FEASIBILITY STUDY

ON

BOHOL IRRIGATION DEVELOPMENT PROJECT

(PHASE II)

IN

THE REPUBLIC OF THE PHILIPPINES

MAIN REPORT

NOVEMBER, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

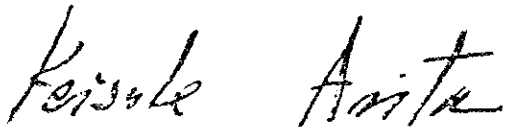
In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a feasibility study on the Bohol Irrigation Development Project (Phase II) and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Philippines a survey team headed by Mr. S. Higuchi from January to May 1985.

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 to the Government of the Republic of the Philippines for their close cooperation extended to the team.

November, 1985



Keisuke Arita
President
Japan International Cooperation Agency

November, 1985

Mr. Keisuke Arita
President
Japan International Cooperation Agency (JICA)
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are very pleased to submit herewith the Final Report on the Feasibility Study for Bohol Irrigation Development Project-Phase II in the Republic of the Philippines.

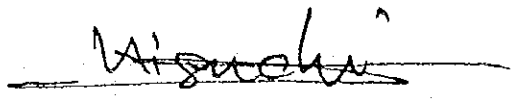
The Study Team completed the feasibility study of the project involving the water and land resources developments, irrigated agricultural development components in the Phase II area, located on the north-eastern part of the Bohol island.

This report consists of five volumes: Volume I-Executive Summary, covering the summary of the results of the study including the conclusion and recommendations; Volume II - Main Report, providing the results of study and analysis; Volume III and IV - Annex, providing the detailed technical information, and Volume V, Supplemental Report of Capayas Irrigation Project (Stage I).

We hope that this irrigation development project can greatly contribute to the social and economic development in the Philippines.

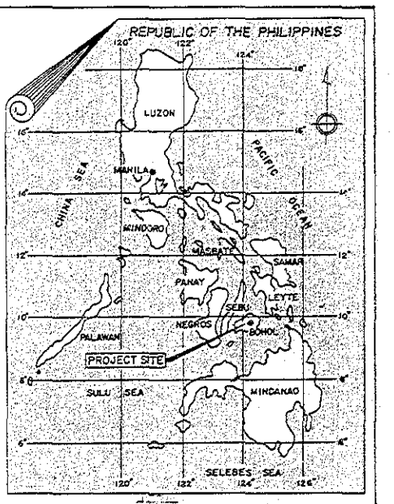
Finally, we take this opportunity to express our sincere gratitude to National Irrigation Administration of the Government of the Republic of the Philippines, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries of the Government of Japan, and Japan International Cooperation Agency (JICA), especially for Japanese Embassy in the Philippines and Advisory Committee which gave useful advices to the Study Team from time to time so as to smoothen the study.

Respectfully yours,



Shoichiro Higuchi
Team Leader for the Bohol
Irrigation Development Project
Phase II

MAP OF BOHOL IRRIGATION DEVELOPMENT PROJECT
(PHASE-II)



UBAY

TRINIDAD RIVER

SOOM RIVER

SAN MIGUEL

BAYONGAN DAM

CAPAYAS DAM

LAT. BF-9

LAT. BF-8

LAT. BF-7

LAT. BF

LAT. BC

LAT. BE

LAT. BD

LAT. BB

LAT. BA

LAT. CC

LAT. CB

LAT. CA

B. M. C.

C. M. C.

DF-1

DF-2

DG-1

DG-2

DG-3

DG-4

DG-11

DG-12

DH-1

DH-2

DH-3

DE-1

DE-2

DE-3

DE-4

DD-1

DD-2

DD-3

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DD-5

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DD-7

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DC-1

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DC-4

DC-5

DB-1

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DB-3

DB-4

DA-1

DA-2

DJ-1

DJ-2

DJ-3

DJ-4

DJ-5

DG-5

DG-6

DG-7

DG-8

DG-9

DG-10

LEGEND

- MAIN IRRIGATION CANAL
- LATERAL CANAL
- DRAINAGE CANAL

0 1 2 Km

SCALE 1:50,000

PROPOSED IRRIGATION AND DRAINAGE CANAL ALIGNMENT

OUTLINE OF BOHOL IRRIGATION PROJECT (PHASE II)

1. Project Area
   - Location : Municipality of San Miguel, Trinidad and Ubay
   - No. of Barangay : 22 Barangay
   - Population : 10,870 Persons (166 persons/sq.km)

2. Irrigation Service Area: 5,300 ha
   - Dry Season Cropping Area
     - ° Paddy : 3,540 ha (65%)
     - ° Upland Crop : 1,760 ha (35%)
   - Wet Season Cropping Area
     - ° Paddy : 5,300 ha

3. Water Resources	Average Year	Dry Year
Trinidad River	10.3 MCM	8.0 MCM
Bayang River	11.0 MCM	8.7 MCM
Surplus of Phase I	49.0 MCM	30.6 MCM
Total	70.3 MCM	47.3 MCM

4. Reservoir Dimension	Bayongan	Capayas
Drainage Area	11.2 sq.km	14.6 sq.km
Reservoir Area	2.8 MSM	0.6 MSM
Full Water Level	50.0 m	34.0 m
Low Water Level	38.0 m	30.0 m
Total Reservoir Capacity	27.5 MCM	2.3 MCM
Effective Reservoir Capacity	22.5 MCM	1.6 MCM
Dead Reservoir Capacity	5.0 MCM	0.7 MCM

5. Dam Dimension	Bayongan	Capayas
Dam Type	Fill Type	Fill Type
Dam Height	31.0 m	17.0 m
Dam Length	810 m	1,150 m
Dam Volume	1.1 MCM	0.2 MCM
Intake Discharge	9.74 cu.m/sec	2.13 cu.m/sec
Intake Type	Tunnel	Conduit Pipe
Spillway Flood Discharge	20.0 cu.m/sec	226.0 cu.m/sec
Spillway Type	Chute	Side Channel

6. Canal Dimension	Bayongan System	Capayas System
Service Area	4,140 ha	1,160 ha
Maximum Canal Capacity	9.74 cu.m/sec	2.13 cu.m/sec
Main Canal Type	Concrete Lining	-do-
Lateral Canal Type	Earth Canal	-do-
Main Canal Length	12.5 km	3.3 km
Lateral Canal Length	68.9 km	18.9 km

7. On-Farm Development	Bayongan System	Capayas System
Existing Area	1,230 ha	470 ha
Land Reclamation Area	2,910 ha	690 ha
Total	4,140 ha	1,160 ha

8. Project Cost
   - Foreign Cost : 400.0 Million Pesos
   - Local Cost : 258.0 Million Pesos
   - Total : 658.0 Million Pesos

9. Project Evaluation
   - Internal Rate of Return : 15.4%

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ABBREVIATIONS AND GLOSSARY

Abbreviations

ACA	:	Agricultural Credit Administration
ADB	:	Asian Development Bank
APC	:	Agricultural Promotion Center
AMC	:	Area Marketing Cooperatives
BAEcon	:	Bureau of Agricultural Economics
BAEx	:	Bureau of Agricultural Extension
BAI	:	Bureau of Animal Industry
BIADP	:	Bohol Integrated Agricultural Development Project
BCD	:	Bureau of Cooperative Development
BFAR	:	Bureau of Fisheries and Aquatic Resources
BOHECO	:	Bohol Electric Cooperative
BPI	:	Bureau of Plant Industry
BS	:	Bureau of Soils
CB	:	Central Bank of the Philippines
CCC-IRDP	:	Cabinet Coordinating Committee on Integrated Rural Development Project
CIA	:	Communal Irrigators Association
CIS	:	Communal Irrigation System
CISP	:	Cooperative Insurance System of the Philippines
CRB	:	Cooperative Rural Bank
DBP	:	Development Bank of the Philippines
DT	:	Ditch Tender
FAO	:	Food and Agricultural Organization
FIA	:	Farmer Irrigators Association
FPA	:	Fertilizer and Pesticide Authority
FSDC	:	Farm Systems Development Corporation
GK	:	Gate Keeper
IBRD	:	International Bank of Reconstruction and Development
IDA	:	International Development Association
IRRI	:	International Rice Research Institute
ISA	:	Integrated Services Association

Abbreviations

JICA	:	Japan International Cooperation Agency
KKK	:	Kilusang Kabuhayan Kaunlaran
LBP	:	Land Bank of the Philippines
MAF	:	Ministry of Agriculture and Foods
MAR	:	Ministry of Agrarian Reform
MF	:	Ministry of Finance
MHS	:	Ministry of Human Settlement
MLG	:	Ministry of Local Government
MPWH	:	Ministry of Public Works and Highways
M-99	:	Masagana 99 Program
NCSO	:	National Census and Statistics Office
NEA	:	National Electrification Administration
NEDA	:	National Economic and Development Authority
NEPC	:	National Enviromental Protection Council
NFA	:	National Food Authority
NFAC	:	National Food and Agricultural Council
NIA	:	National Irrigation Administration
NPC	:	National Power Corporation
NWRC	:	National Water Resources Council
OECF	:	Overseas Economic Cooperation Fund
PAGASA	:	Philippine Atmospheric Geophysical and Astronomical Services Administration
PCARR	:	Philippine Council Agricultural Resources Research
PDSO	:	Provincial Development Staff Office
PCIC	:	Philippine Crop Insurance Corporation
PNB	:	Philippine National Bank
RIG	:	Farmer Irrigators Group
RIS	:	River Irrigation System
RP	:	Republic of the Philippines
RUG	:	Rotational Unit Group
SEC	:	Security and Exchange Commission
SN	:	Samahang Nayon

Abbreviations

USAID	:	United States Agency for International Development
USBR	:	United States Bureau of Reclamation
UNDP	:	United National Development Program
UPIP	:	University of the Philippines, Institute of Planning
WM	:	Water Master
WMG	:	Water Management Group
WMT	:	Water Management Technologist
WMTC	:	Water Management Training Center
ZE	:	Zone Engineer

Units of Measurement

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
sq.cm, cm^2	:	square centimeter
sq.m, m^2	:	square meter
sq.km, km^2	:	square kilometer
MSM, $10^6 m^2$	:	million square meter
l, lit.	:	liter
cu.m, m^3	:	cubic meter
MCM, $10^6 m^3$	:	million cubic meter
lit/sec	:	lit per second
m/s	:	meter per second
PPM	:	part per million
g	:	gram
kg	:	kilogram
ton, m.t.	:	metric ton
cavan	:	50 kg

Units of Measurement

EL	:	elevation above mean sea level
MSL	:	mean sea level
FWL	:	full water level
HWL	:	high water level
LWL	:	low water level
sec.	:	second
minu.	:	minute
hr.	:	hour
min.	:	minimum
max.	:	maximum
%	:	percent
No.	:	number
°C	:	degree centigrade
°F	:	degree fahreheit
Cl	:	chlorine
HP	:	horse power
ET	:	evapotranspiration
N	:	nitrogen
P	:	phosphorous
K	:	potassium
HYV	:	high yielding variety
O & M	:	operation and maintenance
EIRR	:	economic internal rate of return
B/C	:	benefit cost ratio
FY	:	fiscal year
₱	:	Pesos, ₱1 = approx. US$ 0.056
$	:	Dollar, US$ = approx. ₱18.0

