REPUBLIC OF THE PHILIPPINES

NATIONAL IRRIGATION ADMINISTRATION

FEASIBILITY STUDY ON THE ASUE RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

VOLUME 1 MAIN REPORT

AUGUST 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY

ON

THE ASUE RIVER BASIN

AGRICULTURAL DEVELOPMENT PROJECT

LIST OF REPORTS

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PREFACE

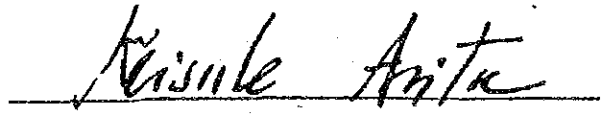
In response to the request of the Government of the Republic of the Philippines, the Japanese Government decided to conduct a study on the Asue River Basin Agricultural Development Project and entrusted the study to the Japan International Cooperation Agency. The JICA sent to the Philippines a study team headed by Mr. Ikurou Inamori from June 5th to August 18th and from October 18th to December 16th, 1984.

The team exchanged views on the Project with the officials concerned of the Government of the Philippines and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

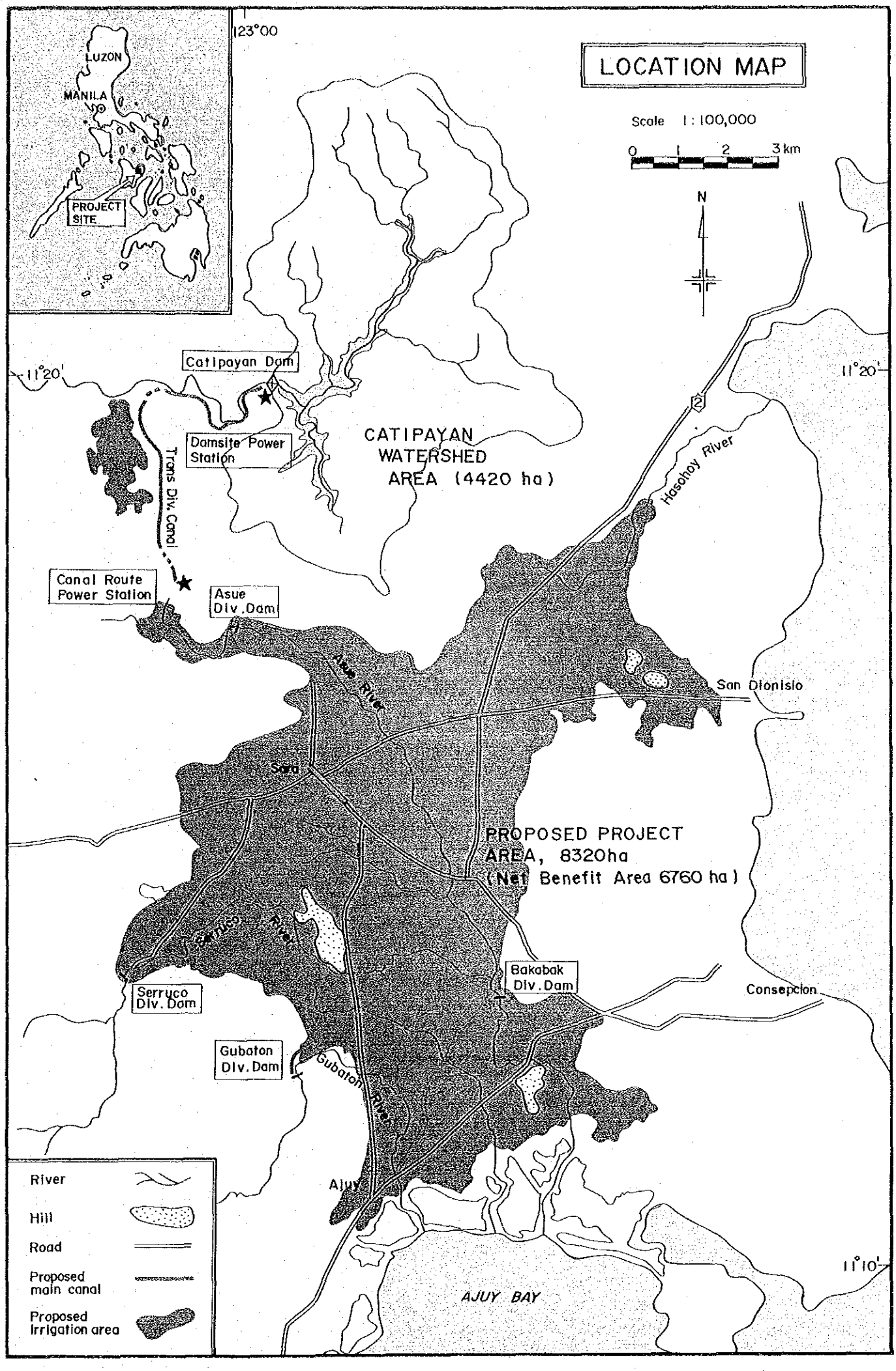
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

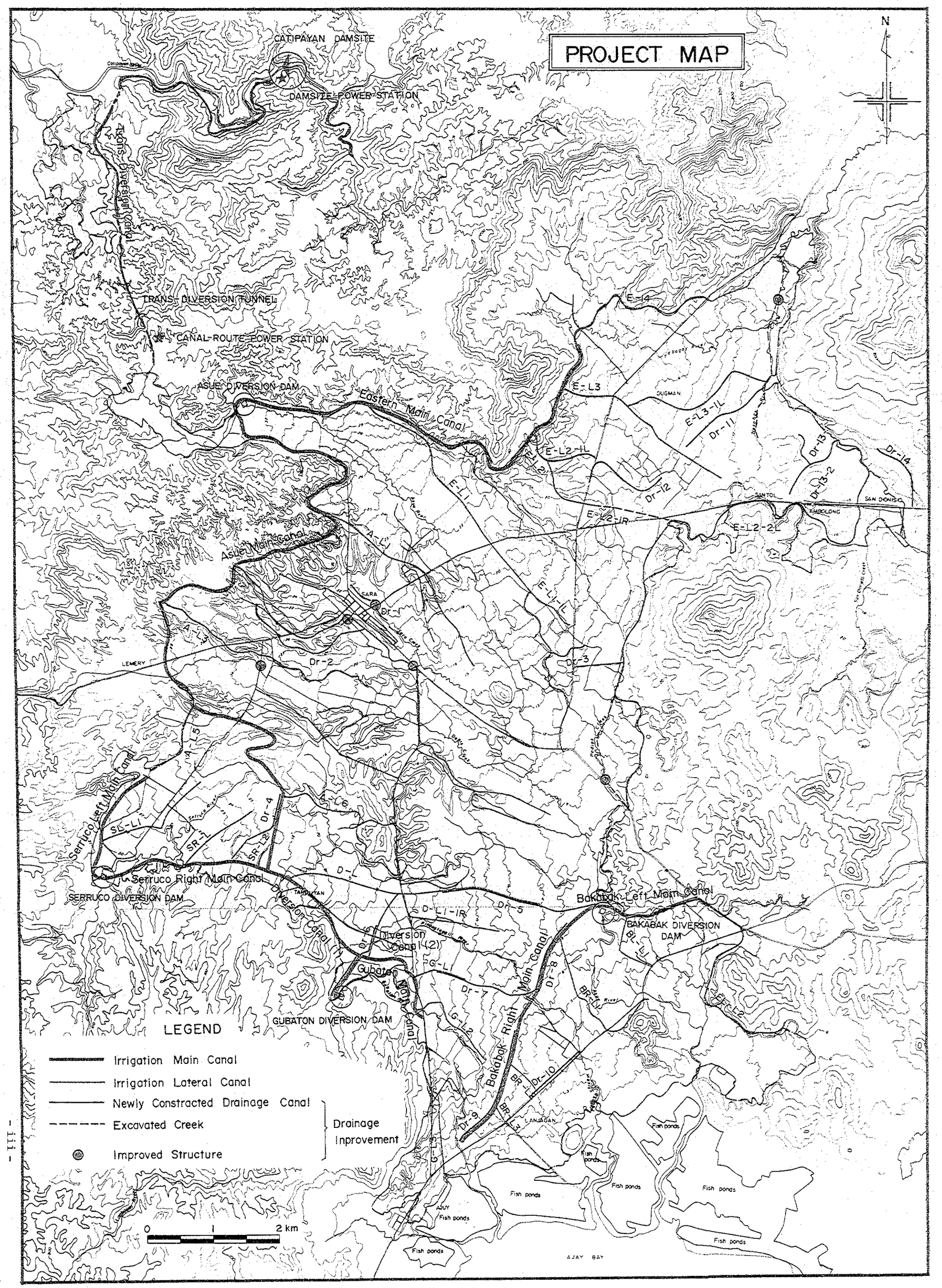
August, 1985



KEISUKE ARITA
President
Japan International
Cooperation Agency (JICA)

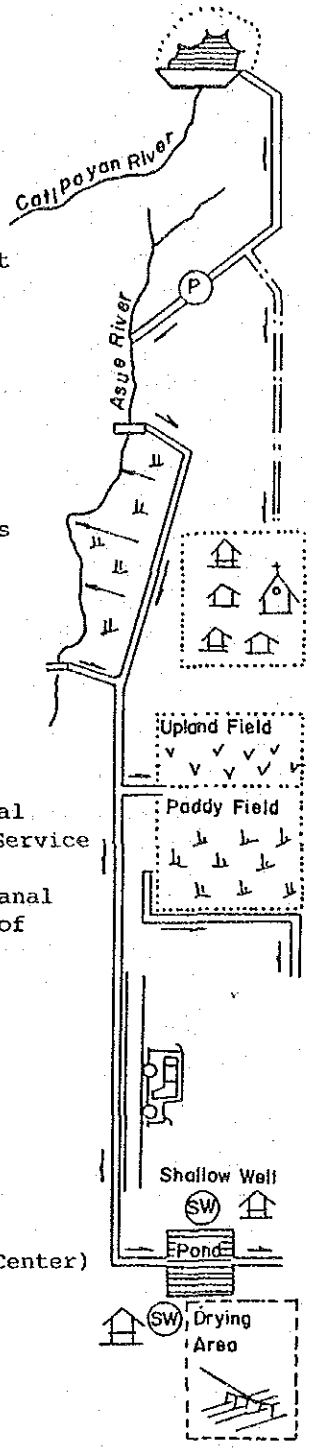

LOCATION MAP
Scale 1 : 100,000
0 1 2 3 km
N
LUZON
MANILA
PROJECT SITE
123°00
11°20'
11°10'
Catipayan Dam
Damsite Power Station
Trans Div. Canal
Canal Route Power Station
Asue Div. Dam
CATIPAYAN WATERSHED AREA (4420 ha)
Hasohoy River
Asue River
San Dionisio
Sara
PROPOSED PROJECT AREA, 8320ha (Net Benefit Area 6760 ha)
Serruco River
Serruco Div. Dam
Bakabak Div. Dam
Consepcion
Gubaton Div. Dam
Gubaton River
Ajuy
AJUY BAY
River
Hill
Road
Proposed main canal
Proposed irrigation area

PROJECT MAP


N
CATIPAYAN DAMSITE
DAMSITE POWER STATION
Catipayan River
Tuguis River
Tuguis Diversion Canal
TRANS-DIVERSION TUNNEL
CANAL-ROUTE POWER STATION
ASUE DIVERSION DAM
Eastern Main Canal
E-L4
E-L3
E-L3-1L
Dr-11
DUGMAN
E-L2-1L
Dr-12
Dr-13-1
Dr-13-2
Dr-14
SANTOL
SAN DIONISIO
E-L2-2R
E-L2-2L
E-L1
A-L1
Asue Main Canal
E-L1-1L
LEMERY
Dr-1
Dr-2
Dr-3
A-L5
A-L3
Serruco Left Main Canal
SL-L1
SR-1
SR-L2
Dr-4
Serruco River
Serruco Right Main Canal
SERRUCO DIVERSION DAM
D-L
TAKOKAN
Diversion Canal (1)
Diversion Canal (2)
SD-L1-1R
Dr-5
Bakabak Left Main Canal
BAKABAK DIVERSION DAM
BR-L1
Gubaton Main Canal
G-L1
Dr-7
G-L2
GUBATON DIVERSION DAM
Bakabak Right Main Canal
Dr-8
BR-L2
Dr-10
BR-1
BR-L3
Dr-9
G-L3
LANJAGAN
Fish ponds
AJUY
AJAY BAY
LEGEND
Irrigation Main Canal
Irrigation Lateral Canal
Newly Constracted Drainage Canal
Excavated Creek
Improved Structure
Drainage Inprovement
0
1
2 km

FUNCTIONS of the Asue River Basin Agricultural Development Project

Project Facilities	Objective	Benefits
1. Dam	a) Watershed Management	..* Increasing of Water Recharge capacity
	b) High Dam Construction	..* Environmental Impact * Water Resource for Year-round Irrigation
2. Hydro Power Prant	c) Electrification of Rural Area	....* Electricity Supply
3. Head Works		
4. Water works	d) Additional Water Supply for Sara Water Works	...* Stable Water Supply
5. Head Works	e) Water Reuse	* Effective Water Use
6. On-Farm Facilities	f) Irrigation for 1st and 2nd Cropping of Paddy and Vegetable	...* Paddy and Vegetable Production
7. Agricultural Extention Service	g) Extension of Agriculture and Farm Management Technique	...* Irrigated Agriculture
8. Drainage Canal (Widening of River)	h) Drainage Improvement	....* Stabilization of Crop Harvest
9. Road (O & M Road of Canal)	i) Road Network Formation for Marketing and Communication	...* Save Transportation * Keep Close Communication between Barangays
10. Integrated Community Center)	j) Water Supply for Villagers	...* Stabilizing of Water Supply * Water Supply For Livestocks
	k) Promotion of Rural Community	* Prevention against the Fire
	- Drying Area of Paddy	... * Selling High Quality Paddy
	- Trading Area	....* Efficiency of Agri.Inputs and Outputs Trading
	- Assembly and Recreation Area	....* Keep Close Communication between Villagers



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ABBREVIATIONS AND GLOSSARY

(1) Agencies

ACA	Agricultural Credit Administration
ADB	Asian Development Bank
AMC	Area Marketing Cooperatives
BAEcon	Bureau of Agricultural Economics
BPI	Bureau of Plant Industry
BS	Bureau of Soils
CLSU	Central Luzon State University
FaCoMa	Farmers Cooperatives Marketing Association
FSDC	Farm System Development Corporation
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
JICA	Japan International Cooperation Agency
LTC	Land Transportation Committee
MA	Ministry of Agriculture
MAR	Ministry of Agrarian Reform
MPWH	Ministry of Public Works and Highways
NCSO	National Census and Statistics Office
NFA	National Food Authority
NFAC	National Food and Agricultural Council
NEA	National Electrification Administration
NEDA	National Economic and Development Authority
NIA	National Irrigation Administration
NPC	National Power Corporation
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
RWDC	Rural Waterworks and Development Corporation
USBR	United States Department of Interior, Bureau of Reclamation
ILECO II	Iloilo Electricity Cooperative

(2) Others

C.A.	catchment area
EL.	elevation above sea level
ETo	reference crop evapotranspiration
ETcrop	crop evapotranspiration
GS	gauging station
G.T.	gravity type
He	effective head
Hg	gross head
HWL	high water level
kc	crop coefficient
LWL	low water level
RH	relative humidity
S/W	Scope of Work
Ve	effective volume of reservoir
Vg	gross volume of reservoir
US	United States

(3) Measurement

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer
ft	foot

Area

cm^2	square centimeter
m^2	square meter
ha	hectare
km^2	square kilometer

Electrical Measures

V	Volt
A	Ampere
Hz	Hertz (cycle)
W	Watt
kW	Kilowatt
MW	Megawatt
GW	Gigawatt

Other Measures

%	percent
HP	horsepower
^oC	degree in centigrade
10^3	thousand
10^6	million
10^9	billion

Volume

cm^3	cubic centimeter
ℓ	liter
m^3	cubic meter
MCM	million cubic meter

Weight

g	gram
kg	kilogram
t/ton	metric ton

Time

sec	second
min	minute
h	hour
d	day
ca	Cavan (50kg)

Currency

US$	US dollar
¢	US cent
¥	Japanese Yen
₱	Philippine Peso

Derived Measures

m^3/sec	cubic meter per second
kWh	kilowatt hour
MWh	megawatt hour
GWh	gigawatt hour
kWh/yr	kilowatt hour per year
KVA	kilovolt ampere
$m^3/km^2/yr$	cubic meter per square kilometer per year
PPT	part per thousand
pH	potential of hydrogen

PROJECT SUMMARY

1. INTRODUCTION

1.1 Project Components

The Asue River Basin Agricultural Development Project (hereinafter referred to as the Project) consists of the following tangible and intangible components.

