-22 Agricultural Labor Demand by Month with Project

(Unit: 10^3 man-days)

	Peak Season							Non Peak Season							
Year	AL	Mar.	Jun.	Jul.	Oct.	Nov.	Dec.	AL	Jan.	Feb.	Apr.	May	Aug.	Sep.	Total
1982	344	32.5	233.1	127.7	201.8	227.2	51.1	286	25.8	45.3	8.7	57.2	57.0	47.4	1,114.8
1983	351	32.5	229.2	171.4	224.8	219.1	46.5	293	35.8	45.4	8.4	54.7	63.5	61.0	1.182.3
1984	372	41.6	226.5	203.2	235.4	215.9	54.5	312	26.9	47.7	9.3	51.1	68.3	70.9	1,251.3
1985	374	78.9	218.5	292.5	264.8	228.4	94.7	314	31.6	58.1	14.8	39.4	91.8	102.9	1,516.4

Note:- AL means the Available Labor force per month

Table 6C-23 Construction Labor per Year

(Unit: 10^3 persons)

Year	Per Year	Per Month
1981	276	23
1982	885	74
1983	1,024	85
1984	781	65

Table 6C-24 Total Labor Demand by Month with Project

(Unit: 10^3 man-days)

	Peak Season							Non Peak Season							
Year	Al	Mar.	Jun.	Jul.	Oct.	Nov.	Dec.	Al	Jan.	Feb.	Apr.	May	Aug.	Sep.	Total
1981	342	55.5	256.1	150.7	224.8	250.2	74.1	284	48.8	68.3	31.7	80.2	80.0	70.4	1,390.8
1982	344	106.5	306.1	201.7	274.8	300.2	125.1	286	99.8	119.3	82.7	131.2	137	121.4	1,999.8
1983	351	117.5	314.1	256.4	309.8	304.1	131.5	293	110.8	130.4	93.4	139.7	148.5	146.0	2,202.3
1984	372	106.6	291.5	268.2	300.4	280.9	119.5	312	91.9	112.7	74.3	116.1	133.3	135.9	2,031.3
1985	374	78.9	218.5	292.5	264.8	228.4	94.7	314	31.6	58.1	14.8	39.4	91.8	102.9	1,516.4

Note: Total labor consist of agricultural labor and construction labor during the construction.

Table 6C-25 Monthly Farm Labor Demand as Percentage of Potential Full Employment

- Without Project -

(Unit: %)

		Peak Season						Non Peak Season						
Year	AL	Mar.	Jun.	Jul.	Oct.	Nov.	Dec.	AL	Jan.	Feb.	Apr.	May	Aug.	Sep.
1981	342	10	68	37	59	66	15	284	9	16	3	20	20	17
1982	344	10	68	37	59	66	15	286	9	16	3	20	20	17
1983	351	9	66	36	57	65	15	293	9	15	3	20	20	16
1984	353	9	66	36	57	65	15	295	9	15	3	20	20	16
1985	355	9	66	36	57	65	15	297	9	15	3	20	20	16

Table 6C-26 Monthly Farm Labor Demand as Percentage of Potential Full Employment

- With Project -

(Unit: %)

		Peak Season						Non Peak Season						
Year	AL	Mar.	Jun.	Jul.	Oct.	Nov.	Dec.	AL	Jan.	Feb.	Apr.	May	Aug.	Sep.
1981	342	16	75	44	66	73	22	284	17	24	11	28	28	25
1982	344	31	89	59	80	87	36	286	35	42	29	46	48	42
1983	351	33	89	73	88	87	37	293	32	37	27	40	42	42
1984	372	29	78	72	81	86	32	312	29	36	24	37	43	44
1985	374	21	58	78	71	61	25	314	10	19	5	13	29	33