Conversion Factors

Unit	Comparison	English Equivalent
Unit of Length:		
Millimeter (mm)	0.001 meter	0.0394 inch
Centimeter (cm)	0.01 meter	0.3937 inch
Meter (m)		3.2800 inch
Kilometer (km)	1,000 meter	0.6213 mile
Unit of Area:		
Square centimeter (sq.cm)	0.0001 sq.m	0.155 square inch
Square meter (sq.m)		10.764 square feet
Hectare (ha)	10,000 sq.m	2.471 acres
Square kilometer (sq.km)	1,000,000 sq.m	0.3861 square mile
Unit of Volume:		
Cubic centimeter (cu.cm)		0.061 cubic inch
Liter (1,000 cu.cm)	0.001 cu.m	1.0567 quarts (liquid)
Cubic meter (cu.m)	1,000 liters	35.3145 cubic feet
Unit of Weight:		
Gram (g)		0.0353 ounce
Kilogram (kg)	1,000 grams	2.2046 pounds
Metric Ton (mt)	1,000 kg	2,204.6 pounds

Miscellaneous

1 cu.m per sec	=	1,000 liters per second (l/s)
	=	35.3145 cu.ft per second (cfs)
	=	15,850 gallons per minute (gpm)
1 liter per second for 1 day	=	8.64 mm depth over one hectare
10 mm depth over 1 hectare	=	1.157 liters per second for 1 day
	=	3,532 cu.ft

Terminology

Project Area	:	Area of 12,700 ha corresponding to the objective area for Bohol Irrigation Development Project (Phase - II).
Service Area	:	Area of 7,100 ha to be benefited by the project implementation.
Irrigation Area	:	Area of 5,300 ha to be irrigated by the project.
Province	:	A political subdivision of a country comprising several towns.
Barangay	:	A political subdivision of town.
Poblacion	:	Political center of town.
Monsoon	:	Periodic wind that blows from the sea to the continent and oppositely in winter.
Trade Wind	:	One of the three Philippine air currents, comprising from a generally easternly direction reaching the islands during the period from February to April.
Typhoon	:	A storm or system of winds occurring in the Philippines and China Sea regions, known as hurricane in the West Indies and South Pacific, cyclone in the Indian Ocean.
Palay	:	The rice plant which bears a staple cereal, or the cereal itself unhulled. Sometimes called rough rice.
IR58, IR60, IR62	:	High yielding rice varieties from the IRRI, Los Baños, Laguna, Philippines.
Cogon	:	A coarse grass which usually covers idle lands or abandoned clearing.
Ganta	:	A common unit of volume for rice equivalent to 2.24 kilograms of milled rice.
Bamboo	:	A woody grass with a big hollow in the center of the internodes, growing in groves or clumps reaching a height of 25 meters or more.
Nipa	:	Heavy-leafed type of reed used in thatching huts.
Share Tenancy	:	A practice where operators rent the land they work and pay as rent a share of the cash or crops grown.

Terminology

Bolo	:	A large single-edged knife for a variety of uses like clearing the field, harvesting and household work.
Calesa	:	A light, two-wheeled, horse-dawn vehicle commonly used to transport passengers of farm produce for short distances.
Carabao	:	The animal that most farmers used for plowing and other farm work. It is about the size of an ox and is similar to the water buffalo in other Asian countries.
Fiesta	:	Spanish term for feast, celebrated pompously once a year to honor the patron saint.

CHAPTER I. INTRODUCTION

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1.1. Background of the Project

Bohol island is located in the Central Visayas and has an area of 4,110 sq.km and population of about 806,000. Major industry in Bohol island is agriculture, and the farmer of about 680,000 is engaged in the agricultural area of about 129,400 ha consisting of paddy of 39,600 ha, upland crop of 27,300 ha and coconuts of 62,500 ha. An agriculture economy in Bohol island, however, has been placed under poverty situation due to several constraints for agriculture such as undulated land, poor soil, irregular distribution of rainfall, limited transportation means, insufficient extension services etc.

Out of 129,400 ha agricultural land, the area of paddy field which is important one to support the farmer's economy is about 90,000 ha and has been cultivated under rainfed condition. However, the area of 40,000 to 60,000 ha has been only under plantation in ordinary year due to shortage of irrigation water. In the dry year such as 1982, the area of 43,000 ha was only cultivated.

The area of upland crops such as corn, vegetable and legumes is about 27,800 ha and also suffered from shortage of irrigation water.

The production of rice is 90,000 to 100,000 ton per year which is not sufficient for the consumer's demand of about 130,000 ton in Bohol island. The production of upland crop does not fill the consumer's demand. Bohol island imports presently rice and upland crops from other island in the Philippines to meet the Bohol island's demand.

In order to improve such present agricultural condition mentioned above, to increase the farmer's income, to stabilize the

agro-economy in rural area and to satisfy the food consumption demand in Bohol island, the Bohol Provincial Government and NIA have planned to materialize the Bohol Irrigation Projects consisting of Phase I and Phase II having the irrigation area of about 5,000 ha respectively.

The Bohol irrigation project Phase I consists of the construction of the Malinao dam diverting the water in the Wahig-Pamacsalan river and the main canal covering the service area of 5,000 ha and is now under the implementation stage by NIA using the OECF Loan in Japan.

The main canal of Phase I project has a function to convey the diverting water from the Malinao dam to the Phase II project.

The Feasibility Study of Phase II was required to ensure the technical and economical feasibility for the project implementation to be carried out after the Phase I project and requested to the Japanese Government by the Philippines Government.

In response to the request of the Philippine Government, the Japanese Government decided to undertake the Feasibility Study on the Bohol Irrigation Development Project Phase II in the Republic of the Philippines and exchanged the Note Verbal on the Study with the Government of the Republic of the Philippines concerning the implementation of the Study in February, 1984 between the two Governments. Japan International Cooperation Agency (JICA) commenced the Feasibility Study from the middle of January, 1985 and completed its study by the end of November 1985, in close cooperation with NIA and other authorities concerned.

1.2. Objectives of the Study

The objectives of the study are as follows in accordance with the Scope of Work agreed upon between NIA and JICA.

i) To analyze the surplus water resources in the Wahig river and another possible water resources in the project area, with well coordination and collaboration with NIA and Consulting Team engaging in the supervision of implementation works for the Phase I project;

ii) To formulate a viable irrigation and drainage plan for the service area of about 7,000 ha and to verify technical and economical feasibility of the project, and

iii) To transfer the technology to NIA counterpart personnel in the course of the study.

1.3. Background of the Study

The Study Team arrived at the Philippines on 15th January, 1985 together with Advisory Committee Team and submitted the Inception Report to NIA.

The survey for basic data collection related to topography, geology, hydrology, soil etc. and the survey for plan formulation of irrigation, agriculture, dam, canal, water management etc. were commenced on 20th January, 1985, in accordance with the result of discussion for the Inception Report and the detailed survey continued until the middle of March 1985.

The office works in NIA main office to prepare the plan formulation in each sector of the project were commenced in the middle of March and completed in the middle of May, 1985.

The survey works in the project area and the office works in NIA main office have been carried out in cooperation with the engineering staff of PDD in NIA, and the Progress Report was prepared and submitted to NIA at the end of May, 1985. After the submitting of the Progress Report, detailed study for the feasibility study of the project was conducted in Japan by the end of August, 1985 and in following elaborate discussion between Study Team and NIA for Draft Final Report on September, 1985, Final Feasibility Report of the Project was prepared in November, 1985.

The Report covers the results of the field studies carried out by the Study Team with the Philippine government officials, and also incorporates all the provisions in respect of interim discussions held among the NIA officials, the JICA's Advisory Committee and the Study Team.

In addition to the Report mentioned above, Supplemental Report on the Capayas Irrigation System, Stage I Development was prepared by the Study Team to analyze the possibility of the construction of the system in advance and submitted to NIA on November, 1985.

Members of the Advisory Committee, Study Team and the NIA counterpart personnel assigned to the project are listed below;

ADVISORY COMMITTEE TEAM

1.	Mr. Isao Nakazawa	Leader Director, Land Improvement Engineering Service Center, Kanto Regional Agricultural Administration Office, Ministry of Agriculture, Forestry and Fisheries (MAFF)
2.	Mr. Saiichi Ohi	Irrigation/Drainage Deputy Manager, Design Division, Construction Department, Agricultural Structure Improvement Bureau, MAFF
3.	Mr. Osamu Sakai	Agro-economy Deputy Manager, Regional Planning Division, Planning Department, Chugoku-Shikoku Regional Agricultural Administration Office, MAFF
4.	Mr. Yoshiya Takashima	Cultivation/Soil Deputy Manager, Resources Division, Planning Department, Tohoku Regional Agricultural Administration Office, MAFF
5.	Mr. Hisao Tanimoto	Project-Economy Deputy Manager, Technical Appraisal Department, the Overseas Economic Cooperation Fund

STUDY TEAM

1.	Mr. Shoichiro Higuchi	Team Leader Sanyu Consultants Inc. (SCI)
2.	Mr. Tomiharu Shimoji	Meteorology & Hydrology, SCI
3.	Mr. Seiji Takeuchi	Irrigation & Drainage, SCI
4.	Mr. Joji Nakagawa	Water Management Nippon Suiko Consultants, Co., Ltd.
5.	Mr. Tadao Inaba	Dam & Reservoir, SCI
6.	Mr. Toshinori Kawamura	Irrigation & Drainage Facilities, Naigai Engineering Inc. (NEI)
7.	Mr. Hiroyoshi Oikawa	Geology & Embankment Materials, SCI
8.	Dr. Yasuo Takijima	Soil & Land Use, SCI
9.	Mr. Yasunori Hasegawa	Agriculture, SCI
10.	Mr. Toshiyuki Yumino	Construction Planning & Cost Estimate, NEI
11.	Mr. Shoji Yamada	Agro-economy, SCI
12.	Mr. Sadao Takada	Survey, NEI

COUNTERPART PERSONNEL

1.	Mr. Avelino S. Rivera	Manager, Project Development Department (PDD), NIA
2.	Mr. Romeo F. Potenciano	Coordinator, Division Manager D. Water Resources Utilization Division (WRUD), PDD
3.	Mr. Edgardo O. Talip	Hydrographer, Sr. Engineer B Hydrography Section, Water Resources Utilization Division (WRUD), PDD
4.	Mr. Othello Razon	Hydrologist, Engineer B Surface Water Section, Water Resources Utilization Division (WRUD), PDD