(1) Tangible Components

- irrigation & drainage development plan
- road network plan
- Sara waterworks supplementation plan
- hydropower development plan
- integrated community center plan (with multipurpose pond and rice drying yard)

(2) Intangible Components

- watershed management plan
- further study and implementation of a program in response to the environmental effects of project implementation (excluding land compensation)

1.2 Development Approach

The above components coupled with such large scale facilities as the proposed dam and transdiversion canal require a large capital investment; however, the proposed Project is considered to be both technically and economically feasible and highly suited to the needs of the area. Indirect benefits envisioned with project implementation include increased employment opportunities for local residents, higher income, improved living conditions, conservation of the natural environment and development of a transportation network. The Project will thereby greatly contribute to improvement of the overall socioeconomic conditions of the rural populace.

To maximize these benefits, implementation of the entire Project should be completed as soon as possible. Should unfavorable economic conditions prevent immediate overall implementation however, stage development is recommended as presented in this report.

1.3 Selection of the Project Area

The Project area includes the area designated for effective irrigation development in the Asue River basin and surrounding basins and the 160ha area along the trans-diversion canal. The area also includes the existing CIS area and the area irrigated by KABSAKA water impoundings.

2. PROJECT AREA

2.1 General

The Project area is situated on the alluvial plain in the northeastern corner of Iloilo Province and comprises portions of Sara, Ajuy, Concepcion and San Dionisio municipalities. It is bounded on the south by a fish culture area along Ajuy Bay, on the north and west by a mountainous area extending from Ajuy Bay to the Iloilo-Capiz Provincial boundary; and on the east by the hilly area facing Bagacay Bay. Population in the Project area is approximately 33,800 as of 1984, representing 30% of the total population of the four municipalities concerned, and the annual rate of population increase is 1.91%. The total number of households is 6,020, of which 2,427 are farm households.

Approximately 7,670ha of the Project area and vicinity is cultivated, 6,415ha of which is covered by paddy. The remaining area is located near the surrounding mountains at higher elevation and is predominantly used for sugarcane and coconut plantations. The majority of paddy is rainfed with only about 25% or 1,590ha under irrigation. Of total irrigated paddy, 400ha is covered by CIS, 132ha by three KABSAKA water impounding projects, and the remaining 1,058ha by private weirs, pumps and impoundings.

In general, the majority of paddy is double cropped with the first crop in the rainy season and the second in the dry season and an annual cropping intensity of 163.0%. Triple cropping is also practised in some areas. Direct seeding is the predominant cultivation method with only about 7% of total paddy area cultivated by the transplanting method. Average farm size in the Project area is 2.4ha and the average annual income of a standard farm household is ₱10,134 for irrigated paddy and net reserve is ₱764.

Paddy area is divided into river basins such as the Asue, Serruco, Gubaton and other basins which discharge into Ajuy Bay, and the Hasohoy and Tabacay river basins which are directly adjacent to the former and flow into Bagacay Bay. Paddy elevation ranges from 2-40m and slope of the Asue area is about 1/300.

The percentage of electrification in the Project area is extremely low; distribution as of 1983 was only 8.8% (1,538 households) of total households in the related municipalities, and the majority is concentrated in barangay and poblacions along the national roads.

Domestic water supply to area residents is mainly dependent on communal wells. Although each poblacion has its own simple waterworks system, the supply rate is low at only 4.1% (224 households) of total households in Ajuy, 2.7% (100 households) in Concepcion, 10% (197 households) in San Dionisio and 18.4% (940 households) in Sara. Moreover, water shortages often occur in dry season due to low water level. Communities dependent on communal wells and other water sources likewise suffer severe water shortages in dry season and thus provision of a stable potable water supply is extremely urgent.

3. THE PROJECT

3.1 *Project Outline*

The proposed Project aims to improve agricultural productivity by irrigation development in the Asue River basin and surrounding area utilizing the water resources of the Asue River, rivers in the Project area and the Catipayan river basin, and thereby to expand production, increase farmers' income, and raise their standard of living. At the same time, such development is envisioned to stimulate general rural development which will in turn increase employment opportunities and the income of local residents and improve living conditions.

To realize the above objectives, the basic concepts of the Project were determined as follows:

a) provision of a stable irrigation water supply;

b) improved land productivity for paddy and increased cropping intensity and overall production through introduction of irrigated farming technology;

c) introduction of vegetables and other diversified crops and increased cropping intensity;

d) establishment of an effective drainage system;

e) introduction of irrigated farming technology and establishment of an extension/instruction system;

f) strengthening and expansion of existing agricultural support systems;

g) introduction of post-harvest technology and improvement of existing facilities;

h) establishment of a road network to ensure effective functioning of irrigation facilities, water management, farm production and marketing activities; and,

i) establishment and reinforcement of farmers' organizations for supply of farm inputs, credit, appropriate water management and irrigation facility maintenance.

3.2 Agricultural Development Plan

The agricultural development plan was formulated in accordance with the above components. With establishment of the irrigation system proposed under the Project, present land use will change as outlined below.

Land Category	Present Area (ha)	Area with Project(ha)
1. Total Cultivated Area	7,120	7,120
Paddy Area	6,320	6,350
Irrigated paddy	1590	6350
Non-irrigated paddy	630	-
Right of way	-	360
Irrigated Diversified crops	-	410
Sugarcane	380	0
Coconut	200	0
Grassland	220	0
2. Others	1,200	1,200
3. Net Irrigated Area	1,590	6,760
4. Paddy Area in the Benefit Area		
1st crop	6,320	6,350
2nd crop	3,825	6,350
3rd crop	130	500

Several alternative cropping systems and crops were studied focusing on profitability, labor, available water resources and farmers' interest. As a result, double paddy cropping is proposed in the majority of the Project area while five paddy croppings biannually are proposed in a portion of the downstream paddy area. Moreover, introduction of triple cropping of diversified crops, particularly vegetables, is proposed to improve nutrition in accordance with the government policy.

Transplanting was judged to be the optimum cultivation method after project implementation on the basis of studies on crop budget and irrigation water consumption; however, in consideration of labor availability, farmers' interest, etc., the percentage of direct seeding after project implementation is proposed at about 60%.

Anticipated unit yield of paddy and other crops and annual paddy production after project implementation is projected as tabulated below.

Crop	Unit Yield(t/ha)		Annual Production(t)	
	Present	Project	Present	Project
Paddy	2.16	4.81 1/	22,161	63,460
Tomato	-	20.0	-	12,310
Corn	-	3.5	-	718
Mung Beans	-	1.0	-	205

1/ weighted mean of 4.6t/ha in 1st Crop and 5.0t/ha in 2nd, while others allow five croppings biannually.

3.3 Water Resources Development Plan

The basic water resources development policy is maximum utilization of water resources in the Asue Basin; however, in order to provide stable irrigation water supply and increase the cropping intensity of irrigated areas, additional development of water resources in another basin is planned to compensate potential insufficiencies within the former.

3.4 Irrigation and Drainage Development Plan

Proposed irrigation development under the Project consists of effective utilization of available water resources combined with minimization and optimum use of required facilities. Components of the plan are as follows:

a) Maximization and effective use of available water resources through construction of intake weirs on the Asue, Serruco and Gubaton rivers and use of the existing CIS weir;

b) Establishment of a systematic canal network from each intake weir to the on-farm level and installation of related facilities required for the same;

c) Stabilization of irrigation water supply and supplementation of possible shortages in the Asue Basin through construction of a dam on the Catipayan River;

d) Construction of a trans-diversion canal to convey water from the Catipayan reservoir to the Asue Basin;

e) Construction of maintenance roads to all types of canal to ensure effective water management and maintenance of irrigation facilities; and,

f) Establishment of farmers irrigators' associations for effective water management, facility maintenance and collection of irrigation fees.

The drainage improvement plan has been formulated to enhance the effectiveness of irrigation development, by both responding to the changes in drainage conditions envisioned with project implementation and improving present conditions. The components of the drainage plan are as follows:

a) Re-excavation of the Hasohoy River and Padios Creek, the capacity of which is presently insufficient for flood discharge;

b) Rehabilitation of existing drainage structures and road crossing structures, such as culverts, etc. where present capacity is insufficient; and,

c) Construction of new drainage canals.

3.5 Road Network Plan

The proposed road network plan focuses on establishment of access roads for maintenance of planned irrigation facilities. The same will serve to improve farm-to-market connections, promote increased agricultural production, facilitate farm support services and increase

communication among local residents. Farm roads are planned to allow free passage of ox-carts with a maximum distance of 500m from the farthest paddy to the farm road. Moreover, all roads will be connected to national or provincial roads.

3.6 Water Supply Plan

Incorporation of domestic water supply is planned to improve the living conditions of area residents. At the same time, this plan is considered secondary to the irrigation development plan and will be designed so as not to interfere with the main objectives and functions of the Project. Proposed water supply consists of Sara waterworks system supplementation which will support the existing waterworks expansion plan, and the Integrated Community Center multipurpose pond plan which will provide stable domestic water supply to area residents during the dry season. Domestic water supply capacity for the former is designed at 100ℓ/day/person for a population of 20,300 in the target year 2,000 based on the Sara waterworks expansion plan and the same will supplement the present shortage of 1,426m^3/day(0.520MCM/year) by gravity supply.

A water supply of 100ℓ/day/person was adopted for the Integrated Community Center multipurpose pond scheme with a supply population of about 500/pond and establishment of 100 ponds throughout the Project area. Shallow wells are planned at each multipurpose pond in the integrated community centers.

3.7 Hydropower Plan

The hydropower generation plan is designed to facilitate effective water resources development in the area and maximize the use of water resources. As the said plan is considered supplementary to the irrigation plan, it has been formulated so as not to interfere with the objectives, development potential and function of the same.

Construction of power stations is proposed in two locations to maximize water resources, one at the intake point for the dam site and the other at the terminus of the trans-diversion tunnel. Available discharge for hydropower under the Project is designated as that which will not interfere with the irrigation plan and, on the basis of a simulation model, maximum available discharge was determined at 3.00m^3/s.

Annual generated energy from a 20 year average is estimated at 3,225MWh at the dam site power station and 4,112 MWh at the canal route power station. In order to connect the two power stations to the proposed ILECO II Sara substation, installation of a transmission line about 10km in length is planned. The proposed transmission line is 13.2kV.

3.8 Planned Facilities

The main facilities proposed under the Project are delineated below.

(1) Facilities Outside the Benefit Area

Main facilities which are planned outside the benefit area include the dam and appurtenant structures, transdiversion canal, hydropower plant and transmission line, and water supply facilities for the Sara waterworks.

(2) Facilities Within the Benefit Area

Facilities and construction work proposed within the benefit area consist of the Asue intake weir, Bakabak intake weir, Gubaton intake weir, main irrigation canals and appurtenant structures, Asue river rehabilitation and drainage canal construction, roads and related structures, on-farm facilities and integrated community centers.

Main features of the above Project facilities are outlined below.

1. Catipayan Dam and Reservoir

- Dam

Type	Center core rockfill
Crest elevation	EL. 129.5m
Freeboard	2.5m
Height	48.5m
Length	265.0m
Embankment volume	796,000m

- Reservoir

Catchment area	44.2km^2
Effective storage capacity	21.5 MCM
Design sediment volume	6.7 MCM
Gross storage capacity	28.2 MCM
Design flood level	EL. 127.0m
Normal high water level	124.0m
Submerged area	2.10km^2

- Spillway

Type	Without gate, chute
Design discharge capacity	850m^3/sec
Crest width	76m
Design overflow depth	3.0m

- Intake Facilities

Intake High water level	EL. 124.0m
Low water level	EL. 109.0m
Type	Drop inlet
Design discharge	6.0m^3/sec

- By-pass Tunnel

Design discharge	207m^3/sec
Type	Standard horse-shoe: 2R=5.5m

2. Trans-diversion Canal and Tunnel

- Canal

Design discharge	6.0m^3/sec
Length	7.7km
Type	Concrete flume

- Tunnel

Design discharge	5.9m^3/sec
Length	472m
Type	Standard horse-shoe: 2R=2.15

3. Irrigation and Drainage

- Diversion Dam

Number	3 (Asue, Bakabak, Gubaton)
Type	Automatic collapsible rubber dam
Intake gate	Manual regulating gate

- Asue River Course Improvement

Length	650m
Design discharge capacity	5.8m^3/sec

- Irrigation Canal

Main canal	7 lines, approx. 37,000m
Lateral canal	28 lines, approx. 74,000m
Canal section	Trapezoidal, earth lining
Related structures	Inverted syphon, Pipe road crossing, Chute, Vertical drop, Check, Head gate and parshall flume, Double orifice, Proportional divisor, Wasteway, Drain inlet, Drainage culvert, Division box, Turnout, Bridge

- Drainage Canal

Newly constructed canal	21,500m
Creek rehabilitation	6,000m
Structure rehabilitation	6 Nos.

- O & M Road

Total length	110.85km
Effective width	3 to 4m

- On-farm Development 6,760ha

4. Road Network

- Farm Road	132.15km
(- O & M Road=already listed above)	(110.85km)

5. Integrated Community Center

Capacity per pond	10m x 10m x 1.5m depth 150m^3 x 100 Nos.
Concrete yard	12m x 2.4m x 20cm x 151 Nos.
Shallow well	1 unit/approx. 2 Nos.