Table 6C-27 Wage Rate by Month without Project

(Unit: Peso/man-day)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	2.6	2.9	2.6	2.2	3.1	5.6	4.0	3.1	3.0	5.1	5.5	2.8
1983	2.6	2.9	2.6	2.2	3.1	5.5	3.9	3.1	2.9	5.0	5.4	2.8
1984	2.6	2.9	2.6	2.2	3.1	5.5	3.9	3.1	2.9	5.0	5.4	2.8
1985	2.6	2.9	2.6	2.2	3.1	5.5	3.9	3.1	2.9	5.0	5.4	2.8

Table 6C-28 Wage Rate by Month with Project

(Unit: Peso/man-day)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1982	3.8	4.2	3.6	2.5	4.4	7.1	5.1	4.5	4.2	6.4	6.9	3.8
1983	3.7	4.0	3.9	3.4	4.1	7.1	6.0	4.2	4.2	7.0	6.9	4.0
1984	3.6	3.9	3.8	3.3	4.0	6.3	6.0	4.2	4.3	6.4	6.2	3.7
1985	2.6	3.0	3.2	2.3	2.8	5.0	6.3	3.6	3.8	5.8	5.2	3.4

Table 6C-29 Farm Labor Costs by Month without Project

(Unit: 10^3 peso)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1982	67	131	85	19	177	1,305	511	177	142	1,029	1,250	143	5,036
1983	67	131	85	19	177	1,282	498	177	137	1,009	1,227	143	4,952
1984	67	131	85	19	177	1,282	498	177	137	1,009	1,227	143	4,952
1985	67	131	85	19	177	1,282	498	177	137	1,009	1,227	143	4,952

Table 6C-30 Farm Labor Costs by Month with Project

(Unit: 10^3 peso)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1982	98	190	117	30	252	1,655	651	257	199	1,292	1,568	194	6,503
1983	95	182	127	29	224	1,627	1,028	267	256	1,574	1,512	186	7,107
1984	97	186	158	31	204	1,427	1,219	287	305	1,507	1,339	202	6,962
1985	82	174	252	34	110	1,093	1,843	330	391	1,536	1,188	322	7,355

Evaluation of Agricultural Benefit

In evaluating the benefit in case of without project, it was assumed that the present cropping pattern would be proceeded further in future. In case of with project, on the other hand, proposed cropping pattern could be introduced into the whole Project Area. However, some areas in the project can not get the target yield due to shortage of irrigation water, then the benefits to be created from such areas are not taken into account in evaluation from conservative view point. Consequently, the evaluations of benefit in the project are made on the basis of two land categories, i.e., i) benefited areas of 8,080 ha to be irrigated and ii) remaining areas of 2,120 ha with shortage of irrigation water

In accordance with the project, the converted lands to the sites for irrigation and drainage canals and roads are estimated at 894 ha in total, which is equivalent to six percent of the cropping area without project.

The yield of crops is forecasted to reach the target one at the year of 1989, which coincides with five years later since enough irrigation water is supplied.

Annual growth rate of yield of crops without the Proejct was assumed as one percent.

According to the result of Farm Management Survey conducted by NIA, the farm mechanization have been not introduced yet. Perhaps, this technics would not progress in the recent future. Then, hired labor and animal costs were counted in the production cost without the Project. The farm mechanization after completion of the Project was assumed as shown in the following Table.

Table 6C-31 Cropping Area with Project

(Unit: ha)

	1978 to 1982	1983	1984	1985
1. Benefited Fields				
Except Madongan Area				
Wet season palay	-	2,140	3,700	5,790
Dry season palay	-	-	550	2,040
Garlic	-	-	20	70
Tobacco	-	-	20	60
Onion	-	-	20	70
Sub-total	-	2,140	4,310	8,030
Madongan Area				
Wet season palay	-	-	-	2,290
Dry season palay	-	-	-	630
Garlic	-	-	-	30
Tobacco	-	-	-	30
Onion	-	-	-	30
Sub-total	-	-	-	3,010
Total	-	2,140	4,310	11,040
2. Remaining Fields				
Irrigated palay				
Wet season except Madongan	5,630	3,843	2,526	948
Madongan	2,411	2,338	2,246	517
Dry season except Madongan	2,389	2,317	1,685	195
Madongan	1,022	991	950	320
Rainfed palay except Madongan	1,822	1,241	816	304
Madongan	779	755	728	167
Corn	489	474	459	275
Tobacco	23	22	-	-
Mongobeans	43	42	20	-
Sugacane	28	27	26	-
Vegetables & Others	24	23	-	-
Sub-total	14,660	12,073	9,456	2,726
Grand Total	14,660	14,213	13,766	13,766