5.	Mr. Alejandro Cantor	Sr. Soil Technologist B, Land Classification Section, Land Resources Utilization & Economic Division (LRUED), PDD
6.	Mr. Cesar Oropilla	Geologist, Sr. Geologist Geology Section, Project Investigation Division (PID), PDD
7.	Mr. Rosauro Puse	Geologist Geology Section, Project Investigation Division (PID), PDD
8.	Mr. Alfredo Formaran	Irrigation Engineer, Sr. Engineer B Irrigation Works Section, Plan Formulation Division (PFD), PDD
9.	Mr. Calixto Timonera	Drainage Engineer, Sr. Engineer B Drainage Section, Project Investigation Division, PDD
10.	Mr. Wilfredo Erese	Drainage Engineer, Engineer B Drainage Section, Project Investigation Division, PDD
11.	Mr. Guillermo de Guzman	Agronomist, Sr. Engineer B Land Use Section, Land Resources Utilization & Economic Division (LRUED), PDD
12.	Mr. Manuel Estefanio	Dam Engineer, Sr. Engineer B Dam & Reservoir Section, Plan Formulation Division (PFD), PDD
13.	Mr. Reynaldo Santos	Irrigation Engineer, Engineer B Irrigation Works Section, Plan Formulation Division (PFD), PDD
14.	Mr. Sergio L. Calalin	Water Management Expert, Provincial Irrigation Engineer II Bohol Provincial Irrigation Office
15.	Mr. Domingo Fulo	Construction Planner, Supvy. Engr. B Dam & Reservoirs Section, Plan Formulation Division (PFD), PDD

16.	Mr. Romulo Ramirez	Environmental Engineer, Supvg. Engr. B Feasibility Report Section, Plan Formulation Division (PFD), PDD
17.	Mr. Pablito Supnet	Environmental Engineer, Supervising Geologist, Geology Section, Project Investigation Division (PID), PDD
18.	Mrs. Socorro Raquepo	Agro-Economist, Sr. Economist Economics Section, Land Resources Utilization and Economics Division (LRUED), PDD
19.	Mr. Asterio Dagang	Water Management Expert, Sr. Engr. B Irrigation Works Section, Plan Formulation Division (PID), PDD
20.	Mr. Olympio Galagala, Jr.	Design Engineer, Survey & Mapping Bohol Irrigation Project, Phase II

CHAPTER II. BACKGROUND OF THE PROJECT

CHAPTER II. BACKGROUND OF THE PROJECT

2.1. Bohol Island in General

2.1.1. Geography

Bohol island lies in the Central Visayas. It covers an area of 4,110 sq.km. It is bounded on the north by the Camotes Sea, and on the south by the Mindanao Sea.

The island is generally formed with mountains, plateau and coastal areas. The mountains occupy about 14 percent of total area being located with elevation between 800 and 80 m and covered with the dense forest. The plateau areas are located at the mountains foot with 61 percent of total area and covered with also dense forest or vegetation of cogon, shrubs and coconuts. A part of plateau area developed along the river course is used for cultivation area of upland and paddy field.

The coast area lies with narrow strip surrounding island, and is occupied with village, town and city as well as agricultural land.

There are four main rivers in the island; the Inabanga and Ipil rivers in the north and Loboc and Abatan rivers in the south. These rivers empty itself into the Camotes Sea and Bohol Sea with the relative steep river slope and form the alluvial plain at their lower reaches. The Wahig-Pamacsalan river, which is the main water resources for irrigation of Phase I and Phase II areas, is a tributary of the Inabanga river mentioned above.

In regard of geology for the island, Bohol is a broad southward plunging syncline with the major axis trending northeast-southwest.

At the northern-central and southern portion of the island, undulating to high rolling sedimentary and calcareous hills and plains covers approximately 70 percent of the island.

The famous Chocolate Hills in Carmen, Karst plain in Cortez, high rolling hills and ridges in Sevilla, Anda Peninsula, Sangungan Mountain and undulating sedimentary rocks from Buenavista to San Miguel are some of the formation that dominates the lithologic units. Extensive conglomerate occurs at Tubigon, pure limestone in Balilihane, limy shale in Batuan, Limestone of different ages exhibit karstic topography and are sometimes structually arranged by NE-SW faults. Sierra Bullones limestone at Mount Mayama reaches a height of 827 m. Low rolling diorite, metamorphic and ultrabasic hills are sometimes associated with high and steep volcanic hills, covering approximately 25 percent of the island, which are exposed in the north-eastern and north-western part of the province. Agglomerate rises as plateau at the central part of the island. Gently rolling metamorphic hills in Ubay are overlain by high steep andesitic to basic Malibalibod Hills.

2.1.2. Socio-Economic Status

a) Land Use

The present land use in Bohol island is as follows;

Classification	Area (ha)	Percentage (%)
Forest	57,700	14.1
Agricultural Land	66,900	16.3
Coconut and Fruit Trees	62,500	15.2
Pasture/Shrubs/Grasses	188,000	45.7
Settlement and Others	35,900	8.7
Total	411,000	100.0

Source: BS/FAO Soil and Land Resources, Appraisal and Training Project, Technical Report 4.

An agricultural area in the Bohol island is limited, because the island is mostly occupied with the mountain areas, pasture, shrubs and grasses.

b) Population

Total population of Bohol island in 1980 was reported about 806,000, of which the rural population is 683,000 and urban population is about 123,000. 85 percent of population has engaged in the agriculture sector.

The annual growth ratio in Bohol, however, is low as 1.7 percent in past ten years, 1970 to 1980, compared with the ratio of 2.7 percent in the whole philippines and also 2.2 percent in the Central Visayas. This reason might be that the rural people has migrated to the city of Cebu and Manila to look for his better living conditions due to the poor agriculture status in Bohol island.

Particularly, the population in Phase I and Phase II project area is not increased due to a lack of governmental investment in the agriculture sector.

c) Natural Resources

Bohol island has no remarkable mineral resources except the limestone which is presently only used for lime production for agricultural soil improvement, cement production and stone production for building construction material. Bohol island, however, has a land and water resources with a potential to be developed for agriculture as well as fishery resources along the coastal area. Therefore, the governmental development policy to improve the living standard of rural area and stabilize the socio-economy of Bohol island should be set forth in the agricultural and fishery sectors.

There is presently about 129,400 ha of agricultural land, which is mostly placed under rainfed, primitive cultivation practice and low productivity.

The government has promoted several irrigation projects to ensure the irrigation water for paddy field and has provided several extension service activities to increase the agricultural productivity. These projects and activities, however, are small scale up to now and the rural economy in Bohol island is still placed under a low level as compared with the other district in the Philippines.

Forest area in the province covers about 57,700 ha, 14 percent of total island area. The reforestation development to keep the watershed of the river basin in a good condition will be considered also the important one. There are two reforestation projects under execution, namely the Loboc Watershed Reforestation Project and Bohol Reforestation Project covering an area of about 22,300 ha.

d) Agricultural Productivity

The basic industry in Bohol province is agriculture and major crops under cultivation are rice, upland crops and coconuts. The central and northeast areas are mainly used for rice and upland crop plantation covering the area of about 39,600 ha for rice land and about 27,300 ha for upland land, totaling in 66,900 ha. On the other hand, southern coastal areas are mostly planted with coconuts trees, of which areas are about 62,500 ha.

The former areas produce presently the rice of about 93,500 tons and upland crops of 97,600 tons on average for the period of 11 years from 1974 to 1984, while the latter areas produce the yield of 54,800 tons of coconuts in 1981 and contribute to the copra industry in Bohol island.

Present agriculture production and amount are summarized in FIGURE 2-1.

e) Social Infrastructure

1) Road

The main track line of road in Bohol is comparatively well developed. The total length of road is about 4,680 km and its paving condition is as follows;

Concrete paving	70.2 km	(1.5%)
Asphalt paving	266.8 km	(5.7%)
Gravel paving	3,196.4 km	(68.3%)
Earth paving	1,146.6 km	(24.5%)

The feeder and farm roads connecting the main track line, however, have not been developed yet. The rural people are presently suffering from the transportation means to import materials and equipments for agricultural production and to export agriculture product to the market.

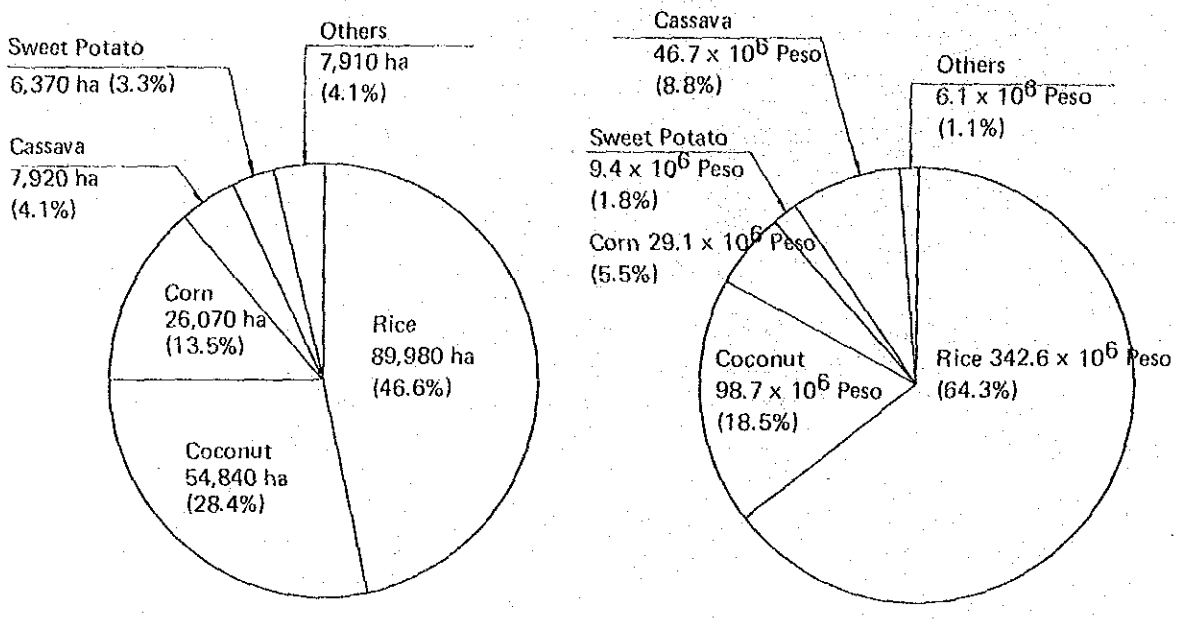
2) Ports

There are 19 seaports along the coastal line of Bohol to communicate the other islands. These seaports have fulfilled a sufficient function to import the commodity required for people in the island and to export the agricultural and fishery products to the markets in the Philippines.

Bohol island has two airports, one is located in Tagbilaran and there are two flights a day to connect Cebu. The other one is located in Ubay which is not used for commercial purpose but only temporary urgent purpose.