6. Hydropower Plant

- Dam Site Power Plant

Turbine type	Cross flow
Generator type	Horizontal shaft synchronous 3-phase
Amplifier type	Parallel gear type
Generator output	650kW
Maximum discharge	3.0m^3/sec
Total water head	34.0m
Maximum intake water level	EL. 124.0m
Minimum intake water level	EL. 109.0m
Rated rotary speed	215-900 r.p.m.
Rated frequency	60Hz

- Canal Route Power Plant

Turbine type	Cross flow
Generator type	Horizontal shaft synchronous 3-phase
Amplifier type	Parallel gear type
Generator output	750kW
Maximum discharge	3.0m^3/sec
Total water head	40.0m
Intake water level	EL. 82.5m
Tailrace water level	EL. 42.50m
Rated rotary speed	240-900 r.p.m.
Rated frequency	60Hz

- Generator

Type	Horizontal shaft synchronous 3-phase
Output	830 kVA

- Penstock	ϕ1,200mm, L=273m ϕ1,000mm, L=155m
- Transmission Line	
No. of circuits	
Cables	2/0 ACSR
Insulators	Porcelain
Support	Wooden pole
Voltage	13.2 kV
Total length	10km

7. Domestic Water Supply

- Sara Waterworks	
Target year	2003
Population	20,300
Capacity	100ℓ/day/person, 0.065m^3/sec
Pipeline	ϕ150mm, L=1.5km

3.9 Implementation Plan

The implementation period was determined at 7 years including a 2-year preparation period. The storage dam, diversion dam, appurtenant dam structures, trans-diversion canal, main canal, roads, and large scale irrigation related structures will be constructed with heavy equipment. Other small-scale structures and on-farm facilities will be constructed by manual labor, thereby increasing employment opportunities for residents in the surrounding area.

3.10 Organization and Management

The Asue River Basin Agricultural Development Project Office to be established by NIA will be responsible for project execution and post-implementation operation and maintenance. In addition, irrigators' associations will be established as the nucleus for operation and maintenance of irrigation facilities, water management, collection of water rates and introduction and extension of modern farm management methods.

The NIA will be responsible for water management related to hydropower generation through the O & M Office. Plant operation and power generation however, will be under the jurisdiction of ILECO II. Water management for the waterworks supplementation plan will be conducted by

the NIA Office where facilities for the same will be maintained by farmers' associations. Integrated community centers will be managed by beneficiaries groups in the respective areas under NIA supervision. Responsibility for road maintenance will be entrusted to the NIA O & M Office by the related government agency.

4. COST ESTIMATES

Project cost consists of direct construction cost, land acquisition and compensation, O & M facilities engineering cost, management cost and price contingencies.

Based on constant prices of October 1984, total financial cost is estimated at ₱730.95 million, the foreign currency portion accounting for 56% (₱410,084,700) and the local currency portion for 44% (₱320,864,500) of the same. Considering future cost escalations estimated at 45.6% in 1985 and 12% in 1986-90 for local currency and 8.0% in 1985, 9.0% in 1986-88, 7.5% in 1989 and 6.0% in 1990 for foreign currency, project cost is estimated at ₱1,383,456,000, the foreign currency portion of which is ₱615,702,300 and the local currency portion of which is ₱767,754,000.

5. PROJECT EVALUATION

5.1 General

The proposed Project consists of three components:agriculture, hydropower and waterworks. Joint construction cost of the Catipayan dam and transdiversion canal totals ₱489.34 million in financial value and ₱396.297 in economic value.

Allocation of construction cost for each component is tabulated below and the evaluation period for economic analysis was assumed at 50 years in consideration of the life of the dam.

Items	Agriculture	Hydropower	Sara Waterworks	Overall
1. Specific Cost				
- Financial	243,165	53,995	1,521	298,681
- Economic	183,545	50,801	1,405	235,751
2. Joint Cost				
- Financial	383,462 (88.71)	48,025 (11.11)	778 (0.18)	432,265 (100%)
- Economic	334,947 (94.41)	19,690 (5.55)	142 (0.04)	354,769 (100%)
3. Total				
- Financial	626,627	102,020	2,299	730,946
- Economic	518,482	70,491	1,547	590,520

5.1.2 Tangible Benefits

Quantifiable benefits include agriculture (crops, integrated community centers and farm roads), hydropower and waterworks. The value for each component in the target year is projected as tabulated below.

	Agriculture						
	Crops	ICC	Farm Road Network	Total	Hydro-power	Sara Water-Works	Overall
Financial	64,663 (74.1)	540 (0.6)	10,089 (11.6)	75,292 (86.3)	11,739 (13.4)	263 (0.3)	87,294 (100%)
Economic	82,998 (85.9)	420 (0.4)	3,644 (3.8)	87,062 (90.1)	8,414 (8.7)	205 (0.2)	96,681 (100%)

Results of comparison of project cost and benefits are presented in the following page.

COMPARISON OF PROJECT COST AND BENEFITS

Items	Agricul-ture	Hydro-power	Sara Water-works	Overall
A. Financial Indicator				
1. Construction Cost (000₱)	626,627	102,020	2,299	730,946
10% Discount Rate	422,890	65,033	1,417	489,337
2. Benefit (000₱)				
- Annual Benefit	75,292	11,739	263	87,294
- Present Worth Value (10% of discount rate)	403,343	65,265	1,462	470,070
3. Benefit Cost Ratio				
- 6% of discount rate	1.56	1.58	1.67	1.57
- 8% - do -	1.20	1.24	1.29	1.21
- 10% - do -	0.95	1.00	1.03	0.96
4. Internal Rate of Return (%)	9.6	10.0	10.3	9.7
B. Economic Indicator				
1. Construction Cost (000₱)	518,482	70,491	1,547	590,520
10% Discount Rate	350,645	44,718	934	396,297
2. Benefit (000₱)				
- Annual Benefit	87,062	9,414	205	96,681
- Present Worth Value (10% of discount rate)	481,221	52,338	1,140	534,699
3. Benefit Cost Ratio				
- 6% of discount rate	1.37	1.17	1.22	1.35
- 12% - do -	1.13	0.98	1.01	1.11
- 14% - do -	0.94	0.83	0.85	0.93
4. Internal Rate of Return (%)				
- Proto-type (Sensitivity Test)	13.3	11.7	12.1	13.2
a. Fluctuation of Crop Target Yield				
a-1 10% increase	15.0	-	-	14.7
a-2 10% decrease	11.6	-	-	11.6
b. Two Year Delay in Project Implementation	-	-	-	11.9
c. Increase in Construction Cost				
c-1 10% increase	12.3	10.7	11.1	12.1
c-2 20% increase	11.4	9.8	10.2	11.2
d. Combination of a-2 & c-1	10.6	-	-	10.6
e. Combination of a-2 & c-2	9.8	-	-	9.8

5.2 Agriculture

5.2.1 Farm Budget Analysis

Farm households in the Project area depend mainly on paddy monoculture with an average farm area of 2.4ha. Annual farm household income without project is estimated at ₱10,554, while that with project is projected to increase to ₱28,624/year due to enhanced cropping ratio, increased yield and upgraded paddy quality. There is a disposable income increase of ₱1,020 from ₱784 without project conditions to ₱1,804 with project.

5.3 Internal Rate of Return(IRR)

(1) Agriculture

Based on comparison between allocated project cost and combined total crop, integrated community center and farm road benefits, financial IRR (FIRR) totals 9.6% while economic IRR (EIRR) totals 13.3%.

(2) Hydropower

The FIRR for hydropower is 10.0% while the EIRR is 11.7%.

(3) Sara Waterworks

The FIRR for Sara Waterworks is 10.3% and the EIRR is 12.1%.

(4) Overall IRR

FIRR and EIRR for the entire Project are 9.7% and 13.2%, respectively. Agriculture occupies 88% of total project cost and 90% of project benefits, and thus overall IRR of the Project is greatly affected by the high economic effectiveness of agriculture.

5.4 Socioeconomic Impact

In addition to the above mentioned tangible benefits, the Project is envisioned to result in the following socioeconomic impacts.

(1) Impact on the National Socioeconomy

a) contribution to self-sufficient food supply and improved national economy;

b) reduced imported fuel consumption and economic expenditure; and,

c) improved nutrition and sanitation.

(2) Impact on the Project Area

a) increase and stabilization of farm household income;

b) improved public health and living environment;

c) increased employment opportunities, particularly for landless farm laborers;

d) expansion of radius of interaction through improved farm road network and development of the transportation system;

e) rural electrification;

f) improved quality of farm produce and market expansion;

g) provision of a stable domestic water supply via establishment of integrated community centers; and,

h) increased consciousness of farmers regarding agricultural cooperatives through integrated community centers and maintenance of irrigation facilities.

6. STAGE DEVELOPMENT APPROACH

Stage development was studied for project implementation. Stage I consists of diversion of available Catipayan surface flow to supplement insufficiencies in the Asue River basin with priority given to irrigation development. The proposed irrigation area for the same is 4,130ha. Stage II, on the other hand, consists of implementation of the overall development plan and construction of the Catipayan Dam with an irrigation area of 3,540ha. The EIRR of Stage I and Stage II are 15.5% and 11.8%, respectively, while overall EIRR is 13.1% indicating that stage development of the Project is economically feasible.

7. ENVIRONMENTAL IMPACT

7.1 Impact of Catipayan Dam

Resettlement of two farm households in the proposed reservoir area will be required with construction of the Catipayan dam. Both households have clearly expressed willingness to resettle in areas within their own leasehold or as designated by the government, on the condition of

appropriate compensation. A total of about 2,100ha of land, including approximately 15ha belonging to the above farm households will be submerged by the proposed reservoir. The majority of this area however, is steeply inclined and unsuitable for agriculture.

Although some roads will be interrupted by the storage dam, replacement of the same is not considered to be urgently required. Moreover, the dam crest can be used as a pedestrian path, thereby facilitating year-round traffic between the right and left banks and increasing the daily sphere of activity for local residents. Maintenance roads to the dam site will also greatly improve the local road network, thus stimulating social and economic activity and promoting further rural development. The estimated impact of decreased discharge below the dam is minimal and is not expected to affect domestic water supply to downstream residents in a normal year.

With the introduction of irrigated farming, it is proposed that present applications of agro-chemicals and fertilizers be tripled. Surface run-off of the same would likewise triple resulting in possible contamination of fish ponds. However, judging by the estimated density of each chemical in fish ponds with project implementation, the proposed applications would result in values lower than the maximum acceptable pollution load.

8. WATERSHED MANAGEMENT PLAN

The watershed management area for the proposed Catipayan dam and reservoir is 4,400ha. Approximately 84% of this area is covered by open grassland with scattered trees while secondary forest area covers only 4.5% (about 200ha). Deep, steeply sloped valleys are numerous and erosion due to shifting agriculture is severe. Accordingly, priority in watershed management should be given to reforestation in order to control erosion and ensure long-term, effective utilization of the Catipayan dam and reservoir.

In consideration of present vegetative cover and topography, the watershed was roughly categorized into the following areas and proposed land uses.

Proposed Land Use	Features	Area	Tree Species
Forest Area (I)	Reservoir basin, very steep slopes EL. 124 - 150 or 175m	570ha	Ipil Ipil
Arable Land, Range and Residential Area	Undulating low hills short slopes and isolated terraces slope 0 - 15° EL. 150 - 200m	1,105ha	Ipil Ipil
Agro-forest Area	High to medium hills slope 15° - 40° EL. 200 - 300m	1,170ha	Ipil Ipil Mango
Forest Area (II)	Mountains with long continuous very steep slopes EL. 300 - 700m	1,325ha	Narra
Reservoir and Others		250ha	

About 2,530ha of the total 4,420ha area is designated for reforestation. Ipil ipil, narra and mango tree types were selected in consideration of growing conditions, profitability, etc. and will be planted in appropriate areas according to the characteristics of the above 4 land categories. Cost required for implementation is estimated at P21.84 million (about $US 1.21 million).

9. CONCLUSION AND RECOMMENDATIONS

(1) This feasibility study report for the Asue River Basin Agricultural Development Project is being submitted seven years after NIA basic investigations were begun in 1978; almost three years after JICA carried out the Preliminary Survey in 1982. During this period, farmers in the Project area have been anxiously awaiting implementation of the Project and consequent year-round irrigation. Economic feasibility, technical soundness as well as advantageous impacts were verified in this report, and early implementation of the Project is strongly recommended in order to achieve rural development and thus contribute to the development of the nation as a whole.

(2) Annual investment for overall development however, is large in consideration of the present financial situation in the

Philippines. In the event that immediate overall implementation is infeasible, staged development is recommended as presented in this report.

(3) The main component of the Project is agricultural development through the introduction of year-round irrigation. Various rural development components such as road network, integrated community development, hydropower generation and domestic water supply have also been incorporated in the Project and thus a substantial impact on promotion of development in rural society is envisioned with project implementation. In order to obtain maximum benefit, it is recommended that NIA discuss the Project with related agencies for smooth implementation and effective operation and management.

(4) Under the Project, double paddy cropping is proposed in the majority of the Project area and 5 paddy croppings biannually in other portions through year-round irrigation. Modern farming technology and effective management will require the positive support of agencies concerned.

(5) Approximately 410ha is proposed as upland crop area for crop diversification in conformity with government policy. Introduction of upland crops will improve nutrition and food supply as well as expand the production of cash crops. To achieve these goals, related agencies should be strengthened and given positive back-up.

(6) Agricultural support services such as credit and farm input supply are required in order to exploit and expand the effects of project implementation. For this purpose, farmers' cooperatives will act as a core organization as well as managing irrigation water, facilities and collection of water charges. NIA will support and direct these cooperatives and the same should be established prior to project implementation.

(7) Existing irrigation systems in the area, i.e. CIS and KABSAKA water impoundings, have been incorporated into the Project as direct benefit and enriched benefit areas based on the interest of farmers concerned. It is recommended that NIA give appropriate

direction in regards to establishment of irrigators' associations and the rate of water charges upon discussion with related organizations.

(8) After implementation of the Project, rice production will triple present production. For post-harvest facilities, a total of 151 multipurpose concrete yards with the main function of rice drying will be introduced under the Project mainly as a feature of Integrated Community Centers. Although the capacity of the existing rice mill facilities will be insufficient under project conditions, milling is sufficiently profitable as a private industry to stimulate private investment. It is envisisioned that milling under the Project will depend on enlargement and improvement of private facilities. Promotion of these activities should be conducted by NIA in consultation with related agencies.

(9) Eighty percent of the total catchment area in the Project watershed is tropical open land resulting from a long history of shifting cultivation. For this report, a study was conducted on the Catipayan watershed area and a tentative plan for watershed management, mainly concerning soil conservation and reforestation, was formulated and is presented herein. It is recommended that NIA coordinate related agencies to conduct more detailed study and implementation of the same. Due to lack of an adequate topographical map of the Asue Basin watershed area, only a draft plan was presented in this report. Preparation of a topographical map and detailed watershed management program is therefore deemed necessary.