Table 6C-32 Production and GPV with Project

(Unit: Qt: tons x 10^3, GPV: Peso x 10^6)

Item		1983	1984	1985	1986	1987	1988	1989
1. Benefited Field								
Palay Wet season	Qt	5.7	10.75	23.56	26.64	29.12	30.61	31.05
Dry season	Qt	-	1.48	7.35	8.72	10.03	10.95	11.22
Sub-total	Qt	5.7	12.23	30.91	35.36	39.15	41.56	42.27
	GPV	8.78	18.83	47.60	54.45	60.29	64.00	65.13
Garlic	Qt	-	0.04	0.14	0.16	0.17	0.18	0.19
	GPV	-	0.22	0.77	0.88	0.94	0.99	1.05
Tobacco	Qt	-	0.02	0.07	0.08	0.08	0.08	0.08
	GPV	-	0.32	1.12	1.28	1.28	1.28	1.28
Onion	Qt	-	0.15	0.56	0.68	0.78	0.85	0.88
	GPV	-	0.27	1.01	1.22	1.40	1.53	1.58
Total	Qt	5.7	12.44	31.68	36.28	40.18	42.67	43.42
	GPV	8.78	19.64	50.50	57.83	63.91	67.80	69.04
2. Remining Field								
Palay	Qt	18.71	14.54	4.02	4.08	4.11	4.15	4.19
	GPV	28.81	22.39	6.19	6.28	6.33	6.39	6.45
Corn	Qt	0.25	0.24	0.15	0.15	0.15	0.15	0.15
	GPV	0.28	0.26	0.17	0.17	0.17	0.17	0.17
Others	Qt	1.56	1.38	-	-	-	-	-
	GPV	0.84	0.25	-	-	-	-	-
Total	Qt	20.52	16.16	4.17	4.23	4.26	4.30	4.34
	GPV	29.93	22.9	6.36	6.45	6.50	6.56	6.62
Grand Total	Qt	26.22	28.6	35.85	40.51	44.44	46.97	47.76
	GPV	38.71	42.54	56.86	64.28	70.41	74.36	75.66

Note: Qt: Quantity, GPV: Gross Production Value

Table 6C-38 Production and GPV without Project

(Unit: Qt: tons x 10^3, GPV: Peso x 10^6)

Item		1982	1983	1984	1985	1986	1987	1988	1989
Irrigated Palay									
Wet season	Qt	14.27	14.42	14.57	14.72	14.86	15.01	15.15	15.31
Dry season	Qt	5.31	5.36	5.41	5.47	5.52	5.57	5.63	5.69
Rainfed Palay	Qt	3.30	3.33	3.37	3.40	3.43	3.47	3.50	3.54
Palay Sub-total	Qt	22.88	23.11	23.35	23.59	23.81	24.05	24.28	24.54
	GPV	35.24	35.59	35.96	36.33	36.67	37.04	37.39	37.79
Corn	Qt	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27
	GPV	0.28	0.29	0.29	0.29	0.29	0.30	0.30	0.30
Tobacco	Qt	0.024	0.024	0.024	0.025	0.025	0.025	0.025	0.025
	GPV	0.38	0.38	0.38	0.40	0.40	0.40	0.40	0.40
Mangobean	Qt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	GPV	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Sugacane	Qt	1.45	1.47	1.48	1.50	1.51	1.53	1.54	1.55
	GPV	0.26	0.26	0.27	0.27	0.27	0.28	0.28	0.28
Vegetables & Others	Qt	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	GPV	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Total	Qt	24.72	24.98	25.23	25.50	25.73	26.00	26.24	26.51
	GPV	36.42	36.78	37.16	37.55	37.89	38.28	38.63	39.03