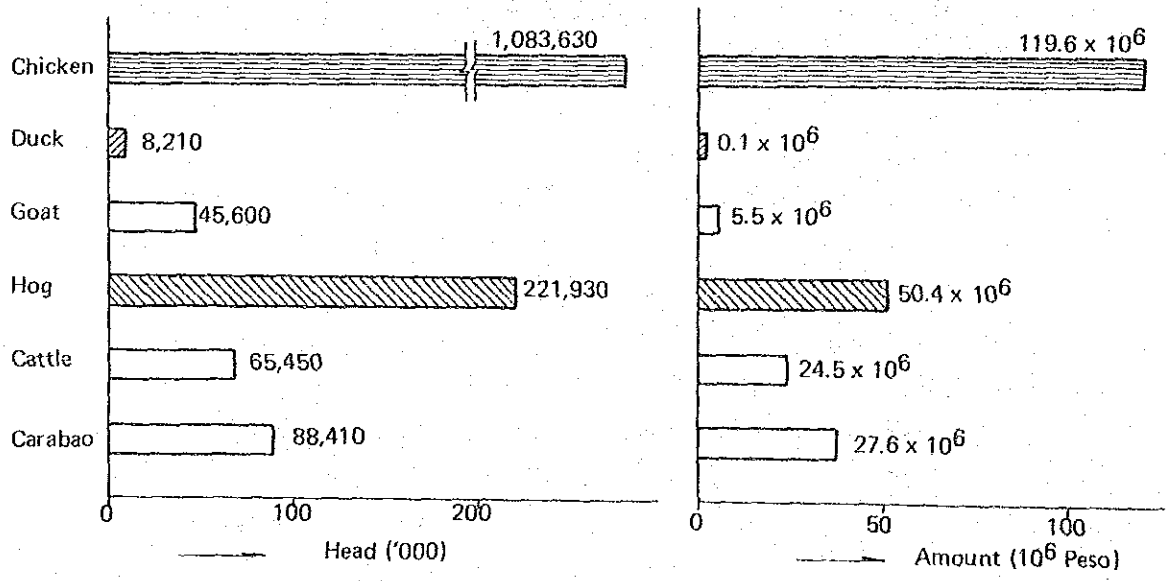
FIGURE 2–1 PRESENT AGRICULTURAL PRODUCTION AND AMOUNTS IN BOHOL PROVINCE

Agricultural Crops



Source: 1981 Census of Agriculture, NCSO

Livestock



Source: Bureau of Agricultural Economics, 1982

3) Domestic Water

There are 114 springs, 54 rivers and 172 creeks in Bohol. This water is used for domestic purposes in rural and uban areas and also will have a potential to be developed for the future demand of people in Bohol island.

There is no critical water supply problem at present for domestic use, except for Ubay, which has met water shortage and water quality problem due to unsuitable water resources.

4) Electrification

Most of urban areas have been electrified by diesel plant operated by the National Power Cooperation and by mini hydro-power plant located at Loboc. However rural electrification has not been developed yet and many rural people are suffered from lack of light in night and energy to process an agricultural product.

f) Gainful Works

Population of 15 years old and over in 1980 amounts to about 476,000 persons corresponding to 51.5 percent of total population. Out of this population, about 245,000 persons are gainful workers. Number and increase ratio of population in grainful workers are as follows;

Sector	Population	Increase Ratio (%)
Agriculture, Forestry, Fishery	156,000	+ 22.5
Other Industry	300	- 40.0
Manufacturing	30,000	- 14.3
Governmental Administration	58,700	- 5.4
Total	245,000	

g) Family Income

Average family income of each province of Central Visayas in 1975 is summarized as follows, in accordance with data issued by NEDA;

Estimated Average Family Incomes
By Provinces, Central Visayas, 1975

(Unit: Pesos)

Province	Average Family Income	Urban	Rural
Central Visayas	5,172	6,494	4,700
Bohol	3,892	4,727	3,767
Cebu	6,638	6,785	6,548
Negros Oriental	2,995	6,279	2,526
Siquijor	2,509	4,336	2,384

Source: National Economic and Development Authority (NEDA)

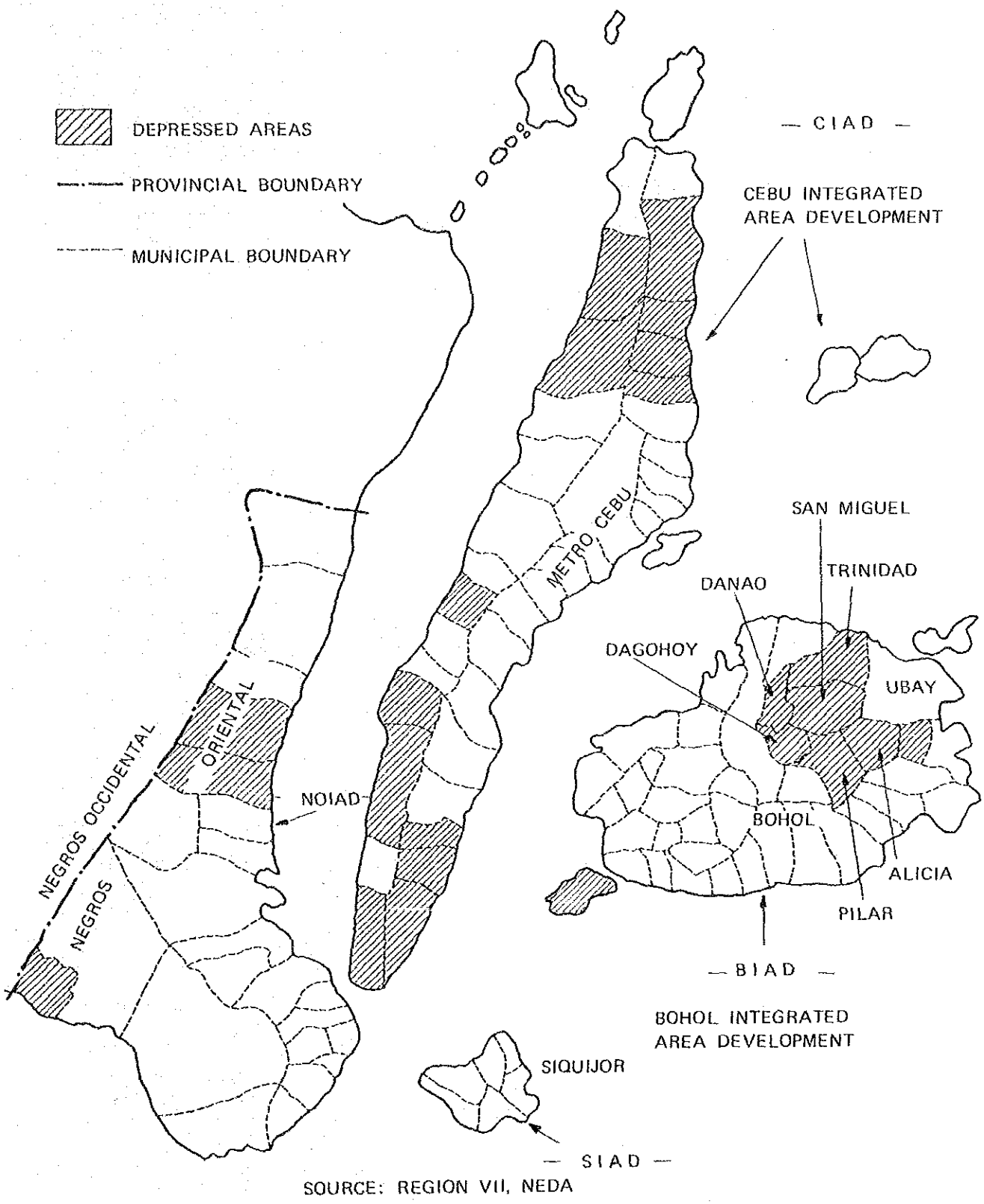
Average family income in Bohol is a little better than that of Negros Oriental and Siquijor, but still lower than that of Central Visayas.

FIGURE 2-2 shows the depressed area from viewpoint of the Integrated Area Development Policy in Region VII, NEDA. Trinidad and San Miguel concerned to the project area are defined as the depressed area.

2.1.3. Agricultural Status

Agricultural status in Bohol has been studied dividing into the whole Bohol province and project municipalities. The "project municipalities" means three municipalities of Ubay, Trinidad and San Miguel, which have a close relation with the project service area of Bohol irrigation project Phase II.

FIGURE 2–2 DEPRESSED AREAS ON INTEGRATED AREA DEVELOPMENT



SOURCE: REGION VII, NEDA

a) Land Use

Agricultural land use in Bohol province and the related areas is summarized in TABLE 2-1.

As clear in TABLE 2-1, Bohol province out of Central Visayas (Region VII) has the largest area of rice cultivation and the potential to develop the rice field. Three provinces of Cebu, Negros Oriental, and Siquijor are formed by mostly mountains and hilly areas and have only a few area suitable for paddy field but upland crop and/or tree crops.

Therefore, the development of rice field in Bohol will be the most important and essential subject in the agricultural development in Central Visayas in order to ensure the rice supply to meet the future rice demand, in accordance with the population increase in the Central Visayas.

The project municipality area covers the most largest area of the rice field in Bohol province and occupies the most important position to supply the rice to the other district in Bohol province and the other provinces in Central Visayas.

b) Number of Farm and Average Size of Farm

Number of farm in Bohol province is presently about 101,000 which has been increased about 43,000 during past 10 years from 1971 to 1980 in accordance with the irrigated agricultural development with small scale.

Average farm size in Bohol province and project municipalities are 1.38 ha and 1.94 respectively with a small size. Therefore, the agricultural development to increase the income of the rural people should be made with the concept of intensive agriculture, such as increase of cropping intensity to use the land at least twice,

TABLE 2-1 PRESENT AGRICULTURAL LAND USE

Item	Region VII (Central Visayas)					Project Municipalities
	Bohol	Cebu	Negros Oriental	Siguijor	Total	
1. Area ('000 ha)						
- Total Area	411	509	541	34	1,495	39
- Classified Area to Alienable & Disposable Land	310	253	270	1/	833	22 2/
- Farm Area	138	163	220	8	530	18
- Rice Land Excluding Upland Rice	46	3	9	1	59	9
- Potential of Irrigable Area	31	6	14	-	51	-
- Irrigated Area	7	2	6	-	16	-
2. Crop Yield (ton/ha)						
- Rice	1.33	-	-	-	1.49	1.14
- Upland						
Mungbean	0.44	-	-	-	0.47	0.09
Peanut	0.34	-	-	-	0.46	0.11
Corn	0.83	-	-	-	0.55	0.56
Cassava	6.00	-	-	-	2.73	1.01
Sweet Potato	5.00	-	-	-	2.02	
Coconut	5.11	-	-	-	1.36	0.85
3. Farm Size and Crop Intensity						
- Average Farm Size (ha)	1.4	1.1	2.7	0.8	1.6	1.9
- Cropping Intensity (Rice Land)	1.77	1.18	1.43	1.66	1.68	-

Note; 1/: included in Negros Oriental

2/: exclusive of Trinidad

Source; 1981 Census of Agriculture, NEDA Philippines Statistical Yearbook.

mechanization of cultivation in small size land and dense guidance by extension services.

c) Agricultural Production

Crop

Major crops in Bohol province at present are rice, coconut, cassava, corn, sweet potato, peanut, leguminous crop and vegetables. Especially rice is an important and security crop.