(10) A large fish pond area is situated in the downstream Project area. Upon project implementation, use of agro-chemicals will increase as a result of the introduction of modern agricultural technology. Therefore propagation and guidance by agricultural extension workers in appropriate use and selection of agro-chemicals will be required upon project completion in order to avoid direct inflow of chemicals into fish ponds and resultant damage.

(11) The Project will have a positive and substantial impact on socioeconomic development and improvement of rural conditions. Some adverse effects however, may also occur to the natural and socioeconomic environment. Prior to project implementation therefore, overall assessment of the environmental impact based on the basic study in this report should be conducted.

(12) Some existing roads will be divided by construction of the Catipayan dam and resultant reservoir. A road network in the Catipayan watershed area must be developed as a link in the chain of rural development especially for watershed management. In planning such a network, operation and maintenance roads, construction access roads, the crest of the Catipayan dam and also use of boats in the reservoir will be taken into consideration.

(13) The proposed Catipayan reservoir, trans-diversion canal and diversion dam upstream can be effectively used for fish culture to improve the nutrition and increase the income of the rural residents. Inland fish culture is not proposed in this report however, due to many constraints such as difficulty in maintaining appropriate water depth and in consideration of the possible effects of agro-chemicals. Development potential of fish culture is high however, and further investigation and studies should be made to effectively utilize these facilities.

(14) From the date of submission of this report until the commencement of detailed design and construction works, it is recommended that NIA investigate and collect data through detailed geological survey, construction material survey, topographical survey, etc. for preparation of the detailed design. To facilitate smooth project implementation, collection of hydro-meteorological data and establishment of an observation network is also required.

CHAPTER I

INTRODUCTION

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INTRODUCTION

1.1 Authority

This Feasibility Report has been prepared in accordance with the Scope of Works for the study on the Asue River Basin Agricultural Development Project agreed upon between the Government of the Republic of the Philippines and the Government of Japan on 31 March, 1983. This report deals with the feasibility study on the said Development Project (hereinafter referred to as the Project) on the basis of the results of field survey and study undertaken by the Feasibility Study Team of JICA and the comments made by the Philippine Government agencies concerned.

1.2 Project History

The Asue River Basin which mainly composes the Project area is situated at the northeast tip of Iloilo Province on Panay Island. This area is the least developed area on the said island. Development projects on Panay Island implemented to date have been concentrated in urban and neighboring areas, while the surrounding rural areas have remained undeveloped. Asue in particular has been overlooked and a substantial income gap exists between residents of the same and those of developed urban areas.

In consideration of these conditions, the Government of the Philippines has promoted agricultural development in the area since the late 1970s formulating the Asue Integrated Area Development Project to eliminate regional socioeconomic disparities and to improve living standards in the area. Recognizing the necessity of early implementation of the said plan, the Philippine Government requested the Japanese Government to provide technical cooperation in the form of a feasibility study in April 1982. In response to this request, the Japanese Government offered to undertake a feasibility study as part of the technical cooperation program. Accordingly, the Government of Japan, through JICA, dispatched the Preliminary Investigation Mission from November 16 to December 3, 1982.

In addition to undertaking a field reconnaissance survey of the Project area, the Preliminary Study Team also met with officials from NIA and other agencies concerned to discuss the present Project. On January 31, 1983 an agreement was reached between NIA and JICA regarding Implementing Arrangements for Technical Cooperation on the Asue River Basin Agricultural Development Project.

In accordance with the above agreement, JICA dispatched the Feasibility Study Team (F/S) composed of 10 members to the Philippines from 5 June 1984 to 18 August 1984. During this period the Team in cooperation with NIA officials carried out field survey. The results of this First Stage Field Work were compiled in a report (Progress Report (1)) and submitted to NIA.

From 19 August to 17 October 1984 the Team undertook various studies in the home office results of which were compiled and presented to NIA in the Interim Report. Subsequently, JICA dispatched a second feasibility study team composed of 9 members to the Philippines from 18 October to 16 December 1984. During this period the Team in cooperation with NIA officials carried out Second Stage Field Work. Prior to actual field study, the Team met with NIA officials concerned to discuss the Interim Report and the scope and purpose of Second Stage Field Work.

Upon completion of the field work, the Team compiled the results in Progress Report (2) and presented the same to NIA. Subsequently, in March 1985, the Draft Final Report was presented to the Government of the Philippines.

Upon returning to the home office, the Team completed the Final Report which incorporates the comments of NIA officials and the Advisory Committee concerning the previous reports.

1.3 Objectives of the Study

Based on the Scope of Works agreed upon in 1983 between the two Governments concerned, the objectives of the Study were to:

a) verify the economic and technical feasibility of the Asue River Basin Agricultural Development Project; and,

b) transfer technical knowledge to Philippine counterparts.

1.4 Scope of Works

The Project area covers the Asue River basin, other river basins in the vicinity, the proposed dam site and the watershed area.

The Study consists of two stages, each including field work and home office work. Work content of the Study undertaken by the Study Team for each stage is set in below.

(1) First Stage Field Work

a) Collection and analysis of data and information related to the Project;

b) field survey of socioeconomic conditions, present agricultural production, and water and land resources which are the material and socioeconomic basis of agricultural production and thus form the basis of agricultural development plan formulation; and,

c) geological and soil surveys, and topographical measurements required for determination of Project site and plan and design of Project facilities.

(2) First Stage Home Office Work

a) Study and analysis of existing conditions in the Project area;

b) formation of a land use plan for the Project area and a water resource development plan;

c) formulation of an agricultural development plan, and tentative development plan proposal for irrigation and related secondary development schemes;

d) planning, preliminary design and preparation of rough cost estimate for Project facilities; and,

e) study of Project implementation plan proposal.

(3) Second Stage Field Work

a) Supplementary field survey and data collection; and,

b) detailed study, and detailed analysis of data and results obtained during the First Stage Study of the present Project.

(4) Second Stage Home Office Work

a) Detailed study of the Project and formulation of a draft development plan;

b) determination of Project implementation approach and draft implementation plan;

c) cost estimation; and,

d) estimation of Project benefits and economic and financial analysis.

1.5 Activities of the Study Team

The Team undertook field and home office work in the following stages.

First Stage	Field Work: 5 June 1984 - 18 August 1984 Home Office Work: 19 August 1984 - 17 October 1984
Second Stage	Field Work: 18 October 1984 - 16 December 1984 Home Office Work: 5 January 1985 - 5 March 1985

All field work was conducted in cooperation with NIA officials and survey results were compiled into progress reports at the end of each period. The said progress reports were submitted to NIA and the contents discussed. On 5 June 1984 the Team including members of the JICA Advisory Committee arrived in Manila where they presented the Inception Report to NIA. Discussions between the Team, Advisory Committee and NIA were held concerning scope of works, and basic approach to formulation of an agricultural development plan.

The report on First Stage Field Work (Progress Report (1)) was submitted to NIA on 13 August 1984. First Stage Home Office Work was undertaken subsequently, and the results compiled in the Interim Report. The latter was submitted to NIA on 22 October 1984 prior to field work and the same was discussed with NIA officials concerned.

On 12 December 1984, the Team submitted Progress Report (2) which consisted of the results of Second Field Work to NIA. The comments of Philippine Government officials concerned and of the JICA Advisory Committee regarding study results in the progress and interim reports were incorporated in this Draft Final Report. Discussions were held with Philippine government officials concerning the said Draft Final Report in April 1985.

The full cooperation of Philippine counterparts during the field work period and discussions on all aspects of work ensured effective technical transfer to the same. Names of the members of the JICA Advisory Committee, Philippine Government officials, the Study Team and counterpart personnel involved in the feasibility study are as listed in TABLE-1.

PERSONNEL INVOLVED IN THE FEASIBILITY STUDY

ASSIGNMENT	NAME	POSITION
Members of Project Advisory Mission		
Team Leader	Takeshi NASU	Director Construction Department Office, Tokai Regional Agricultural Administration Office, Ministry of Agriculture, Forestry and Fisheries
Irrigation/Drainage	Jiro NAKAJIMA	Deputy Director Land Improvement & Consolidation Div., Construction Dept., Agricultural Structure Improvement Bureau, MAFF
Dam/Structure	Tetsuya UMEZAKI	Deputy Director Project Planning Div., Planning Dept., Agricultural Structure Improvement Bureau, MAFF
Agronomy	Yoshiya TAKASHIMA	Deputy Director Resources Div., Planning Dept., Office, Tohoku Regional Agricultural Administration, MAFF
	Junichi HASEGAWA	Personnel Div. General Affairs Dept., Overseas Economic Cooperation Fund
Members of Feasibility Study Team		
Team Leader	I. INAMORI	
Hydrology	K. SASABE	
Geology	K. EGUCHI	
Irrigation/Drainage	T. KOBAYASHI	
Agronomy	T. TAMURA	
Soil/Land Use	K. NAKABAYASHI	
Dam Planning/ Hydropower	T. TAKAGI	
Dam Design	M. TAKENAGA	
Irrigation/ Facility Design	S. MATSUSHIMA	
Agro-sociology	K. NAKAOKA	
Economy	M. ANAI	

PERSONNEL INVOLVED IN THE FEASIBILITY STUDY

ASSIGNMENT	NAME	POSITION
NIA PERSONNEL		
Project Coordinator	Rogelio P. DE LA ROSA	Division Manager, Project Investigation Div.
Assistant Coordinator	Orlands D. PASCUAL	Chief Geologist, Geology Section
Hydrology	Rolando M. MALOLES	
Hydrography	Edgardo O. TAILIP	
Geology	Antonio S. SANTOS	
Geology	Ricardo V. DIMACULANGAN	
Geology	Arturo F. TORRALBA, Jr.	
Irrigation/Drainage	Cesar F. CARBONELL	
Irrigation/Drainage	Alfredo FORMARAN	
Agro-economy	Carlito D. HERRERIA	
Soil and Land Use	Alejandro S. CANTOR	
Dam/Power	Domingo G. FULO	
Dam/Power	Cesar B. RAMOS	
Economy	Candido L. RAQUEPO	
Cost Estimate	Roman R. DE LEON	
NIA PERSONNEL CONTACTED DURING THE STUDY		
	Cesar L. TECH	Administrator
	Jose B. DEL ROSARIO, Jr.	Assistant Administrator, Director of Project Development & Implementation
	Manuel R. TICAO	Assistant Administrator for Operations
	Avelino S. RIVERA	Manager, Project Development Department
	Isidro R. DIGAL	Div. Manager, Plan Formulation Division
	Romeo F. POTENCIANO	Div. Manager, Water Resources Utilization Division
	Epifanio C. GACUSAN, Sr	Div. Manager, Land Resources Utilization & Economics Division

PERSONNEL INVOLVED IN THE FEASIBILITY STUDY

ASSIGNMENT	NAME	POSITION
	Conrado Q. TINGZON	Head, Land Class Section
	Dominador D. PASCUA	Head, Land Use Section
	Primo B. VILLANUEVA	Head, Economics Section
	Clemente T. ALANANO	Head, Dams and Reservoir Section
	Edelberto B. PUNZAL	Head, Irrigation Works Section
	Abelardo Y. ARMENTIA	Head, Feasiblity Studies Section
	Jovito A. NAVARRO	Head, Hydrology Section
	Felipe G. PERDIDO	Head, Hydrology Section
	M. PEREZ	Head, Groundwater
	Patricio C. MARQUEZ, JR.	Head, Surface Water Utilization Section
	Wilfredo D. SILVA	Head, Project Identification Section
	Faustino M. GALIT	Head, Surveys and Mapping Section
	Emerson M. COLOMA	Head, Drainage Section
	Jose CONCEPCION Jr.	Director, NIA Region VII & VIII
	Rudy R. IBABAO	OIC, Planning Investigation Section NIA, Region VI
	N. YAMADA	JICA Advisor
	Y. HARADA	Former JICA Advisor
	K. MORIMOTO	- do -
	T. TAMURA	JICA Advisor
	O. UMEKAWA	- do -

CHAPTER II

PROJECT BACKGROUND

CHAPTER II

PROJECT BACKGROUND

2.1 National Background

2.1.1 Socioeconomy

The Philippines is composed of over 7,100 islands covering a total land area of 300,000km^2. About 30% or 9 million ha of the said area is farmland. According to the 1980 Census, the total population of the Philippines is 48,098,460 with a density of 160.3 persons per km^2, while the rate of population increase was 3.1% from 1961-70 and 2.7% from 1971-80.

Nationwide population over 15 years of age totalled 31,676 thousand in 1983, 64.6% (20,465 thousand) of which were members of the labor force. Of the latter, 95.4% or 19,524 thousand were gainfully employed, with unemployment at 4.6%. In 1983, the percentage of total employed laborers engaged in agriculture, forestry and fisheries was 52.2% with 47.8% employed in non-agricultural sectors. Although this ratio may vary by about 1% from year to year, the proportion of laborers engaged in each sector appears to follow a fairly stable trend.

Gross domestic production in the Philippines in 1983 totalled ₱380,821 million in current prices and ₱100,125 million at constant prices of 1972. The annual growth rate during the period from 1972-1983 was approximately 5.4%; however, in recent years the growth rate has declined and was 1.1% in 1982/83. Agriculture, fisheries and forestry related production comprised 21.6% of gross domestic product in 1983 or 24.8% at constant prices, indicating a relative decrease in production from the agricultural sector. The average annual production growth rate was 4.1% from 1972-83.

Philippine exports have shown a significant increase since 1974. Total export earnings in 1983 equalled US$12,492 million which is 5.42 times and 2.12 times greater than those of 1970 and 1974, respectively. Taking into consideration currency fluctuations, 1981 export earnings represent an increase of 3.7 and 1.7 times greater than 1970 and 1974, respectively. Exports accounted for 40.07% of the total volume of trade

in 1983 while imports accounted for 59.93% and the average trade volume over the last five years was 41.44% and 58.56% for imports and exports, respectively. With the exception of 1973, the unfavorable balance of trade has continued since 1950, trade deficits for 1983 amounting to US$15,555 million.

Main export items are agricultural products and raw mineral resources. Agricultural products accounted for 67% of total export value in 1970, 64% in 1975, 40% in 1980 and 34.3% in 1983 indicating a declining trend. On the other hand, in 1983 consumer goods accounted for 22.5% of total imports, industrial goods for 23.5% while the remaining 54% was composed of raw materials. Oil, however, which is included within the latter category, accounted for 28.5% of total imports.

While oil in 1970 accounted for only about 10.3%, of total import volume, this figure rose sharply, particularly after 1974. Oil imports in 1983 were 17.9 times those of 1970 and 3.26 times those of 1974. In 1981, however, oil imports peaked and the same are presently declining.

2.1.2 Agricultural Production and Food Demand and Supply

As shown in the following table total harvested area in the Philippines in 1983 was 11,656,300ha, of which 3,239,600ha (27.8%) was palay. Said area comprised approximately 28.4% of total agricultural production, about 28.4% (7,730,500t) of food grain production, approximately 24.7% (₱10% 219 billion) of revenue from total agricultural production and about 40% of revenue from total food grain production.