Note: Qt: Quantity, GPV: Gross Production Value

Table 6C-34 Production Cost per Hectare in Full Development

		Wet season Palay				Dry season Palay				Rainfed Palay				Garlic		Tobacco				Onion				Corn	
		With		W/o		With		W/o		With		W/o		With		With		W/o		With		W/o		W/o	
		Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)	Qt	Cost (₱)
Seed	kg	50	77	55	85	50	77	65	100	-	-	55	85	450/2	1,238	30	30	45	45	5/2	1,150	4/2	920	18.5	20
Fertilizer																									
N	kg	51	240	27	127	62	291	50	235	-	-	17	80	62	291	36	169	71.1	335	135	635	25	118	5.6	27
P	"	31	93	4.5	14	31	93	11.5	35	-	-	6	18	71	213	50	150	20.7	60	90	297	25	75	5.6	17
K	"	1	2	4	6	1	2	10.4	17	-	-	3	5	99	158	60	96	2.9	6	120	192	25	40	5.6	9
Pesticides																				Line 2.5	125				
Liquide	Qts	6.25	300			6.25	300																		
	"	0.77	59	0.5	24	0.77	59	0.63	30	-	-	0.4	19	4	160	28	1,288	2.0	96	(Powder)		3	144	0.56	27
Granula	kg	-	-	0.65	4	-	-	0.25	2	-	-	0.64	4	-	-	-	-	-	-	24	1,080	-	-	-	-
Herbicide																									
Liquide	Qts	2.0	44	-	-	2.0	44	-	-	-	-	-	-	-	-	-	-	-	-	(Powder)		-	-	-	-
Granula	kg	-	-	2	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	360	-	-	-	-
Transplanting		-	-	Hired Labor	44	-	-	H.L	50	-	-	H.L	33	-	-	-	-	-	-	-	-	-	-	-	-
Land preparation																									
Animal		60%	-	100%	69	60%	-	100%	80	-	-	100%	35	60%	-	60%	-	-	35	60%	-	-	80	-	35
Machine		40%	42	H.L	28	40%	42	H.L	32	-	-	H.L	11	40%	42	40%	42	-	-	40%	42	-	-	-	-
Threshing																									
Pedal		50%	4	H.L	76	50%	4	H.L	44	-	-	H.L	70												
Power		50%	27	-	-	50%	27	-	-	-	-	-	-												
Drying		50%	34	-	-	50%	34	-	-	-	-	-	-												
Miscellaneous		-	46	-	26	-	49	-	31	-	-	-	18	-	105	-	89	-	120	-	194	-	70	-	10
Total		-	968	-	547	-	1,022	-	656	-	-	-	378	-	2,207	-	1,864	-	697	-	4,075	-	1,447	-	110

Internal Rate of Return

Internal rate of return is obtained by computation of present worth value. Present worth value of benefit and cost was computed at 50 years term as shown in the following Tables. Both streams of benefit and cost are shown in main report.