The total annual planted area and products for major crop in Bohol province and project municipalities are as follows;

Crops	Whole Bohol		Project Municipalities	
	Area	Products	Area	Products
	ha (%)	(ton)	ha (%)	(ton)
Rice	89,980 (46.6)	122,350	18,070 (61.2)	25,900
Coconut	54,840 (28.4)	63,860	7,590 (25.7)	6,430
Corn	26,070 (13.5)	18,440	620 (2.1)	350
Cassava	7,920 (4.1)	19,280	1,870 (6.3)	2,770
Sweet Potato	6,370 (3.3)		940 (3.2)	
Gabi	1,930 (1.0)		90 (0.3)	
Ubi	770 (0.4)		20 (0.1)	
Leguminous Crops	1,350 (0.7)	130	60 (0.2)	5
Peanut	580 (0.3)	190	120 (0.4)	10
Fruit Vegetable	2,700 (1.4)	240	30 (0.1)	10
Others	580 (0.3)		120 (0.4)	

Source: 1981 Census of Agriculture, NCSO

Of course, harvested area for each crop had been fluctuated depending on the rain condition. Especially the rice cultivation considerably varied from 42,900 ha to 98,500 ha in dry and wet year. In addition, the rice productivity is also changeable as 1.68 ton/ha in wet year and 0.86 ton/ha in dry year.

The agricultural productivity in Bohol pronvice is mostly on the same level as that of the Philippines on the wet year but considerable low in the dry year.

Livestock

Kinds of animal fed in Bohol province are carabao, cattle, hog, goat, duck and chicken. In the last five years, 1978 to 1982, considerable number of carabao and chicken decreased, while cattle, goat and duck increased as shown belows;

	1978	1982
Carabao	97,010	88,414
Cattle	59,150	65,452
Hog	220,680	221,931
Goat	28,060	45,600
Duck	5,560	8,218
Chicken	1,487,890	1,083,634

Source: BAEcon

e) Food Supply and Demand Balance

According to the balance study on demand and supply of rice for 1974 to 1984, rice production in 1980 in Bohol province was in surplus at about 5,000 tons. This is only surplus year during study years. In general, the rice supply in Bohol province has been shortage to the demand of inhabitants. The most deficit year was 1983. About 67 percent of total demand of 123,000 tons was in deficit due to small supply of 42,000 tons caused by drought damage.

Corn is also important staple food for inhabitants in Bohol province or the Central Visayas. Annual production in Bohol province is around 20,000 tons and always insufficient for consumer's demand. The worst production was 14,000 tons in 1983, hence this quantity could supply at only 33 percent of total demand. Even in 1982 of good harvest, the production could supply at 62 percent.

Production of other crops such as mungbean, peanuts and vegetable is shortage for the demand of Bohol consumption estimated using national consumption per capita. Ratio of self-sufficiency is around 35 percent of mungbean and peanut and 20 percent of vegetable.

2.2. National Policy in Agriculture

a) In the Philippines, the gross domestic product (GDP) in the agricultural sector increased at an average yearly rate of 4.3 percent (at constant 1972 prices) from 1972 to 1982. This rate shows a little lower rate than 5.3 percent on all sectors. The share of the agricultural sector occupied in GDP decreased from 28.6 percent in 1972 to 25.6 percent in 1982.

In 1983, the agricultural sector faced difficulties as a result of production setbacks and external adversities. Main reason was the eight drought months which hit the country, particularly in Mindanao and Visayas area.

The Five-Year Philippine Development Plan (1983-1987) issued in 1982 was updated in September, 1984, responding to the recent domestic development and realities in the international economic environment. The essence of the Updated Philippine Development Plan, 1984-1987 is to strengthen the national will and capability for selfreliant development through a conscious effort to raise productivity and attain self-sufficiency.

Annual growth rate in the agricultural sector is projected at a higher rate than other sectors from 1984 to 1987 as shown in the following table;

Gross National Product and Composition of 1983 and 1984-1987

(Unit: %)

Item	Actual	Estimate	Projections	
	1983	First Semester 1984	1984	Annual Average 1985-1987
1. Real GNP	1.3	-5.4	-5.5	2.8
2. Real GDP	1.1	-3.7	-4.5	3.0
- Agriculture, Fishery, Forestry	-2.1	2.2	1.5	4.4
- Industry	0.7	-9.0	-10.3	2.5
- Services	3.7	-2.4	-2.9	2.3

Source: Updated Philippine Development Plan, 1984-1987

The average agricultural growth rate of 4.4 percent mentioned above will result from a more remunerative pricing mechanism and better yields owing to technological and farm management innovations.

b) There are wide disparities in levels of development and rates of growth among and within regions. As regards the Central Visayas, the expansion of the agricultural sector is hindered by land constraints, poor soil fertility and declining yields. The regional strategy for the development of agriculture requires the modernization of this sector.

The regional target of agricultural production is planned in the Region VII Five-Year Agricultural Indicative Plan (1983-1987), which is prepared by the regional office of the Ministry of Agriculture and Foods.

Especially, actual average paddy production of 166,000 tons in 1978-1982 is planned to increase in 277,000 tons in 1987.

Related to the production target of rice, the following specific strategy for the agricultural development is proposed;

i) During the planning period, specific areas suited for rice production, like in Bohol province shall be prioritized for development of rice production;

ii) Large scale irrigation projects in Bohol province will be implemented.

c) The Provincial Five-Year Agricultural Development Plan (1983-1987) schemed by the Provincial Development Council has the following major goals.

i) To ensure rice self-sufficiency with the raise of rice growing farmers' income through increase of yield per hectare by 25 percent, expansion of rice land area and provision of irrigation water in the full potential irrigable area;

ii) To increase corn production through yield increase by 2.0 ton per hectare in the programmed area of yield increase project;

iii) To increase cassava and other root crops production by 75 percent of present production, especially for the development of cassava agro-industry;

iv) To improve production technology of leafy vegetables and fruit tree crops in the programmed area for marketing and also for encouragement in establishing of fruit processing;

v) To increase coconut productivity per hectare by 25 percent through introduction of high yielding varieties in the existing area and also the new planting area;

vi) To develop livestock production of cattle and swine through improvement of production technology, planting of pasture and forage and establishment of feed mill processing factories;

Of goals mentioned above, paddy production is projected to increase from actual quantity of about 97,000 tons in 1978-1982 to about 219,000 tons in 1987 and 360,000 tons in 2000. This target is the volitional plan to extend the share of rice production occupied in the Region VII from 58 percent in 1978-1982 to 79 percent in 1987.

The full irrigation water supply in the about 31,800 ha of total potential irrigable area is planned through the national irrigation project of Wahig-Pamacsalan and also ten of new communal irrigation projects.

Recently Human Settlements Regulatory Commission (HSRC) undertook the formulation of the Comprehensive Development Plan in the project municipalities of San Miguel, Trinidad and Ubay, in the corporation works between HSRC and the municipal development staff.

CHAPTER III. THE PROJECT AREA

CHAPTER III. THE PROJECT AREA

3.1. General Features

3.1.1. Location and Geography

The project area is located in the north-eastern part of Bohol island and about 100 km far from Tagbilaran, capital of the island as shown in Project map. The whole project area is approximately 12,700 ha which lies on the elevation of 40 to 5 m from the south to north direction with undulated hilly topography. The project area is formed by extensive sequence of sedimentary formation consisting of mainly siltstone, mudstone and sandstone.

Several streams well developed flow down from the southern ridge in the project area to the northern area nearby the highway No.1 between Trinidad and Ubay, and finally empty into the Camotes Sea collecting the rain water in the project area.

Although the paddy area is extended over in the lower land along the streams, the higher hilly area is covered mostly with grass land. A few upland crop field and coconut area are scattered in the project area.

Several swamps covered with broad leaf tree are found in the downstream of the Soom, Sonoc and Ipil rivers, which are inundated with two to three meters depth by the back water of sea in the high tide period.

3.1.2. Administrative Division and Social Conditions

a) Administrative Division

Bohol province is divided into 47 municipalities and one poblacion (city). The project area belongs to three municipalities

of San Miguel, Trinidad and Ubay located in the north west corner of Bohol island. There are of 82 barangays in three municipalities, of which 22 barangays are located in the proposed irrigation service area.

Historically, the project area was a part of Ubay municipality. In 1947, Trinidad was established in a part of Talibon and Ubay municipalities located on the left and right bank area of the Ipil river. San Miguel was lastly set forth in 1961 independently from Trinidad and Ubay municipalities.

The summary of administrative outline is as follows;

Item	Administrative Division				Project Service Area
	San Miguel	Trinidad	Ubay	Total	
No. of Barangay	18	20	44	82	22
Total Area (sq.km)	91.6	94.3	205.6	393.4	127.0
Agricultural Area (ha)	6,407	8,123	9,166	23,696	6,070
Total Population (1,000)	12.2	15.1	38.3	65.6	10.9

b) Local Government Systems

In order to secure more substantial and effective planning and development on reasonable level to barangay level, the administrative reforms and innovations were instituted recently by the Philippine Government. The Regional Development Council composed of regional executives of line agencies is made in Bohol province and the highest development planning body in the province. The governor is the representative in the Regional Development Council and assisted for planning by the Provincial Development Council members composed of the heads of provincial offices and national agencies operating in the province.

The Provincial Development Staff (PDS) assists the governor with planning works and also coordinating and integrating the

diverse efforts of the various governments and private entities directly engaged in implementing plans and projects. On the municipal levels almost same systems are applied for the municipal planning and development. The Five-Year Development Plan (1983 - 87) on regional level to municipal level are formulated by the respective organizations and is under implementation currently. The Barangay Council is expected to serve as the basic body in determining essential needs on the barangay level and the needs are incorporated in the municipal planning and development activities. The recent administrative reforms on regional to municipal levels include the regionalization of the Ministry of Agriculture and Foods and creation of the provincial and municipal farmers in the local government bodies on each level.

NIA is one of the important agencies to plan, design and construct the irrigation and drainage project as well as the operation and maintenance of the project facilities completed. The provincial office of NIA located at Tagbilaran has been in charge of the communal irrigation project.

The branch office of the Ministry of Agriculture and Foods also exists to serve the rural people and to promote the extension services in the agricultural field.

In addition, the agricultural promotion center has been established in 1984 for the research on the suitable crop, modernization of cultivation practice and increasing method of agricultural productivity in Bohol province. This center was constructed by the grant of Japanese Government and is presently under operation by assistance of Japanese experts.

c) Population and Employment Opportunity

The population in the project area of about 10,900 has increased at a relatively high rate of 2.0 percent per year on the

average from 1970 to 1980 in comparison with 1.7 percent of Bohol province. On the other hand, the population over 15 years old in the project area has increased at a rate of 0.7 percent annually during the same period. This is quite less than that for Bohol province of 2.2 percent. This may explain that a large number of workable population, especially new graduate of schools, has migrated out (see Annex K, TABLE K1-1 to TABLE K1-4).

According to the 1980 Population Census, about 81 percent of male population (15 years old and above) and 22 percent of the female population had gainful occupations in the project area. About 53 percent of the gainful workers of both sexes were engaged in the crop production.

The result of agro-economic survey conducted by NIA indicates the facts that about 75 percent of farm household is obtaining the income from the other sources than agriculture sector. The salaries or wages obtained from other working sectors, gifts from relatives and earnings from cottage industries are main sources to get the cash income. The income from the other sources occupies about 20 percent against total income.

d) Infrastructure

Domestic Water Supply

The domestic water of the area is supplied by open wells, artesian wells and surface water. Artesian wells are not so commonly developed in the area due to lack of reliable water veins.

The number of households and existing water facilities for domestic purposes in the barangays related to the project area are as follows.