AGRICULTURAL AREA HARVESTED, QUANTITY AND VALUE OF AGRICULTURAL PRODUCTION IN 1982

	Harvested Area (1,000ha)	Quantity (1,000t)	Value (million ₱)
Total	11,656.3	27,261.4	43,457.8
Food Crops	7,727.6	20,116.9	26,739.3
Rice	3,239.6	7,730.5	10,721.9
Other Food Crops	4,488.0	12,386.4	16,017.4
Industrial Crops	3,928.7	2,144.5	16,718.5

Source: 1984 Philippine Statistical Yearbook (NEDA)

Rice production in the Philippines was unstable until the early 1970s. Since 1976, however, rice production has been steadily increasing with an average unit yield of 1.681t/ha in 1970 and 2.386t/ha in 1983. Annual production volume increased from 5,233,400t in 1970 to 6,431,000t in 1976 and to 7,730,000t in 1983.

Year	Harvested Area (1,000ha)	Annual Production (1,000t)	Unit Yield (kg/ha)
1970	3,133.4	5,233.4	1,681
1975	3,632.5	5,909.5	1,627
1976	3,674.0	6,431.0	1,750
1982	3,432.8	8,107.9	2,360
1983	3,239.6	7,730.5	2,386

Source: 1982 Philippine Statistical Yearbook

According to NIA Corporate Plan rice supply and demand projections, (TABLE-2) 14.1% of the demand will be stockpiled by 1990. However, this projection is conditional to on-schedule implementation of NIA's planned projects. Irrigation development is crucial to avoid implementation delay and resultant shortages.

2.1.3 Development Plan

(1) Agricultural Development Plan

At present, the Philippine Government is promoting the current Five Year Development Plan (1983-87). Under the development plan, real Gross National Product (GNP) is expected to achieve an average annual growth of 6.5% in 1983-87. GNP at current prices is expected to be ₱749 billion by 1987, resulting in per capita income of ₱13,199.

As the major source of economic growth in the coming years, the agricultural sector will concentrate on the following objectives.

RICE SUPPLY AND DEMAND PROJECTION

Crop Year		1980	82/83	83/84	84/85	89/90	94/95	99/2000
Supply								
Yield (Mt/Ha)								
Irrigated: Wet Season (WS)		2.43	2.69	2.78	2.87	3.16	3.41	3.66
Dry Season (DS)		3.02	3.16	3.20	3.25	3.50	3.70	3.90
Lowland Rainfed:	WS	1.87	2.00	2.04	2.08	2.19	2.32	2.44
	DS	1.72	1.77	1.78	1.80	1.92	2.07	2.22
Upland:	WS	1.32	1.14	1.15	1.16	1.24	1.36	1.49
	DS	1.45	1.40	1.44	1.48	1.71	1.86	2.01
Rice Area (1,000ha cropped)								
Irrigated:	WS	916	1,058	1,106	1,174	1,398	1,595	1,647
	DS	690	728	777	824	984	1,114	1,148
Lowland Rainfed:	WS	1,122	1,034	981	903	661	402	344
	DS	533	530	530	530	530	402	344
Upland:	WS	334	250	250	250	350	350	350
	DS	42	15	15	15	14	14	14
Palay Production (1,000Mt)								
Irrigated:	WS	2,228	2,846	3,075	3,369	4,418	5,439	6,028
	DS	2,085	2,300	2,486	2,678	3,444	4,122	4,477
Lowland Rainfed:	WS	2,101	2,086	2,001	1,878	1,448	933	839
	DS	919	938	943	954	1,018	832	764
Upland:	WS	442	285	288	290	434	476	522
	DS	61	21	22	22	24	26	28
TOTAL		7,836	8,459	8,815	9,192	10,785	11,828	12,658
Less: Seed, Feed, Waste (10.8%)		846	914	952	993	1,165	1,277	1,367
Palay Available for Consumption		6,989	7,545	7,863	8,199	9,620	10,550	11,291
Milling Recovery Ratio		0.65	0.653	0.654	0.655	0.66	0.665	0.670
Rice Available for Consumption		4,543	4,927	5,142	5,370	6,349	7,016	7,565
Demand for Rice								
Population (1,000)		48,406	52,374	53,768	55,199	62,227	68,865	76,215
National Income Growth (% PA)		5.5	5.5	5.5	5.5	5.5	5.5	5.5
Income Elasticity of Demand		0.10	0.10	0.10	0.10	0.10	0.10	0.10
Per Capita Consumption (kg)		86.5	87.3	87.5	87.80	89.4	91.70	94.00
Total Demand (1,000Mt)		4,187	4,572	4,705	4,846	5,563	6,315	7,164
Surplus (1,000Mt)		356	355	438	524	786	701	401
As Percent of Supply		7.83	7.20	8.51	9.76	12.38	9.99	5.30
As Percent of Demand		8.50	7.76	9.30	10.81	14.13	11.10	5.59

a) Acceleration of the pace of agricultural development and improved agricultural productivity;

b) Establishment of food security and maximization of agricultural contributions to economic recovery particulary in improving the country's balance of payments position; and,

c) Increased contribution from the agricultural sector to national reduction of poverty, better nutrition, enhanced welfare of the small farmers and landless rural workers, and general improvement of the welfare of the majority of the Filipino people.

Based on the assessment of the plan for 1978-82, the objectives for development of the agricultural sector in the next five year development plan are to:

a) accelerate the pace of agricultural development and attain food security and self-sufficiency;

b) establish an efficient marketing and distribution system and to modernize the agricultural production price system;

c) rehabilitate the agricultural financing system and credit assistance;

d) promote effective irrigation development and improvement of the operation and maintenance system;

e) develop land resources and promote effective use of the same;

f) develop and promote rural welfare;

g) rehabilitate and expand post harvest facilities;

h) effectively introduce modern agricultural technology; and,

i) improve the agricultural sector management system and cooperativize the same.

Agricultural production targets of the Five Year Development Plan are shown in the following table. Self-sufficiency in corn production is planned by 1986. The plan also promotes diversification of crops such as vegetables, peanuts, mung beans, industrial crops and others and reduction of sugarcane production.

PRODUCTION OF MAJOR AGRICULTURAL CROPS/COMMODITIES, CY 1983-87

Unit:'000mt

	Actual	Projections			
	1983	1984	1985	1986	1987
TOTAL AGRICULTURAL CROPS					
Food Crops					
Grains					
Palay	7,295	7,412	7,671	8,100	8,675
Corn	3,134	3,334	3,601	3,961	4,341
Other Crops					
Coffee	88	89	98	103	110
Cacao	5	6	6	8	10
Sorphum	17	18	21	24	27
Beans, Seeds & Nuts	96	99	112	117	123
Fruits	7,038	6,321	6,396	6,614	6,815
Vegetables	858	886	914	939	968
Root Crops	2.961	3,019	3,064	3,116	3,190
Commercial Crops					
Sugar	2,000	2,200	2,056	1,848	1,861
Coconut	2,010	1,780	1,894	2,068	2,273
Tobacco	48	43	48	51	53
Rubber	75	76	81	82	83
Abaca	88	96	102	107	116
Cotton	12	13	16	21	32
Ramie	2	3	3	5	6
LIVESTOCK	1,033	1,068	1,117	1,173	1,232
POULTRY	238	248	263	282	302
FISHERY	1,533	1,656	1,745	1,843	1,948

Source: BAEcon for agricultural crops, livestock and poultry, and Bureau of Fisheries and Aquatic Resources (BFAR) for fishery.

(2) Irrigation Development Plan

Irrigation is the most important infrastructure to increase yield and to enlarge production of rice. The 5-year development plan proposes promotion of irrigation development as an important strategy to attain self sufficiency in rice production. The substantial production decrease in non-irrigated area due to the drought in 1983 underlines the importance of this strategy.

The irrigated area in 1983 was 1,476,416ha or about 47.2% of potential irrigable area of the entire country (3,126,330ha).

Under the 5-year development plan, irrigation development for an area of 245,035ha is expected to be completed from 1984-87, resulting in a total irrigated area of 1,721,000ha in 1987. Expansion of multipurpose communal irrigation development is also planned including rehabilitation of operation and maintenance systems.

In addition, the 10-year development plan for 1983-92 in the NIA Corporate Plan targets development of two million hectares which corresponds to 64.5% of total irrigable area in the country. Newly proposed irrigation development area for this period is 518,120ha, while that for rehabilitation is 405,060ha to promote stable food supply and storage for future use. Total funding required for the above was estimated at P23,564 million at 1983 prices.

Since 1976 national rice production was re-stablized by the introduction of modern cultivation technology and expansion of irrigation development. In 1977 rice was exported rather than imported with a total export volume of 543,264t for the period from 1977-83. Supply and demand projections for rice as reported in the NIA Corporate Plan (1983-92) indicate that stored volume will reach 14.1% by 1990. To achieve this target, NIA strongly suggests that proposed irrigation projects be implemented as scheduled since delay in irrigation development will create an unfavorable balance of food demand and supply after 1990.

(3) Power Development Plan

The shift to alternative domestic energy sources is particularly being accelerated in the power sector where oil will be displaced mainly by geothermal and hydro (including minihydro) resources. Consequently, the share of these resources will increase substantially, precipitating the drop in the share of oil-generated electricity from the present 61% to 15% by 1987. With the expansion of the electrification program, at least 62% of total potential households in the rural areas will have access to electricity as an alternative energy form by 1987.

(4) Water Supply Development Plan

As of 1983, about 53% of the population is served by public water supply systems with a service coverage of 82% in Metro Manila, 55% in other urban centers, and 47% in rural areas. The rest of the population rely mainly upon wells and rivers.

A total of about 10,000 tubewell units and approximately 1,000 communal faucets were installed annually by the Government. Rural water supply development is carried out under the Rural Waterworks Development Corporation (RWDC) and the Local Water Utilities Administration. The Government established a development plan to realize the following targets:

1) Immediate

By the end of 1985, i) all barangays in the country will have a minimum of Level I service; ii) about 50% of poblacions and 10% of rural barangays will have at least Level II service; and iii) about 25% of the poblacions will have Level III service.

2) Intermediate

By the end of 1987, i) about 30% of rural barangays will have a minimum of Level II service; ii) the incremental demand for repair and rehabilitation of wells, Level II will be satisfied; iii) all sitios or clusters of population with 50 households or more will have a minimum of Level I service; and iv) all poblacions will have a minimum of Level II service.

3) Long-range

i) By the end of 1992, about 50% of all barangays will have a minimum of Level II service; ii) by the end of 2000, 70% of the sitios or clusters of population will have a minimum of Level II service, while 30% will maintain Level I service; and iii) by the end of 2000, all poblacions will have Level III service.

(5) Road Conditions

The entire road network of the Philippines covers a total length of 155,540km, of which 23,961km (15.4%) is national road while the remaining 131,578.42km is local access road. The percentage of unpaved national roads is comparatively low with only 2.52% or 603.79km remaining unpaved. More than half of paved national roads, however, are surfaced with macadam. As for local roads, approximately 7.4% (9,747km) are unpaved, while 86% (113,093km) are paved with macadam and the remaining 6.6% with asphalt or concrete.

Total road length in Region VI is 7,625km or 8.19% of the national total. Types of road within Region VI include national roads (24.3% or 1,855km), provincial roads (41.3% or 3,152km), municipal roads (26.0% or 1,985km) and city roads (8.3% or 633km). Only 8.2% or 622km of the total road network in Region VI is concrete, while bituminous roads represent about 10.7% or 813km, unsurfaced roads 17.9% or 1,366km, and gravel roads 63.3% or 4,824km, the latter accounting for the largest road kilometerage. Road density per 1,000 population is 1.84km and, in terms of land area, 2.79km per 1,000ha.

2.2 Regional Background

2.2.1 General Conditions in Region VI

The proposed Project area is a part of Region VI, also known as the Western Visayas Region. The said Region consists of 5 provinces; namely, the 4 provinces on Panay Island, and another on Negros Island. The Region's total area of approximately 20,233km^2 represents 6.7% of total national area, while the population of 4.526 million (as of 1980) represents 9.4% of national population. Population density is almost 223.8 persons/km^2 which is greater than the national population density and the annual rate of population increase was 2.26% from 1971-80, which is less than the national figure.

The population of 15 years of age in 1983 totalled 2,927,000 of which 70.6% (2,066,500 people) comprised the working population. Of the latter, 96.9% are gainfully employed with an unemployment rate of 3.1%,

and 63.1% of the total labor population are employed in agricultural related work while 36.9% are engaged in the non-agricultural sector.

Gross domestic product for Region VI in 1983 was ₱29,206 million at current prices, or ₱8,290 at constant prices, amounting to about 8.2% of national GDP. The overall annual growth rate from 1978-1983 was 3.2% which is less than the national growth rate. The reason for this low growth ratio is that agricultural production accounted for 38.3% of regional GDP reflecting a drop in international prices for agricultural produce and a slump in agricultural production. The annual growth rate for the 1982-83 cropping year in current prices is 10.6%; however, the actual growth rate was minus 1.4%. The growth rate of the agriculture, forestry and fishery related industries was 1.55% for the 5-year period from 1978-83.

2.2.2 Regional Development Plan

In Region VI, agricultural production accounted for 40.2% of GRDP in 1982 and 38.5% in 1983. Due to the decreasing price and demand for agricultural products in the international market, GRDP is presently stagnated. Under these circumstances, the major themes of the Five Year Plan (1983-87) in the Region are improvement of the quality of rural life through strengthening of the Region's socioeconomic structure, maintenance of a high standard of living, and education for the enhancement of the individual and general lifestyle.

In agriculture, any further development in the Region is constrained by limited cultivable land and decreasing farm sizes. Hence, development efforts mainly focus on improving land use and raising production efficiencies in presently cultivated areas. Since surplus production of major crops like rice and sugarcane has been attained, emphasis is now placed on improving area productivity, quality, post-harvest technology and marketing of products. Moreover, development of secondary crops and other non-traditional agricultural products that could be suitable in the region and which have good market prospects will be promoted.

Toward this end, crop estates will be set up and adequately provided with technical, financial, marketing and other institutional

support services to bring about the accelerated development of these crops. In support of this thrust, vital infrastructures will be expanded such as irrigation projects, farm-to-market roads, warehouses and processing centers, and other service facilities. Within the period of the 5-year development plan various development schemes such as JRMP-II, SWIM, CIS, etc. will be completed with an additional area of 14,600ha. Total export volume of the Region in 1981 was 723.5 million tons amounting to a total of US$252.8 million in export earnings. Although export volume increased at an annual rate of 12.54% during the Five-year Plan from 1977-81 (total increase: 62.7%), export volume and export earnings of 1981 indicate a decrease of 18.72% and 14.84%, respectively in comparison to those of 1980. This is mainly due to decline in prices of major export goods such as raw sugar, refined sugar and coconuts.

Imports to Region VI, on the other hand, amounted to 251.7 million tons in the five year period from 1977-81, representing roughly 8% of total export volume during the same period. Main import items included machinery, cars, medicine, and chemicals. In addition to the above, outflow of goods such as rice, livestock, fish and vegetables from Region VI to Manila and other areas within the Philippines is balanced by substantial inflow of food products such as milk, juice, spaghetti, noodles and sausages.