Table 6D-1 Present Worth Value of Incremental NPV

(Unit: Peso x 10^6)

Year	Project year	Benefit	Discount Rate 5%	10%	15%
1979	1	..			
1980	2	..			
1981	3	..			
1982	4	..			
1983	5	2.70	2.11	1.67	1.34
1984	6	5.38	4.01	3.03	2.32
1985	7	17.41	12.36	8.93	6.53
1986	8	23,40	15.82	10.90	7.63
1987	9	28.26	18.20	11.98	8.03
1988	10	31.21	19.13	12.02	7.71
1989	11	32.18			
..	..		Σ339.02	121.32	52.84
..	..				
..	..				
2028	50	32.18			
Total		1,395.56	410.65	169.85	86.40

Table 6D-2 Present Worth Value of Economic Cost

(Unit: Peso x 10)

Year	Project Year	Economic Cost	O & M Cost	Total	Discount Rate 5%	10%	15%
1979	1	1.27	..	1.27	1.21	1.15	1.10
1980	2	7.76	..	7.76	7.04	6.41	5.87
1981	3	20.19	..	20.19	17.52	15.16	13.26
1982	4	49.35	..	49.35	40.57	33.71	28.18
1983	5	55.66	..	55.66	43.58	34.51	27.66
1984	6	45.95	..	45.95	34.28	25.92	19.85
1985	7	..	3.66	3.66			
1986	8	..	3.66	3.66			
			3.66	3.66	Σ48.24	Σ20.27	Σ10.55
			3.66	3.66			
2028	50	..	3 66	3.66			
Total		180.18	161.04	341.22	192.44	137.13	106.47

Cost Recovery

NIA has the authority to collect irrigation fee from users of national irrigation systems to finance operations. (Based on Republic Act. No. 3601)

Ilocos Norte Province has eight national irrigation systems of which five are for gravity irrigation and three for pump irrigation, as shown below;

Irrigation fees of the gravity system are equivalent to 2.0 cavans of paddy per hectare in the wet seasons and 3.0 cavans in the dry seasons and fees of pump system are 3.0 cavans in the wet seasons and 5.0 cavans in the dry seasons. Cash has been collected only since 1977.

The following Table shows the benefited area of above eight national irrigation systems as of 1977.

Table 6G-1 National Irrigation System, Ilocos Norte (1977)

Item	No. of System	Service Area	Irrigated Area		Benefited Area	
			Wet	Dry	Wet	Dry
Gravity	5	5,435	5,030	3,344	5,030	3,288
	(%)	(100)	(93)	(62)	(93)	(60)
Pump	3	1,807	1,266	987	1,252	987
	(%)	(100)	(70)	(55)	(69)	(55)
Total	8	7,242	6,296	4,331	6,282	4,272
	(%)	(100)	(87)	(60)	(87)	(59)

Acreage to collect irrigation fees as of 1977 was 93 percent of the service area of gravity system in the wet seasons and 62 percent in the dry seasons.

Table 6G-2 Irrigation Fee Collection Rate

Item	1976	1977
Collection Terms	July 1976 - June 1977	July 1977 - June 1978
Fees Collected	₱637,405	₱788,045
Target Fees		₱1,441,250
Rate Collected	-	54.7 %

Note: These figures are fees collected by the Ilocos Norte Provincial Irrigation Office from eight national irrigation systems. Target fees were estimated on the irrigated area as of 1977 using each fees.

According to the information of the Provincial Irrigation Office, the irrigation fee collection rate was estimated at 54.7 percent as of 1977 crop season.

Major reasons for low collection of irrigation fees are the following: (Source: LRED, NIA)

- Some farmers are not served with irrigation water because of bad on-farm situation.
- Some farmers on the low-lying areas claim for their non-benefit.
- Some farmers had already irrigated their farm land (from with creeks or developed natural springs).
- Low production.
- Farmer's organization is not very active.
- Some NIA Systems say that they do not have enough bill collectors and transportation facilities
- Some farmers still believe that it is the government's responsibility to provide them with irrigation water.

On-farm facilities would be constructed based on the NIA criteria and many Farmers Irrigators Associations would be organized to operate and maintain such facilities.

This Farmers Irrigators Association should be responsible to collect the irrigation fee. It is nice idea to NIA Policy that if the supplementary farm ditch level group and the turnout level group collect 90 percent or more and 100 percent of the current account fees, respectively, such groups are entitled to a five percent rebate, and granted a five percent discount.