Municipality	Household 1/	Open Wells	Artesian Wells
San Miguel	540	202	4
Trinidad	496	463	4
Ubay	1,081	685	5
Total	2,117	1,350	13

Source: 1/ Household: 1980 Population Census.
Facilities: Municipal Governments.

The water quantity and quality will be suitable for requirement of rural people except Ubay poblacion.

Rural Electrification

Electrification of the project area commenced in 1981 by Bohol Electric Cooperatives (BOHECO) II. As of January 1985, five barangays in the project area have been energized. According to the practical electrification program of the BOHECO II, additional 13 barangays will be given with electricity by 1989. However, there is no schedule on electrification of four barangays remaining in the project area.

The present status of electrified barangays is as follows:

Municipality	Potential Consumer	Energized Household	Diffusion Rate (%)	Consumption per Month (kw)
San Miguel	-	-	-	-
Trinidad	119	11	9	17
Ubay	614	107	17	19
Total	733	118	26	36

Source: BOHECO II

Road Network

Two routes of national highway serve the inland transportation of the area, one is the route No.1 from Tagbilaran to Trinidad through Ubay, and the other the route No.3 from Tagbilaran to Trinidad through San Miguel. The project area is bounded on the east and the north by national highway of the route No.1, while the route No.2 is located on the west of the Trinidad river which is bounded on the west of the project area.

Two lines of provincial roads connected each other in the middle of the area serve the local communication; one is from the southeast to the middle and the other from the southwest to the north through the middle of the area respectively. Several barangay roads extended between barangays are not sufficient in their density to communicate each barangay.

The total road length in the project area for public communication, length of paved section and their density are as follows:

	Gravel (km)	Earth (km)	Total (km)	Density (m/ha)
Provincial Level	9	12	21	2.1
Barangay Level	47	73	120	12.4
Total	56	85	141	14.5

Source: Municipal Government

The national highways surrounding the project area paved by gravel are maintained in good conditions. On the contrary, public roads in the project area are still in bad conditions and difficult for transportation by vehicles during rainy season due to lack of cross drainage and poor maintenance.

Communication

There is no telephone system in the three municipalities. Bureau of Telecommunication (BUTEL) has established telegraph stations in Ubay and Trinidad municipalities. As to other communication systems in the area, Integrated National Police (INP) Office of each municipality owns FM/BM radio for direct communication with the other offices within the province.

Public Health

Each municipality has its main health center for public health and sanitary as well as residents medical care, which is managed with a physician, a nurse, midwives of less than ten in number depending upon the number of population served, and a rural sanitary inspector. There is no public hospital in the municipalities but only one private clinic provided with 16 beds in Ubay municipality.

3.2. Physical Conditions

3.2.1. Topography and River System

a) Topography

The Phase II project area has an elevation of 40 to 5 m above mean sea level, which is about 90 m lower in elevation than those of the Phase I project area, and it is developed in generally undulated area and slopes moderately toward the national highway No.1 which links Ubay and Trinidad.

From the viewpoint of topography, the project area could be classified into two areas, north-western part of the project area and the remaining area. The former forms complicated topography

with considerable undulation and is developed along both sides of the Mahagbo river which is the lower reach of the Bayongan river. The latter has relatively flat topography although partial undulation of topography can be seen in spots.

b) River System

The main water sources of the Phase I project area are the Wahig and Pamacsalan rivers. These rivers get together at the immediate upstream of the proposed Malinao damsite with a catchment area of 138.8 sq.km.

Total length of the Wahig river is about 16 km, with the mean river bed slope of about 1/160. On the other hand, total length of the Pamacsalan river is about 12 km, and its river bed slope ranges from 1/15 to 1/160.

The available water resources in Phase II project area are the Bayongan river, a tributary of the Trinidad river and the Bayang river, a tributary of the Soom river. The former river has a catchment area of 11.2 sq.km, a length of 11 km and the mean river slope of about 1/270 at the proposed Bayongan damsite. The latter river has a catchment area of 13.1 km, a length of 6 km and the mean river slope of about 1/60 at the proposed Capayas damsite.

3.2.2. Meteorology

a) General

The meteorological types in the Philippines are classified into four types by the annual rainfall pattern. The Bohol island belongs to the climatic type IV, in which the rainfall is more or less evenly distributed throughout the year.

The 10-day rainfall for the last 28 years, 1956 to 1984, at Dagohoy Station, which had been successively observed for the longest period, is shown in FIGURE 3-1. According to this figure, it is quite difficult to clearly identify the wet and dry seasons. General meteorological data except for the rainfall data are collected by PAGASA station in Tagbilaran as shown in FIGURE 3-2, and they are summarized as shown in TABLE 3-1.

b) Rainfall

There are 10 rain gauge stations in the neighborhood of the Phase I and Phase II Project areas as shown in FIGURE 3-2.

The annual mean rainfall at the Dagohoy station is about 2,050 mm for the last 28 years since it was installed in 1956 (see TABLE 3-2). However, an annual rainfall fluctuates year by year with considerable ranges such as about 1,400 mm in dry year and 3,200 mm in wet year. According to this data, there is comparatively little rainfall from February to May, and much rainfall from June to January. In any case, it can be seen that there is rainfall throughout the year, which is a characteristic of the climatic type IV.

On the other hand, there are three rain gauge stations in the neighborhood of the Phase II project area, that is, Ubay Bayang, Ubay Central and Ubay Gabi. Annual rainfall of each station is 1797 mm/year at Ubay Bayang, 1,324 mm/year at Ubay Central and 1,725 mm/year at Ubay Gabi. It has a tendency to be less than Phase I project area, which can be considered due to the influence of oceanic climate at the Ubay area (see TABLE 3-3 and FIGURE 3-3).

According to these data, rainfall shows the same tendency as that of the Dagohoy station.

The nine rain gauge stations do not have sufficient data to be applied for various analyses except for the Dagohoy station.

TABLE 3-1 CLIMATOLOGICAL DATA AT TAGBILARAN (1960 - 1984)

Data	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Rainfall (mm)[1/]													
Mean	103	83	78	65	83	140	121	111	128	179	208	112	1,411
Maximum	249	183	155	234	181	303	231	186	327	385	383	192	3,009
Minimum	18	3	8	10	19	9	10	57	41	71	76	51	379
2. Temperature (°C)													
Mean	26.1	26.2	26.8	27.6	28.4	28.2	28.0	28.3	28.1	27.6	27.3	26.7	27.4
Mean Maximum	30.4	30.8	31.7	32.8	33.1	32.6	32.3	32.6	32.5	32.1	31.8	31.2	32.0
Mean Minimum	21.7	21.6	21.8	22.5	23.6	23.8	23.7	23.9	23.7	23.3	22.8	22.5	22.9
3. Relative Humidity (%)													
Mean	82.9	81.3	79.2	77.4	78.8	81.5	81.0	79.0	80.8	83.0	84.5	83.9	81.1
Mean Maximum	93.3	90.8	90.5	86.8	89.1	90.7	91.5	90.5	90.8	92.4	93.5	93.5	91.1
Mean Minimum	72.1	70.3	69.8	68.0	71.3	72.6	71.4	70.4	72.7	73.5	75.0	74.4	71.8
4. Mean Dew Point (°C)	22.6	22.4	22.5	23.3	24.3	24.4	24.2	24.1	24.1	24.1	24.0	23.6	23.6
5. Mean Cloudness (0-10)	7.2	7.1	6.3	5.6	6.7	7.8	7.9	8.0	8.0	7.6	7.3	7.5	7.3
6. Wind													
Mean Velocity (km/hr)	5.5	5.7	5.4	5.0	4.4	4.0	4.7	5.3	4.8	4.2	4.5	4.9	4.9
Mean Direction	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	-

Note: 1/ Average of observation periods of 1960 - 1975 and 1978 - 1981.

TABLE 3-2 MONTHLY RAINFALL AROUND PHASE I AREA

* STATION --- DAGOHOY UNIT : mm

YEAR	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1956	180.6	35.1	118.5	221.7	302.4	171.2	252.1	--	161.0	107.2	201.8	458.2	--
1957	195.4	187.2	101.9	143.4	47.4	310.9	409.7	177.5	134.5	309.3	123.7	91.0	2231.9
1958	131.9	108.3	75.3	104.1	67.0	159.1	252.1	152.1	130.4	72.8	163.9	62.8	1479.8
1959	264.8	84.0	238.7	16.8	89.3	116.8	442.9	207.2	178.0	116.9	128.2	154.7	2038.3
1960	261.0	97.1	56.8	168.9	124.5	285.8	172.7	90.5	244.5	158.1	264.1	154.5	2078.5
1961	179.7	101.9	54.9	106.0	69.1	103.3	410.4	123.1	240.3	395.7	182.2	179.1	2145.7
1962	124.9	291.1	185.7	21.9	132.5	232.1	240.0	297.4	300.3	130.2	390.9	161.3	2508.3
1963	317.0	152.5	221.4	52.8	6.3	47.4	326.9	232.3	288.6	331.8	168.6	75.2	2220.8
1964	139.2	320.2	19.4	80.5	366.5	107.6	206.4	56.4	269.7	179.1	934.3	257.9	2937.2
1965	364.9	171.5	136.4	72.9	9.8	326.6	155.4	173.9	150.1	206.2	122.3	189.2	2079.2
1966	93.0	58.4	29.1	65.6	215.1	61.3	372.3	219.4	106.8	352.5	106.5	187.0	1867.0
1967	436.9	260.7	255.7	49.6	109.3	129.3	147.0	112.6	189.2	145.3	186.9	191.6	2214.1
1968	123.8	51.7	82.7	4.5	3.3	151.7	115.9	110.8	210.3	262.3	399.5	319.9	1836.4
1969	33.0	9.4	81.6	18.6	95.1	151.0	248.7	126.8	164.2	123.1	132.3	228.8	1412.6
1970	78.4	142.2	34.0	20.8	42.2	349.7	263.6	140.5	153.6	388.6	209.1	124.8	1947.5
1971	266.7	49.9	117.5	115.6	248.6	339.5	239.8	179.9	202.6	214.3	330.5	92.3	2397.2
1972	388.7	33.8	97.1	33.2	189.3	207.6	135.6	255.7	284.8	168.2	161.3	147.4	2102.7
1973	33.8	35.0	28.0	5.9	0.7	209.4	194.4	303.0	244.1	158.0	564.0	262.6	2038.9
1974	53.5	278.6	123.9	231.7	109.7	267.5	114.9	105.7	86.0	119.2	304.8	253.2	2048.7
1975	362.9	126.9	94.9	147.8	18.8	228.6	251.9	153.2	263.3	226.0	116.0	172.3	2162.6
1976	298.8	65.7	42.3	12.9	57.9	198.1	144.6	337.7	117.9	47.4	71.9	342.6	1737.8
1977	347.4	296.4	67.1	2.8	170.3	125.9	272.9	283.6	132.2	158.6	201.2	49.8	2108.2
1978	292.1	133.7	29.0	67.3	39.5	333.4	173.3	85.0	218.8	172.1	114.6	192.9	1851.7
1979	128.0	42.2	32.8	71.9	174.4	314.4	228.8	71.1	148.4	126.6	101.9	132.3	1572.8
1980	227.5	310.5	29.7	72.7	65.0	216.5	338.4	714.5	271.5	441.8	194.6	301.3	3184.0
1981	225.1	95.3	59.7	41.1	64.8	77.5	323.4	98.9	192.4	295.9	127.3	428.3	2029.7
1982	83.9	147.2	213.2	7.5	77.7	152.8	152.1	270.8	139.1	269.1	61.5	99.3	1674.2
1983	30.2	9.4	1.3	0.0	6.0	119.1	337.1	148.1	236.1	227.2	131.1	297.8	1543.4
1984	181.1	254.2	157.7	54.9	65.5	62.6	57.3	28.8	281.2	222.4	154.0	418.9	1938.6
MEAN	201.5	136.2	96.1	69.4	102.3	191.6	240.7	187.7	197.9	211.2	218.9	207.8	2049.6