Region VI has already achieved self sufficiency in rice, palay production reaching 1,394,600t in 1983 which is twice actual demand. Surplus rice is exported to nearby regions and to Manila.

2.3 Provincial Status

The Province of Iloilo has an overall area of 532,397ha, representing approximately 26.3% of the Regio 1 area and 1.8% of the total area of the entire country. With the exception of Iloilo City and Guimaras sub-province, the total area is 466,332ha while major land use as of June 1983 is presented below.

LAND USE IN ILOILO PROVINCE

Classification	Area (ha)	%
Commercial Forest	3,374	0.72
Non-Commercial Forest	11,118	2.38
Brush-land	22,439	4.81
Open Land	98,843	19.91
Marsh or Swamp	8,948	1.92
Cultivated	327,610	70.26
Total	466,332	100.00

Source: Bureau of Forest Development

The 1980 population census registered a total of 1,433,641, equivalent to 2.98% of the total population of the country, for the whole province of Iloilo including Iloilo City and the sub-province of Guimaras. The number of private households was 252,595 with an average of six (6) persons per household. The population density average is 269.3 person/km^2 which is 20% more than the regional average. The province is still predominantly rural, with 72.4% of the total population residing in rural areas and only 27.6% in urban areas. Population increase rate for the past 5 years was 1.77%.

A total of 412,539 persons or 48.50% of the total private household population 15 years old and over are gainful workers. Agricultural, animal husbandry and forestry workers, fishermen and hunters still make up the biggest group of gainful workers with 56.45%, despite a decrease of 3.47 percentage points since 1975. Production and related workers, transport equipment operators and laborers constitute 16.20%. Service workers rank third with 7.52%, while the remainder is 19.83%.

In Iloilo Province, 70.26% of the total land area or 327,610ha is agricultural land on which commercial and food crops such as rice and sugarcane are widely cultivated. Iloilo maintained its enviable position as the premier food-production province in the entire country, ranking first in rice and mango production, second in sugar production, forth in coconut and among the top ten in other kinds of food commodities such as fruits, vegetables, root crops, and livestock.

Iloilo is the core of the RDAP island development scheme on Panay Island. Under this scheme, agriculture, particularly food production, was given major priority in the promotion of socioeconomic development. Sectoral priority projects such as the Masagana 99, Masagang Maisan, and the Barangay Irrigation Service Association Program were enthusiastically received by both the government and the private sector in the province.

Iloilo Province is the largest rice producing area in the Philippines. Total agricultural production in the province for the 1981-82 crop year was 10,686,128 cavans in a total planted area of 185,680ha. Of this area, irrigated rice fields covered 40,051ha, or about 22%, of total planted area, producing 3,257,381 cavans of rice or about 30% of total agricultural production at an average of 81 cavans/ha. Rainfed rice fields cover 145,629ha or 78% of total planted area producing as much as 7,428,647 cavans, or about 70% of total production at an average of 51 cavans/ha.

According to NFA data, 639,953 bags of rice weighing 50kg each were exported to neighoring provinces such as Negros, Cebu and Metro Manila in 1983, and 14,000t of rice were exported to Indonesia in 1981. Rice production within the province continues to exceed local demand; however, unit yield of rice productivity is below the reasonably attainable limit and therefore unstable. The reasons are as follows:

- Insufficient irrigation and drainage facilities
- Shortage of post-harvest facilities
- Insufficient seed supply of high yielding varieties
- Insufficient post-harvest facilities
- Poor soil conservation program
- Insufficient agricultural support services
- Inappropriate management of agricultural credit

CHAPTER III

THE PROJECT AREA

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3.1 Selection of the Project Area

As stated in the "Scope of Works", the Study area includes the Asue River basin and the surrounding basins amounting to 8,160ha and the 160ha area along the trans-diversion canal, totaling 8,320ha. On the basis of the study results concerning available water resources, present land use, land classification, and geological and topographical conditions, the optimum area for effective agricultural development through irrigation development under the Project was delineated. This Project area includes the existing CIS area and the area irrigated by KABSAKA water impoundings.

3.2 Location

The Project area is situated in the northeastern tip of the province of Iloilo, and is about 105km northeast of Iloilo City. It embraces practically all the basin-like alluvial plain of the municipality of Sara and portions of the municipalities of Ajuy, Concepcion and San Dionisio. Situated between 11°10' and 11°18' north latitudes and between 122°58' and 123°06' east longitudes, it is bounded on the south by Ajuy Bay; on the north and west by a vast rugged to mountainous terrain extending up to the Iloilo - Capiz provincial boundary; and on the east by the hilly areas of Concepcion and San Dionisio which are intermediary between the alluvial plain and the coastline of Concepcion and Bagacay Bay. Paddy in the area lies at an elevation of about 2-35m and rainfed cultivation is predominant.

There are several rivers in the area; namely, the Asue, Serruco, Pasaka, and Gubaton rivers and their tributaries. The Asue River is the main river in the Project area, which flows down from the northern hilly area to Ajuy Bay through the central part of the basin where it is joined by several tributaries. The Catipayan River lies in the northern basin of the Asue River and the upstream basin of the Maayon River.

The four municipalities in the area are composed of 130 barangays of which 58 barangays are covered by the Project. Land area of the Project is 8,813ha out of the total area of 60,021ha of the four municipalities combined as shown in the following table.

PROJECT AREA

Municipality	Area (ha)			No. of Barangay		
	Total	Project Area	%	Total	Project Area	%
Sara	18,300	4,760	26.0	42	34	81
San Dionisio	12,677	1,290	10.2	29	8	28
Ajuy	19,342	1,940	10.0	34	12	35
Concepcion	9,702	330	3.4	25	4	16
Total	60,021	8,813	13.8	130	58	45

3.3 Human Resources

The population of Iloilo Province is 1,433,641 according to the 1980 Census. In 1984 population of the 4 municipalities concerned in the Project amounted to 111,330 or about 7% of the total population in Iloilo Province while total population of the 58 barangay in the Project area is 33,840 or 30.4% of that of the 4 municipalities combined.

The average rate of population increase from 1975-80 was 3.08% which is higher than that of the entire province at 1.77%. According to farm survey, the number of farm households and the farm population is as presented in the following table.

Project Area	Number of Farm Households	Population	Households of All Occupations
Ajuy	480	2,699	1,260
Concepcion	140	787	250
San Dionisio	260	1,447	520
Sara	1,550	8,702	3,990
Total/Average	2,430	13,635	6,020

The number of farm households in the Project area is 2,430 which corresponds to 40.4% of the total number of households. Farm population is about 14,000, which represents 40.3% of the total population. Farm laborer population is as shown in 3.8.6.

3.4 Land Resources

The Project area was classified into 7 land classes on the basis of soils, topography, and drainage conditions. About 8,300ha or 92% is arable land, and of these lands 6,400ha is presently cultivated for paddy.

Relatively higher lands including the gentle hills and lower mountain slopes which border the Project area are undulating or rather steep slopes, and therefore, are inappropriate for paddy cultivation. Some portions presently used for sugarcane cultivation, however, can be converted to paddy cultivation if irrigation water is provided and present the possibility of crop diversification. Development of cultivation on steeper slopes i.e. hills and mountains around low flat valleys will stimulate soil erosion. Accordingly, agro-forest and orchard development is to be carried out for these areas. Major characteristics of the seven land classes are described hereunder.

Class 1R/1D lands (3,805ha) are suitable for both rice and diversified crop production under irrigation. These lands are located in the alluvial plain with slopes ranging from zero to 3%, and have good external drainage and fair internal drainage.

Class 1R/3D lands (1,710ha) are suitable for rice production under irrigation, but have drainage limitations for diversified crop production due to poor external drainage and very poor internal drainage resulting from heavy soil texture. About 20% of the Project area belongs to this class.

Class 2R/1D lands (920ha) have minor limitations for rice production, but have no limitation for diversified crop production. This land class was mapped on slightly undulating areas with slopes ranging from 2 to 5%. About 10% of the total Project area was delineated under this class.

Class 3R/2D lands (1,140ha) has physical limitations for rice production, but are moderately suitable for diversified crop production. These lands include some local valleys where rice productivity is moderate.

Class 6R/3D lands (125ha) have severe physical limitations for rice production due to rolling topography though they are marginally suitable for diversified crops. These lands are presently used for coconut and fruit tree plantations or grasslands.

Class 6 lands (200ha) include all drainage channels, steep slopes and hills, which are not suitable for irrigation development; however the steep slopes and hilly areas could be used for tree crops or for pasture.

M Lands (245ha) are occupied by residential areas and commercial centers and others.

The total area of the above 7 classes is 8145ha excluding 100ha of roads and 75ha of rivers and creeks.

3.5 Water Resources and Hydrology

Groundwater and river flow from rivers in the Project area and vicinity are used for irrigation and domestic water supply; however, facilities for utilization of the same are inadequate and consequently, present water supply is insufficient to meet local demand. The potential of each river to provide sufficient irrigation water for cultivation is low. River regime coefficient is large, as is river density while river basin area and discharge of each river is low, particularly in dry season. However, discharge in wet season is comparatively high and is particularly abundant in the downstream portion at the confluence of numerous rivers. Effective use of flow from these rivers is therefore desirable.

(1) Rivers

Numerous rivers run through the Project area including the Asue, Gubaton, Pasaca, and Hasohoy rivers and their tributaries, the Serruco, Dahis, Padios, Sara, Lanjagan, etc. Of these, development of the water resources of the Asue, Serruco and Lanjagan rivers is desirable based on such factors as their catchment area and flow conditions. A CIS irrigation diversion dam has already been constructed on the Serruco River.

As no long-term observation data was available for discharge of each river in the Project area, water level data collected after 1978 was used. Based on estimations from the above data as well as discharge data from neighboring rivers and hydrological data, development of available water resources is feasible with construction of effective irrigation facilities. Discharge of the major rivers is presented in the following table.

DISCHARGE OF THE 4 MAIN RIVERS

Unit: m^3/sec

Catchment (km^2)	Catipayan 44.2	Asue 9.48	Serruco 22.9	Gubaton 18.8
January	1.41	0.26	0.79	0.65
February	0.82	0.15	0.46	0.38
March	0.78	0.12	0.37	0.30
April	0.72	0.11	0.32	0.26
May	1.23	0.15	0.44	0.36
June	3.16	0.33	1.01	0.83
July	3.52	0.44	1.32	1.09
August	3.19	0.43	1.29	1.06
September	3.26	0.45	1.37	1.12
October	3.57	0.50	1.52	1.25
November	3.34	0.51	1.53	1.25
December	2.40	0.40	1.19	0.98
Ave.	2.29	0.32	0.97	0.80

(2) Return Water

Rivers in the Project area function as drainage channels and, as the plot-to-plot irrigation method used results in comparatively high water loss, return flow to the lower reaches, particularly below the confluence point, is also high. Effective utilization of return flow is thus an important consideration in development of water resources in the basin.

(3) Supplementary Water Resources

The rate of utilization of discharge from rivers in the Project is low and present methods of use are inefficient. However, rivers which can provide a reliable source of irrigation water in the Project area are limited due to river discharge

characteristics, river density, topography and rainfall. Dependable flow in dry season is particularly scarce and is estimated to be insufficient to meet irrigation requirements in the Project area. Accordingly, development of water resources in other basins to supplement irrigation water supply is necessary.

The basin of the nearby Catipayan River, which divides the Project area and the watershed, requires a comparatively short diversion and is endowed with an abundant flow volume. Moreover, trans-diversion of the Catipayan River will not affect the water rights of downstream residents. The said river is therefore considered as a source of supplementary water supply for the Project.

The Catipayan River is a mountain torrent in the basin of the Maayon River, a tributary of the Panay River. In the said area, Catipayan riverbed elevation is more than 60m and slope of the same is more than 1/150. Long-term observation data on Catipayan discharge were unavailable and data since 1978 were used. Monthly discharge obtained from the said data is as presented previously with rivers in the Asue Basin.

3.6 Infrastructure

3.6.1 Roads and Transportation

National road No. 2 runs from south to north connecting Iloilo to poblacions Ajuy, Sara and Estancia. Other national roads i.e. No.340 and No.350 branch off from national road No.2. The total length of the 3 national roads in the Project area is 35.4km with a density of 401.7m/km^2. The same are well maintained; however, only about 30% are paved.

All provincial roads are gravel paved, and, as a result, maintenance is poor. In addition, except for newly constructed roads, bridges of the same cannot sustain transport of heavy freight or passage of large vehicles. Municipal and barangay road networks are insufficient. Maintenance of the same is poor, and in many places roads are impassable, while passage of vehicles over the majority of bridges is not possible.

Farm roads in the Project area are distributed at a comparatively high density in sugarcane fields, although density of the same in rice

fields is low. Present road conditions in paddy area are poor and the main farm roads are levees. The latter are extremely narrow, following the shape of the field, and thus hinder free passage of farmers, particularly decreasing the efficiency of extraction and transportation of harvested crops.

Different types of motor vehicles registered with the Bureau of Land Transportation serve the nine municipalities of Iloilo including the four Project municipalities. The Project barangay residents make use of tricycles to travel from barangays to the poblacions while jeepneys and buses are used in going to other municipalities.

3.6.2 Domestic Water Supply

Domestic water for the Project area and surrounding residents is supplied by waterworks systems in the few areas around the poblacions of each municipality. In the majority of areas, however, domestic water supply is dependent on ground water, springs or rain water. In many barangays, communal artesian wells with hand pumps have been set-up while near the mountains, springs and open dug wells are common.

Each poblacion in the four municipalities concerned in the Project has its own simple waterworks system. None of these systems however, are equipped with water purifier facilities and spring or reservoir water is distributed without treatment. The number of households receiving domestic water supply is 224 households in Ajuy or 4.1% of total households in the same, 100 households or 2.7% in Concepcion, 197 households or 10% in San Dionisio, and 940 households or 18.4% in Sara. Demand is increasing in each area; however, with the exception of Ajuy, corresponding increases in water supply facilities have not occured, and development of new water supply is desirable.

In the case of the Sara waterworks system, which has 940 recipient households, water is supplied by gravity systems from two reservoirs each having a capacity of 80,000 gallons; however, the majority of recipients frequently lack water supply during the day in the dry season due to decreased water level in the reservoir.

3.6.3 Communication

Although there is no telephone system within the Project area, the Sara Private Telegraph Company is equipped to send international as well as domestic communications. In addition, each municipal hall has a government telegraph/telex system to facilitate communication between central and local governments.

3.6.4 Electrification

The rate of electrification within the Project area is extremely low and is limited mainly to households along the national roads and in poblacions. Only 8.8% of the 1,538 households concerned are electrified.

HOUSEHOLDS SUPPLIED WITH ELECTRICITY

Municipality	Houses Connected	
	Number	%
Ajuy	282	5.2
Concepcion	245	6.7
San Dionisio	204	6.0
Sara	807	15.8
Total	1,538	8.8

3.6.5 Others

(1) Health facilities

In the Project area, 61% of barangay have access to centers or family planning clinics, with one health center serving 4-6 barangay. There is also a 50-bed hospital in Sara.