TABLE 3-3 MONTHLY RAINFALL AROUND PHASE II AREA (OBSERVED DATA)

Station: Ubay Central (Unit: mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1975	-	-	-	-	-	-	81.3	32.2	166.3	218.0	73.0	173.4	-
1976	160.5	66.5	27.8	21.6	73.1	150.0	54.7	104.3	127.9	75.7	147.4	145.2	1154.7
1977	147.4	115.3	111.7	9.9	37.3	81.7	151.9	133.9	50.5	154.7	88.3	56.8	1139.4
1978	104.2	83.0	23.2	44.1	57.6	61.3	62.5	106.0	139.3	68.4	46.4	97.2	893.2
1979	29.0	-	-	-	-	-	-	70.6	112.6	149.6	47.5	84.9	-
1980	275.7	316.1	11.9	17.5	23.4	217.1	139.1	121.1	262.9	283.9	51.7	216.0	1936.4
1981	311.8	76.2	115.8	15.0	29.0	128.5	262.0	32.1	24.4	120.7	134.0	171.6	1421.1
1982	35.0	155.6	174.8	0.0	121.8	108.4	266.0	277.6	76.0	163.0	74.0	90.8	1543.0
1983	43.2	4.0	7.4	2.0	0.0	64.9	78.0	208.2	100.0	95.6	230.8	345.0	1179.1
1984	153.2	175.8	81.2	50.0	88.0	80.8	125.8	119.4	-	-	-	-	-
Mean	140.0	124.1	69.2	20.0	53.8	111.6	135.7	120.5	117.8	147.7	99.2	153.4	1323.8

Station: Ubay Bayang (Unit: mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1957	-	-	-	-	-	-	-	-	-	38.1	30.5	85.9	-
1958	132.0	119.5	109.2	17.8	-	-	-	10.8	236.0	312.4	266.8	228.6	-
1959	195.8	111.8	95.3	6.3	116.9	47.1	345.5	203.2	200.7	148.6	37.0	54.5	1562.7
1960	120.0	80.0	24.1	-	0.0	61.0	251.5	80.1	147.5	247.2	200.1	136.7	-
1961	144.4	84.8	67.8	88.2	34.3	71.1	216.9	126.9	163.0	274.5	127.1	105.5	1504.5
1962	129.6	248.5	157.1	18.8	211.3	264.1	260.3	285.6	266.8	189.8	280.8	100.6	2413.3
1963	257.4	85.1	140.5	21.6	6.8	115.1	199.6	397.4	138.4	318.5	54.5	58.5	1793.4
1964	53.3	238.4	14.0	64.8	242.6	127.1	247.6	43.5	205.8	183.0	191.7	100.3	1712.1
1965	199.5	231.2	-	10.2	34.2	174.2	140.0	47.2	188.0	91.4	5.1	-	-
Mean	154.0	149.9	86.9	32.5	92.3	122.8	237.3	149.3	193.3	200.4	132.6	108.8	1797.2

Station: Ubay Gabi (Unit: mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1978	-	-	-	-	-	-	-	-	310.9	190.8	199.7	265.8	-
1979	111.5	31.3	19.4	43.5	194.4	270.0	144.7	137.1	238.5	114.3	141.3	120.9	1566.9
1980	293.4	120.3	11.5	37.8	103.6	246.1	197.9	292.1	199.3	402.4	145.3	270.1	2319.8
1981	252.4	60.5	71.4	15.9	134.6	74.6	130.4	17.0	141.2	180.0	120.6	220.3	1418.9
1982	95.4	106.5	263.4	28.0	136.4	169.8	290.7	251.7	84.8	223.9	65.7	89.5	1805.8
1983	49.3	9.3	5.3	10.2	2.3	115.3	302.4	288.3	150.8	196.0	169.6	213.7	1512.5
1984	164.5	181.9	61.2	77.7	35.2	131.4	249.2	54.4	-	197.9	127.5	323.0	-
1985	261.6	-	-	-	-	-	-	-	-	-	-	-	-
Mean	175.4	85.0	72.0	35.5	101.1	167.9	219.2	173.4	187.6	215.0	138.5	214.8	1724.8

FIGURE 3-1 DISTRIBUTION OF 10-DAY RAINFALL (STATION: DAGOHOY)

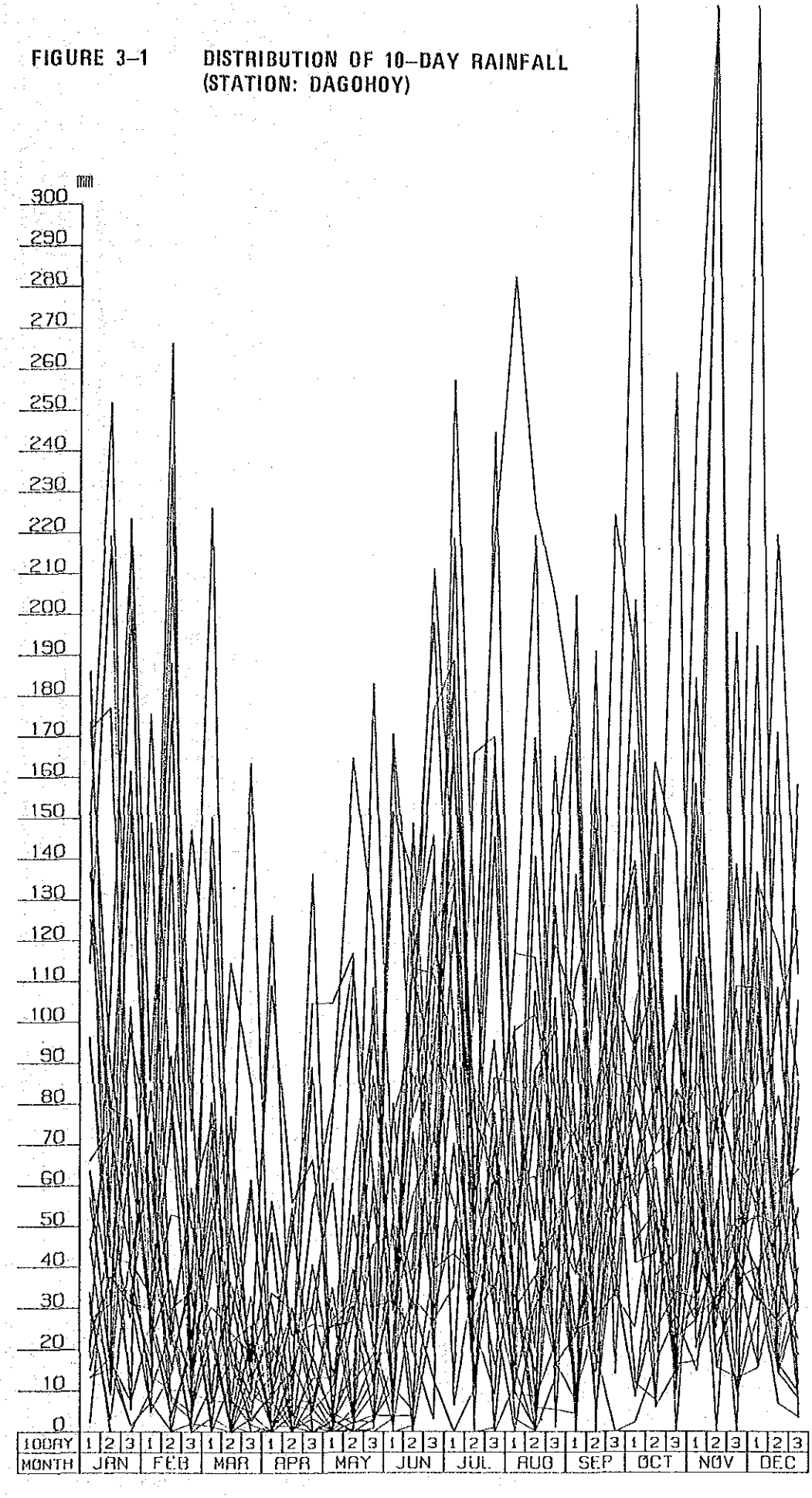
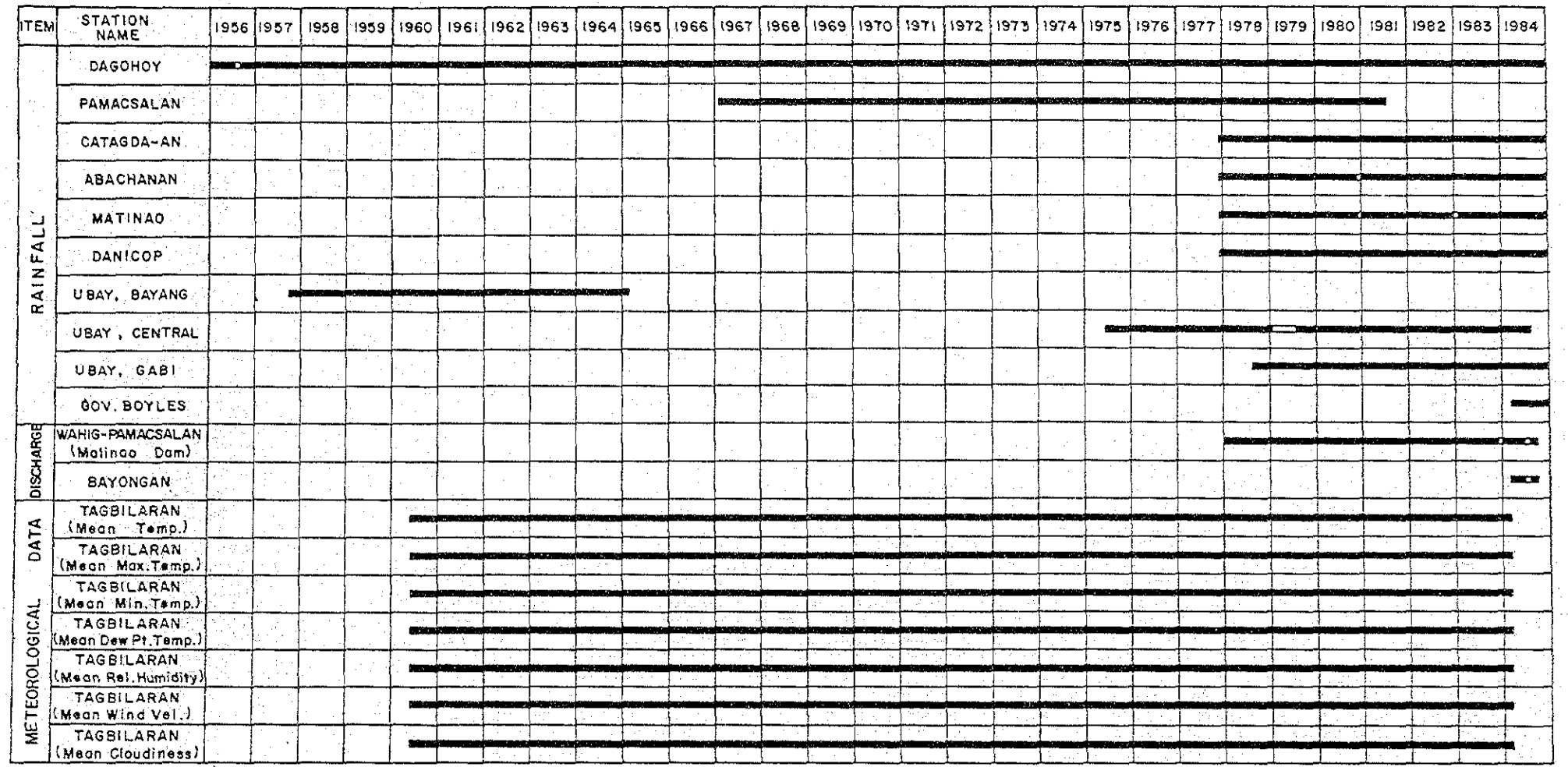
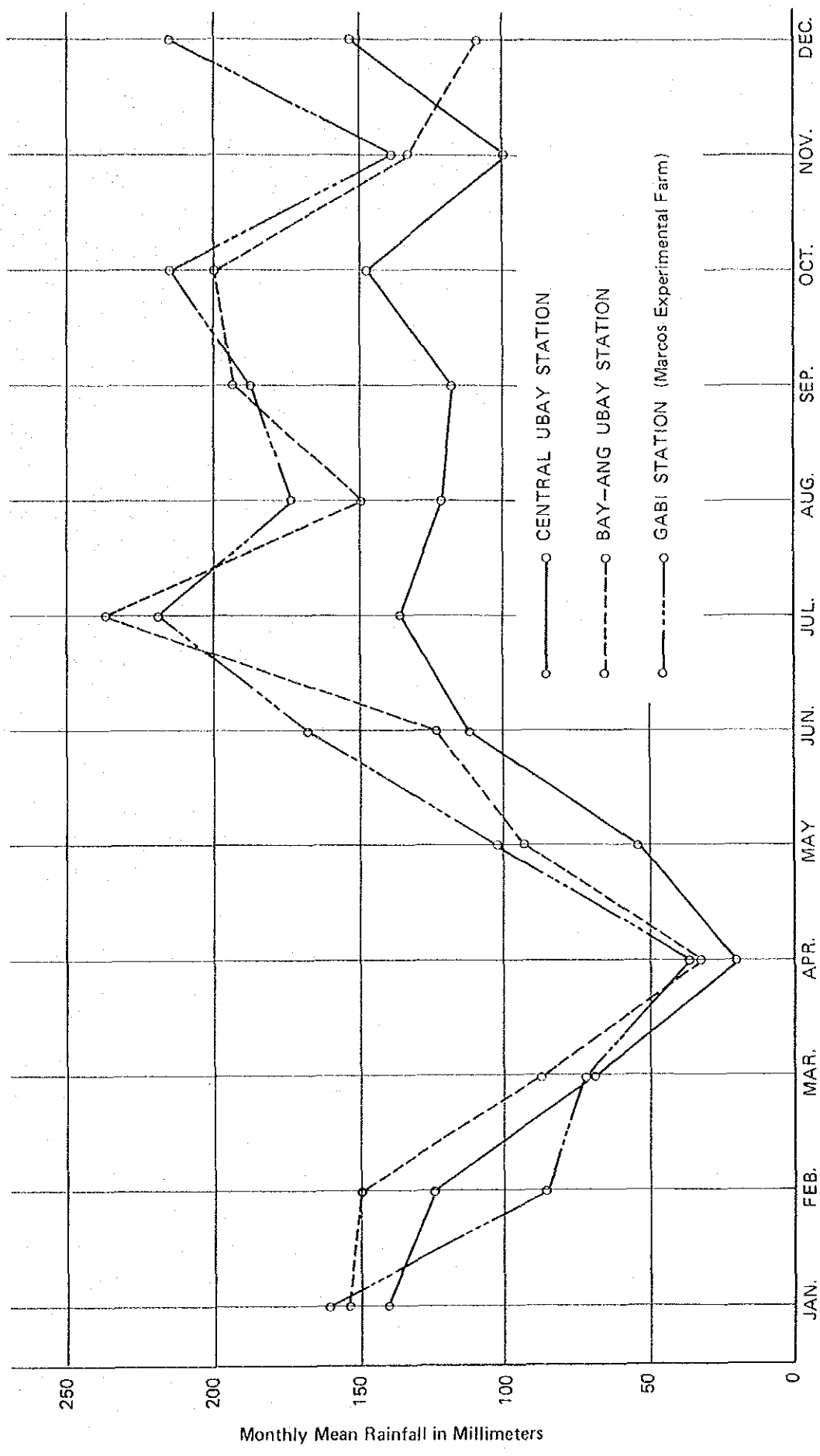