(2) Schools

There are 61 elementary and 12 high schools in the Project area, respectively. In addition, there is one college level school in the Project area.

(3) Churches and Markets

Almost all barangay in the Project area have churches. Moreover, each of the four municipalities concerned in the Project have a market with a regular market day. The poblacion of Sara has the largest market of the four municipalities.

3.7. Physical Conditions

3.7.1. Topography

The Project area is situated on alluvial plain surrounded on three sides by mountains and hills and includes undulating area in the surrounding mountains ranging from 30-50m in elevation and with slopes of 2-15%, and lowland area from 2-35m with slopes of 0-3% through which several rivers flow. The alluvial lowland is an extensive paddy cultivation belt while the upland area is utilized for sugarcane and coconuts.

The Asue, Serruco and Gubaton rivers originate in the mountains to the west and northwest at elevations of 100-150m flowing east and then south through the Project area, finally emptying into Ajuy Bay. The Tabagay River originates in the northern mountains and flows northeast into Bagacay Bay. Several smaller rivers originate in the eastern mountains and flow either northeast or south.

The proposed dam and reservoir site is situated in a V-shaped ravine in an undulating mountainous area. Riverbed elevation at the dam site is 80m while both banks rise steeply from 150-700m in elevation.

3.7.2 Geology

In the Asue River basin, alluvial sediments extend in the central plain area, diorite in the northern to western mountainous areas and pyroclastic rocks in the eastern mountainous areas. In the Catipayan River basin, pyroclastic rocks are extensively distributed around the proposed dam site and reservoir areas. However, diorite is sparsely distributed in the northwestern ridge of the Catipayan area as a small intrusive mass from the Asue River basin. Alluvial sediments are scattered along the narrow flood plain in the Catipayan River and relatively broad flood plains in the Asue River basin.

3.7.3 Climate

The climate of the Project area belongs to type III, defined as "not very pronounced, relatively dry from November to April wet during the rest of the year" according to Coronas' classification. According to Hernandez's classification, the area belongs to B-type in which the ratio of dry months to wet months ranges from 0.14 to 0.33.

The climate is generally suitable for crop cultivation; however precipitation varies widely according to the season and year. Annual average temperature in the Project area is 27.4% with a maximum monthly average of 30.7°C in October and a minimum monthly average of 26.1°C in January. Maximum daily temperature occured in May at 32.3°C. The average daily temperature variation is 5°-7.6°.

A-pan evaporation at the observation site averaged 130.4mm while the maximum was 182.3mm occuring in April, and the minimum was 94.2mm in November. Annual A-pan evaporation is almost equivalent to annual precipitation.

Annual average relative humidity observed at Iloilo was 82%, maximum humidity was 85% from July-December and minimum humidity was 74% in April. Monthly average wind velocity was between 9.1 and 16.5km/hr and the annual average was 12.7km/hr.

The average annual rainfall in the Project area for the period from 1964 to 1984, was 1,825.7mm while maximum monthly rainfall was 257.9mm in June and the minimum was 37.1mm in February. Seventy-five percent of annual rainfall occurs from June to November.

3.7.4 Soils

The soils of the Project area can be classified into two main groups according to land formation; namely, alluvial plain soils which are mainly used for wetland paddy, and the intermediate upland soils which are used for sugarcane fields, coconut plantations mixed with fruit trees, and scattered dwellings.

(1) Alluvial Plain Soils

The alluvial plain soils cover about 80% of the Project area. These soils have good water holding capacity but poor internal drainage. They are fertile and intensively utilized for rice production. Considering the chemical characteristics, these soils are best suited for crop production under full irrigation development. Two soil series were delineated in this soil group; as follows;

Sara series

Soils of this series are fine loamy, deep to very deep and somewhat poorly drained. They are developed from alluvial deposits on nearly level or level basin-like plain. Subsoils are brown, grayish brown or yellowish brown sandy loam, sandy clay loam or clay texture. External drainage is fair to good and internal drainage is poor to fair.

Bantog series

Soils of this series were formed from old waterlogged alluvium. They belong to the fine clayey, very deep and poorly drained soils. External drainage is fair to poor while internal drainage is very poor. The relief is generally level or nearly level. This series is predominant in the eastern and northeastern peripheries of the Project area.

(2) Intermediate Upland Soils

Intermediate upland soils are comprised of elevated undulating or rolling hills and cover about 20% of the Project area. These soils primarily originate from basaltic rocks overlaid by shales. External drainage is somewhat excessive which tends to induce soil erosion.

Most of the intermediate upland soils are used as sugarcane and coconut plantations, with some scattered dwellings. Rice is also grown on localized man-made terraces. The Barotac series is the only soil series found in the intermediate upland area.

Barotac series

This soil series occupies the terraced and hilly areas, and belongs to the loamy, moderately deep soils. These soils are residual, originating from basaltic rock. Drainage condition is excessive externally and fair to poor internally.

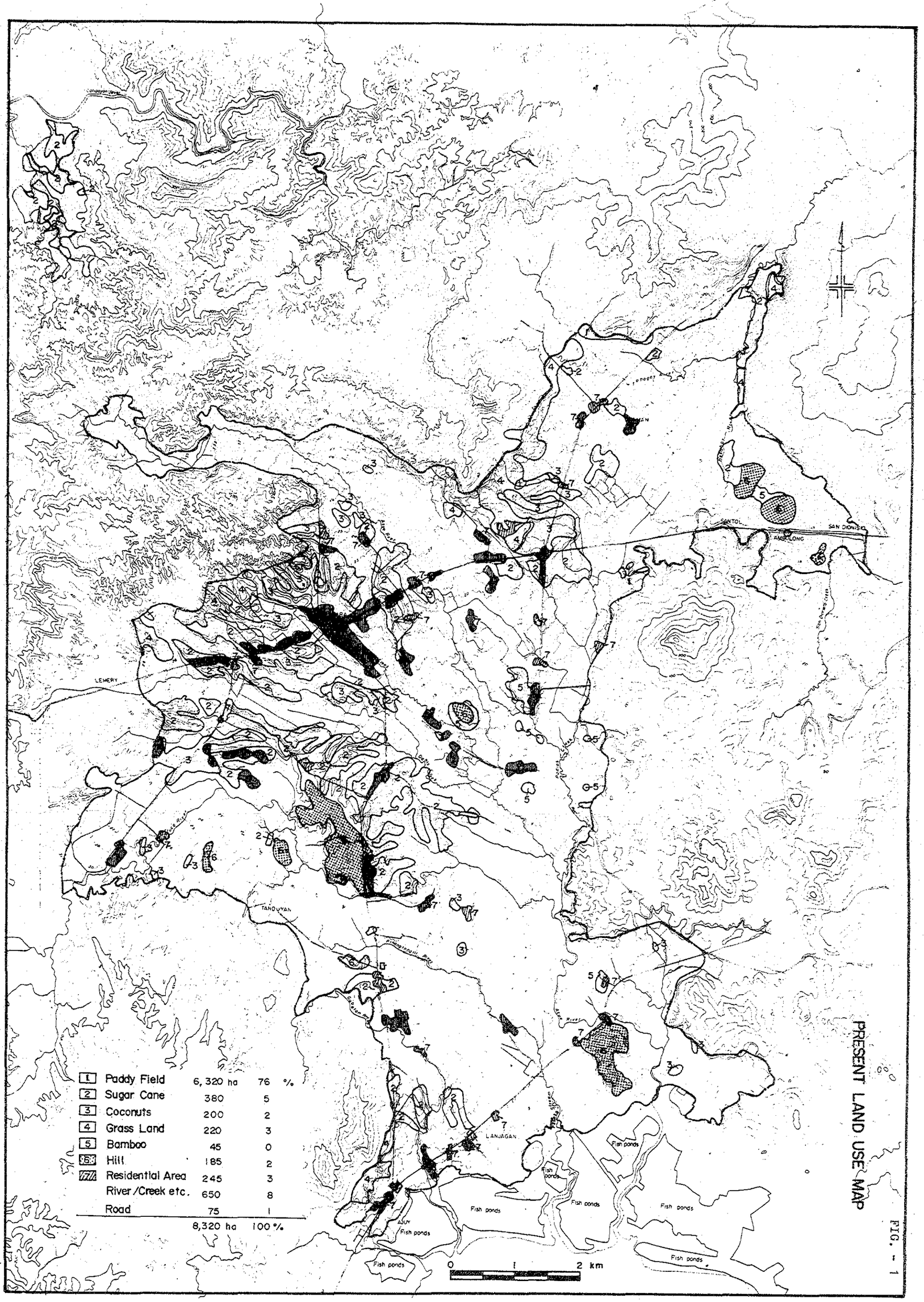
3.8 Agriculture

3.8.1 Land Use

Present land use patterns are summarized in the table below, and FIG.-1. Cropped lands which can not be included in the Proejct were classified as Others for simplification.

Land Use Category	Area (ha)	Extent (%)
Paddy	6,320	76
- Irrigated area	1,590	19
- Rainfed area	4,730	57
Upland Crop	800	10
- Sugarcane	380	5
- Coconut	200	2
- Grassland and others	220	3
Bush	45	0
Hills	185	2
Residential Area	245	3
Others	725	9
Total	8,320	100

Land use is roughly classified into five categories; namely, paddy, upland crops, bush and hills, residential area and others. Paddy comprises the largest area of 77% while upland crops comprise the second largest area of 15% of the total Project Area.



PRESENT LAND USE MAP

FIG. - 1

3.8.2 Farm Size and Land Tenure

The average farm size per household is 2.4ha which is similar to the national average of 2.6ha (1980, Agricultural Census). As for land tenure; owner and other farms excluding the landless, occupy about 47.2% and 52.8% of total farms respectively, while owner farms account for 54.9% of total farmland and others for 45.1%.

Distribution of farms by size and tenure was studied and the results are depicted in the table below.

DISTRIBUTION OF FARMS BY SIZE AND TENURE

Tenure	Total	-1.0ha	1.0 -1.9	2.0 -2.9	3.0 -3.9	4.0 -4.9	5.0-
Owner	47.2	3.1	11.7	19.7	6.1	3.4	3.2
Lessee	43.0	1.6	14.5	17.8	6.7	1.5	0.9
Share Tenant	7.9	0.1	2.5	3.3	1.4	0.5	-
Other	1.9	-	0.3	1.0	-	0.2	0.4
Total	100	4.9	29.0	41.8	14.2	5.6	4.5

Note: Details may not add up to total amount as numbers were rounded off.

The farm size for all land tenure types is from 2.0 to 2.9ha, and the rate is about 42%. By tenure the ratio of owner cultivators is 47.2% which is the largest among all tenures types. The majority of farms are, 2.0 to 2.9ha in size. The farm size of lessess ranges from 1.0 to 2.9ha.

3.8.3 Cropping Pattern

The major crops planted in the Project area are rice, sugarcane and coconut. In addition, corn, cassava, and upland rice are planted in hilly areas and vegetables, perennial crops and fruit trees are usually planted on a small scale in residential areas.

Single cropping, double cropping and triple cropping of paddy are practiced in 36.2%, 53.6% and 1.9% of total cropped area respectively. The cropping intensity of all paddy is 162% at present as shown in the table below. Sugarcane is generally planted in the beginning of the rainy season and harvested in dry season.

3.8.4 Farming Practices

Paddy cultivation methods include direct seeding and transplanting with a rate of 93% and 7% respectively. Planting technology is generally extensive and labor input is minimal. Farm mechanization rate for paddy cultivation is 16% for plowing, 59% for harrowing, 0% for leveling, 100% for threshing and 60% for winnowing. Harrowing by tractor is much more effective than with draft animals and the demand for tractor harrowing is forecasted to increase. Accordingly farm road improvement will be required. Sugarcane is planted with a substantial amount of farm inputs and machinery with each farmer holding approximately 45ha.

3.8.5 Crop Production and Budget

(1) Crop Production

Estimated paddy yield is 2.59t/ha for 1st crop and 2.24t/ha for 2nd and 3rd crop under irrigation. In rainfed areas, paddy yield is 2.17t/ha for 1st crop and 1.80t/ha for 2nd crop. Total paddy production is approximately 22,200t. Sugarcane yield is 56.96t/ha and coconut is 480 nuts amounting to a total production of 21,600t and 96,000 nuts.

Paddy yield in the Project area under irrigation is lower than the average yield in Iloilo Province. The reason for this low yield is instability of irrigation water resources. The cropping intensity in the Project area is 154%, and the cropping intensity for paddy is 163%.

(2) Crop Budget

The crop budget by crop and planting method was studied through the farm survey. The detail is presented in Appendix V and is summarized below.

PRESENT CROP PRODUCTION COST AND RETURN

Item	Paddy				Sugarcane		Coconut
	Direct Seeding		Transplanting		Plant Cane	Ratoon Cane	
	Irrigated	Rainfed	Irrigated	Rainfed			
	1st 2nd	1st 2nd	1st 2nd	1st 2nd			
1. Production Cost (₱)	5,230 4,730	4,510 4,310	5,210 4,920	4,560 3,820	18,090	12,560	300
2. Gross Income (₱)	6,860 5,940	5,750 4,770	6,860 5,940	5,750 4,770	20,440	15,460	640
3. Net Incom (2 - 1)	1,630 1,210	1,250 750	1,660 1,010	1,190 950	2,350	2,920	340

Note: Details may not add up to total as numbers were rounded off.

The present crop budget is characterized by the following items:

a) Sugarcane requires a high production cost;

b) Paddy with irrigation is profitable;

c) Mechanized land preparation is more costly than by draft animal; and,

d) Profitability per unit land/year is similar to sugarcane and paddy.

As presented in APPENDIX V, detailed study showed that direct seeding and transplanting methods under irrigated and rainfed conditions have the following characteristics:

Irrigated

a) Transplanting requires more labor than direct seeding;

b) Farm mechanization for land preparation is more advanced for transplanting. Consequently land preparation for transplanting is more costly than that for direct seeding; and,

c) Direct seeding is more expensive than transplanting as more seeds are used.

Rainfed

a) Transplanting requires more labor than direct seeding;

b) Transplanting is less mechanized than direct seeding, and consequently land preparation for transplanting costs less than that for direct seeding; and,

c) There is a significant difference in materials cost between transplanting and direct seeding.

3.8.6 Farm Labor Balance

The total population of the Project area is 33,840 with 79% (or 26,680) of the same dependent on farming. Considering labor efficiency by age, sex, and school attendance, the available labor force per month is 23/430 man/days. Population per farm household is 5.6 and the labor force is 2.4.

The total number of carabao in the related four municipalities is approximately 9,000 out of which 7,220 are regarded as available draft animals. As for machinery there are 180 two wheel tractors and 33 four wheel tractors.

The labor force requirement according to crop type and operation was estimated and the total labor force requirement was calculated on the basis of cropping pattern and cropping area as shown in APPENDIX V. The peak labor force requirement occurs at harvest time in October with a rate of 48% of the total available labor force. The peak draft animal requirement occurs in May and June and the rate is only 18%.

3.8.7 Marketing of Farm Materials and Farm Products

(1) Marketing of Farm Inputs

Certified seed production is controlled by BPI and seeds are produced in 101ha of the Project area. However, only 0.5% of the Project area is actually planted with certified seeds. The common variety planted is IR-36 at a cost of ₱170/45kg in October 1984. Certified corn seeds are not produced in or around the Project area. The price of BPI Variety I and Sweet Corn is ₱9.5/kg and ₱14.5/kg, respectively. The main suppliers of certified seeds in the Project area are retail traders located in each town.

The main suppliers of farm inputs are also retail traders. Before 1983, when farm inputs were less expensive, farmers could afford to use more. However, the subsequent steep increase in the cost of the same resulted in a decline in use. Agro-chemicals are generally available. On the other hand, fertilizer supply tends to be insufficient.

(2) Marketing of Agricultural Products

The Philippine Government has set the farm gate support price and a support market price. Approximately 60% of paddy produced in the Project area is sent to market mainly through middlemen. Since there is no post harvest system easily available to farmers, farmers must sell paddy rice soon after harvesting to middlemen at a low price.

(3) Post-Harvest Facilities

Existing post-harvest facilities in the 4 municipalities concerned are threshers, driers, mills and storage houses with capacities of 230, 13, 47, and 663,649 cavans, respectively.

The present problems of post-harvest facilities are:

a) shortage of driers which causes quantity loss and quality decrease;

b) old rice mills with a recovery rate lower than 65%, except for the rubber-roll type; and,

c) poor storage system and significant storage loss.

(4) Food Balance

Paddy rice consumption per capita is 186kg/year in Region VI and the present and future demand was estimated as in the following table:

RICE DEMAND IN THE PROJECT AREA

	Paddy Rice Consumption per Capita 1/	Projected Population ('000) 2/	Food Demand (t)
1984	186kg/year	34	6,324
1987	- do -	42	7,812
2000	- do -	44	8,184

1/: NIA Region VI
2/ NCSO

Paddy rice production in the Project area is 22,200t. Of this, 12,500t is exportable after reduction of food consumption, seed, and etc. Present vegetable consumption per capita is 35.30kg at the national level and is estimated to become 58.01kg per capita in the year 2000 according to NCSO's projection. Vegetables are imported mainly from Luzon and Negros Oriental. Vegetable shortage in Region VI was 77,000t in 1984 and is projected at 191,000t in 2,000.

3.8.8 Agricultural Support Services

(1) Experiment and Research Work

Experimental and research institutes directly and indirectly related to the Project are the International Rice Research Institute, and the Maligya Rice Research Training Center (MRRTC) operated by BPI and the University of the Philippines in Los Banos (UPLB). The Asian Vegetable Research and Development Center in UPLB, MAF (Special Studies Division), and PCARR are conducting research on vegetable production and marketing. The main research systems directly concerned with the Project are the Visaya Experimental Station (VES) of BPI and the Sara Outreach Site of the KABSAKA Project. The main activities of VES are paddy breeding, and seed multiplication. The Sara Outreach Site carries out experiments mainly focusing on paddy with mung beans, pigion peas and other drought resistant crops to raise the cropping intensity in rainfed areas with double and triple cropping.

(2) Agricultural Extension Service

The targets of the agricultural extension service conducted by RAEx are to increase agricultural productivity and qualitative improvement in the life of the farmers through agricultural extension. The total number of BAEx staff in the 4 municipalities concerned is 40, and there is thus a sufficient number of BAEx technicians available in the Project area. However, the poor road network is an obstacle to extension work. At present, the main agricultural extension activity is demonstration of cultivation methods for 0.1ha paddy through the key-farmer system of KABSAKA Project which is aimed only at rainfed paddy area.

(3) Agricultural Credit Situation

In Magasana 99, Maisagana, KKK and the KABSAKA Project, the farmers' credit system is included, but actual activity is limited. The maximum credit amount per hectare was ₱1,200 before 1983, ₱1,350 in 1983 and was raised to ₱2,700 in October 1984. The interest rate was initially 12% for 120 days but has also been raised to 25% for 210 days.

In July 1984 bank credit was provided to 7% of the farmers, covering 14% of the farmers' requirement. Approximately 70% of farmers interviewed borrowed money from private lenders at higher interest rates than the banks. Strengthening of the credit system is an important and urgent issue.

(4) Farmers' Associations

The main farmers' associations in the Project area are 40 Samahang Nayons, 74 ARBAs, 1 CIS, and farmers groups in KABSAKA Barangays under KABSAKA Project.

Samahang Nayon was previously under the Ministry of Local Government and Community Development, but is now under the Ministry of Agriculture and Food. ARBA is implementing agrarian reformation under the Ministry of Agrarian Reformation and CIS is implementing operation and maintenance of irrigation facilities under FSDC.

Samahang Nayons are now being reactivated by BAEs; however, only one group is functioning. The reasons for this low activity is i) on-going reactivation by BAEx on-going and, ii) lack of leadership.

3.8.9 Agro-Related Industry

(1) Livestock and Poultry

In the Project area, there is no large scale livestock or poultry industry but family stock exist on almost every farm. According to data for Iloilo Province there are 9,024 carabaos, 1,129 cattle, 12,003 hogs and 185,641 chickens in the municipalities concerned. The livestock population started increasing very recently due to the Government's efforts in

multiplication of the farm economy, improvement of nutrition and increased standards of living.

(2) Fisheries

The fishing industry in Iloilo Province is prosperous in comparison with other provinces on Panay Island. In 1982 the annual inland catch was 1,6141t in Ajuy, 449t in Concepcion and 511t in San Dionisio while the average kg/ha yield was 1,500, 1,500 and 1,758, respectively. Aqua-culture industry is being financed by World Bank and others.

3.8.10 Farm Budget and Farmers' Interests

(1) Farm Budget

The farm budgets of the average rice farmer according to size were estimated as shown in the table below.

₱ (Unit: Pesos)

Item	1.5ha Farm	2.4ha Farm (Average Size)	3.5ha Farm
Gross Income	19,485	27,812	38,042
Farm Income	13,963	22,290	32,520
Off-Farm Income	4,981	4,981	4,981
Income from Livestock	541	541	541
Production Cost	11,072	17,678	25,791
Net Farm Income	8,413	10,134	12,251
Living Expenses	7,780	9,370	11,330
Net Reserve	633	764	921

The gross income of the average farm is ₱27,812, while production cost is ₱17,678 and net farm income is ₱10,134 resulting in a net reserve of ₱764. On the other hand, for large and smaller farms, gross incomes are ₱38,042, and ₱19,485 production costs are ₱25,791, and ₱11,072 and net farm incomes are ₱12,251 and ₱8,413 resulting in net reserves of ₱921 and ₱633.

From this analysis it can be concluded that a production increase can hardly be expected with present unstable and low farm productivity and thus the standard of living for farmers in the Project area remains low.

(2) Farmers' Interest

As it is the farmers who are directly engaged in agricultural production, the agricultural development plan must reflect the farmers' interests in order to succeed. Accordingly, to determine farmers' interests in the Project area, a farm survey was conducted and the results are shown in TABLE V-35 and V-36. From this survey, the following statements can be made.

a) Present paddy farmers are not willing to convert paddy to other crops.

b) Reasons for this unwillingness are i) poor yield, ii) lack of knowledge, iii) low price and poor market prospects, iv) difficult agricultural practices, and 5) the high price of inputs, in that order.

c) All farmers are willing to be involved in the Project.

From these results, it can be concluded that farmers are keen to plant rice but are reluctant at present to replace paddy with diversified crops. The same are also very keen to aquire irrigation water.

3.9 Irrigation and Drainage

3.9.1 Irrigation Conditions

(1) Irrigation Area

The service area consists of two distinct alluvial plains along two separate rivers. One area extends along the alluvial plain of the north-south flowing Asue River and is referred to as the Asue Area in this report. The other area is located east of the Asue Area and extends along the Hasohoy and Tabagay rivers which flow south to north. This area is referred to as the Eastern Area.

There are four main rivers in the Project area; namely, the Asue River, Gubaton River, Pasaka Creek and Tabagay River. These rivers are not only the main sources of irrigation water supply for existing paddy but also the main drainage channels in the Project area. Along these rivers, concrete weirs and pumps are installed by farmers in order to tap river flow for irrigation. However, the present irrigation area is quite limited and the majority of existing paddy is rainfed.

The average slope of the existing paddy fields is approximately 1/300, and the elevation of the service area varies from 2 to 40m. The lower portion of the area adjoins fish ponds in the coastal area. The average size of farm plot varies from 0.3-0.5ha. The western portion of the Asue area is undulating and sugarcane is planted in the elevated area.

Most paddy fields in the Project area are rainfed while irrigated paddy accounts for 23.2% of the total area. Existing irrigated areas by the different irrigation method are tabulated as follows:

IRRIGATION SCHEMES IN THE PROJECT AREA

Type	Area (ha)	Ratio (%)
Private Weir	460	29
Private Pump	580	37
Private Impounding	18	1
CIS Diversion Dam	400	25
KABSAKA WIP	132	8
Total	1,590	100

In general, paddy field in the upstream area are irrigated by private diversion weirs, while those in the lower area are normally irrigated by pumps.

1) Communal irrigation system

Serruco Communal Irrigation System (CIS), the only existing communal irrigation system in the Project area, was constructed in December 1980, and presently serves about 300-400ha of paddy area through the Serruco diversion dam. Although the original service area was planned at 700ha, only 300ha of irrigated area have adequate irrigation facilities at present, such as lateral canals, turnouts, etc. For the remaining area, main concrete structures such as turnouts and siphons have been constructed, but construction of the main

canal and lateral canal has been deferred due to incompletion of land compensation for the canal routes.

2) Water impounding component of KABSAKA Project

The water impounding component of the KABSAKA Project has been implemented under the supervision of the Bureau of Soils, Ministry of Agriculture and Food. Sixteen out of the 40 water impounding projects were constructed in the eastern part of Panay Island in 1982 and 1983. Out of the total 16 constructed water impounding projects, 5 dams are located within or near the Project area, while 3 more water impounding projects are under planning in the Project area.

Specifications of the water impoundings are given in the table below.

ILOILO KABSAKA WIP WITHIN THE ASUE IADP POTENTIAL IRRIGATION AREA

	Project		
	Bondolan	Castor	Moto
Barangay/ Municipality	Bondolan San Dionisio	Castor, San Dionisio	Moto, San Dionisio
Water Source	Hasohoy River Tribs	Tabagay Streams	Hasohoy River Tribs.
Service Area (ha)	50.00	32.00	50.00
Average Farm Size (ha)	2.50	2.00	2.00
Beneficiaries	20	16	25
Dam Pondage Area (ha)	2.70	1.10	1.20
Dam Height (m)	10.00	10.00	10.00
Dam Length (m)	110.00	122.00	148.00
Dam Storage Capacity (CM)	100,000	38,550	40,500

3) Private irrigation facilities

Besides the KABSAKA Water Impounding Projects, there are three private water impoundings within or near the Project area that employ lift-pumps. Pump irrigated areas can be categorized into 2 types; fixed and portable. The fixed pump type is installed in a pump house and normally has a concrete lined canal. The portable type of pump is carried by farmers to available water sources such as rivers or creeks.

There are several privately owned fixed type concrete weirs along the Asue River and related creeks. Twelve concrete weirs are located in the service area; 7 on the Asue River, 2 on Sara Creek, 2 on the Pasaka River and 1 on the Lanjagan River. Most weirs are stoplog type about 2-3m in height and 4 weirs out of 12 have been washed out by floods.

(2) Existing Irrigation Area

Irrigated area and facilities were investigated in the rainy season from June to August 1984. Present irrigated acreage under the Serruco CIS and KABSAKA WIP were confirmed by the related authorities. However, the acreage covered by private facilities was difficult to verify due to the plot to plot irrigation system. Total irrigated area in the wet season as of 1984 is approximately 1,700ha, although some of this is located outside of the Project area as shown in the following table.

PRESENT IRRIGATED AREA

Type of Irrigation	Acreage (ha)	Remarks
Serruco CIS	400	Project Area
KABSAKA Water Impounding Projects	232	
Castol WIP	32	Project Area
Moto WIP	50	Project Area
Bondolan WIP	50	Project Area
Aglosong WIP	50	Outside of Project Area
Belen WIP	50	Outside of Project Area
Private Water Impounding Projects	28	
Sanson	7	Outside of Project Area
Pacig	12	Partially in the Project Area
Salcedo	9	Partially in the Project Area
Private Weir	460	Project Area
Private Pump	580	Project Area
Total	1,700	

3.9.2 Drainage Conditions

(1) *Drainage Problems*

In general, no severe drainage problems were observed in the service area except for some problems occur in the Eastern Area, where the soil type is heavy clay and no drainage canals exist.

In the upstream area of the Asue River basin, paddy fields are sometimes affected by floods. These floods are mainly caused by backwater from privately owned concrete weirs since the farmers can not remove stop-logs from them during floods.

(2) Flood Mark Investigation

Typhoon "Undang" hit Panay Island on November 5, 1984 during the course of the second field investigation. Existing rain gauges could not measure total rainfall due to the strong wind. It is assumed that total rainfall caused by the typhoon was at least 200 to 300mm and the duration of rainfall was about 12 hours. In spite of the short duration of rainfall, almost all of the service area

was abnormally inundated. The flood probability return period was estimated at about 25 to 50 years or more. In order to determine flooding conditions, 300 points in the Project area were investigated through interviews with the local people.

According to data obtained the lands near Ajuy, along the Lanjagan and Serruco rivers were not submerged, but most area was totally submerged during maximum flood conditions. Peak flood occured at about 2:00 p.m. in the upstream area of the Asue River and from 3:00 to 5:00 p.m. in the downstream area. Inundated areas 24 hours after the typhoon were investigated to determine the area where water stagnated for more than 24-hours, and the acreage was estimated at about 1,500ha.

According to the results of flood investigation, the following conclusions can be made.

a) Approximately 5,000ha of paddy were submerged during peak flood conditions.

b) The maximum flooding height was observed at 1.8m along the Tabagay River.

c) The severest inundation in the Project area occured along the Tabagay River in Barangay Capinang and near San Dionisio Town where about 130ha was submerged for more than 3 days. Areas along the Tabagay River, upstream of Padios Creek in Barangay Lanciola and the middle part of the Asue River in Barangy Padios and Salcedo were submerged for more than 2 days. About 2,000ha of land in the Eastern Area and along the Asue River were submerged for more than 24 hours. However, water in most paddy stagnated about 20 hours or less.

d) Field investigation results concerning the area submerged more than 24 hours, correlated very closely to the area indicated by the interview survey proving that the results of interviews are reliable.

e) Consequently, it was determined that the Project area does not have a severe drainage problem, as flood water in the service area did not stagnate long enough to damage paddy. The duration of water stagnation in most of the service area was less than 24 hours in spite of the very rare flood frequency of the typhoon. The area submerged more than 2 days, resulting in heavy damage, amounted to only about 400ha. In such areas, drainage improvement works will be necessary.