FIGURE 3–2 HISTORIC METEOROLOGICAL AND HYDROLOGICAL RECORDS



NOTE: LOCATION OF ABOVE STATIONS ARE SHOWN IN FIGURE B1-1, ANNEX B.

FIGURE 3-3 MONTHLY MEAN RAINFALL AROUND PHASE II AREA



Therefore, first of all, the rainfall data were to be analyzed for estimation of the correlation between the Dagohoy station and the other stations, and all the missing data were complemented by a regression line.

3.2.3. Hydrology

a) Runoff at Malinao Damsite

There are several runoff observation stations in the neighborhood of Phase I and Phase II project areas as shown in FIGURE 3-2.

Main water resource for the Phase I project area is the Wahig-Pamacsalan river, which has a catchment area of 138.8 sq.km at the proposed Malinao damsite. The staff gauge has been installed at national highway bridge located at the immediate downstream of the proposed damsite. The runoff of this station is observed only for seven years from 1978 to 1984, and presents the amount of 102 MCM to 169 MCM. The monthly observed runoff data are shown in FIGURE 3-4.

According to these data, it is found out that the runoff discharge is decreased from February to May, and there is a good correlation between rainfall and runoff discharge in the catchment area.

The long term daily discharge of the Wahig-Pamacsalan river was analyzed based on the correlation between the observed runoff data and the available rainfall data, and its monthly runoff for 28 years is summarized in TABLE 4-2. As clear in the table, there is comparatively a little runoff from February to May and a much runoff from June to January.

b) Runoff in Phase II Project Area

The staff gauges for discharge measurement of the Bayongan river and the Bayang river, which are the water resources of Phase II project, were installed in March 1984 and February 1984 respectively . The discharge measurement has been made eight times at each station since installation, but almost no or a few flow record is available. Therefore, the estimation of the Bayongan and Bayang river was made based on the result of runoff analysis of the Wahig-Pamacsalan considering the different conditions of catchment area and rainfall pattern in two rivers. The catchment area is small as 11.2 sq.km for the Bayongan reservoir and 13.1 sq.km for the Capayas reservoir.

The runoff caused by the rainfall in the catchment area will appear in considerably shorter time than that of Phase I area. The analyzed procedures of runoff is explained at Section 4.3.2.

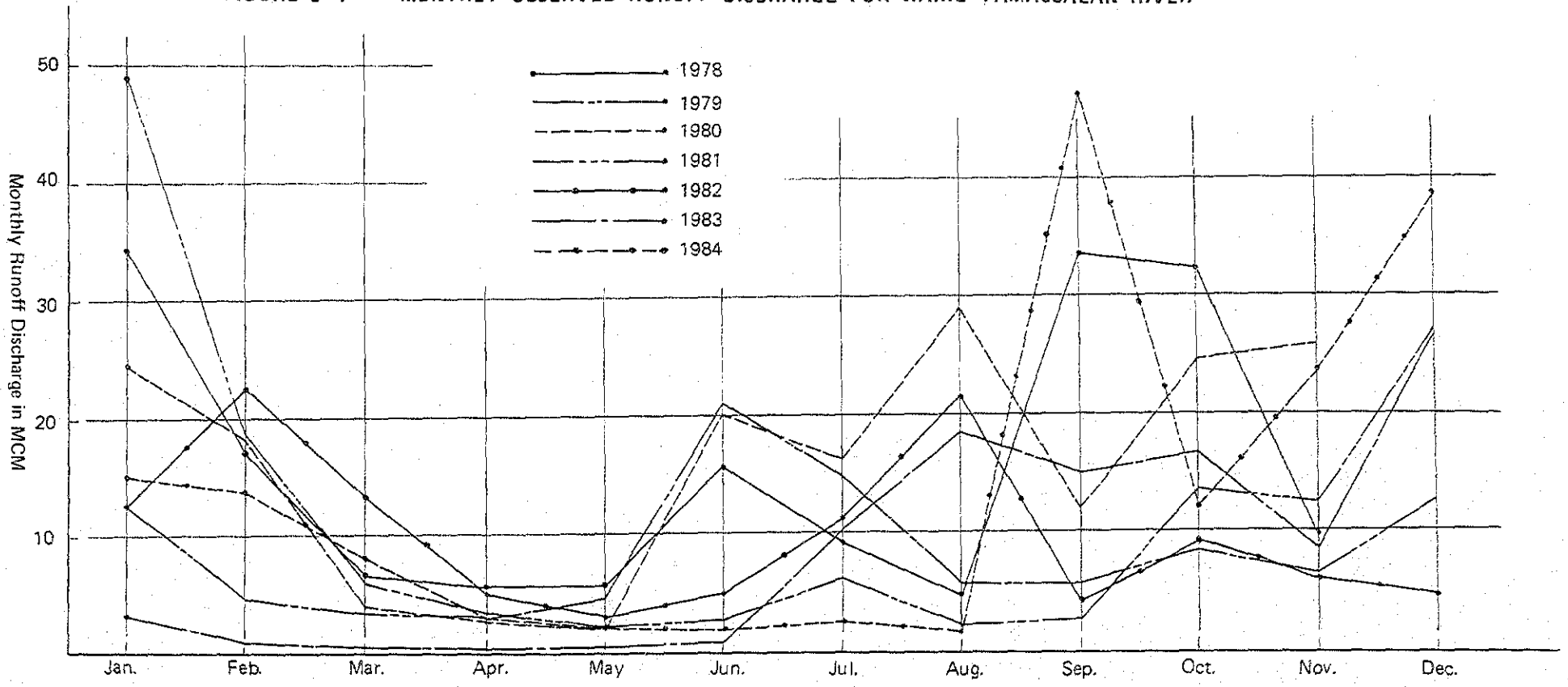
Annual mean runoff at the Bayongan reservoir is about 10.3 MCM on an average for the last 28 years, with the amount varying from 16.4 MCM (Maximum) to 6.9 MCM (Minimum). On the other hand, annual mean runoff at the Capayas reservoir is about 11.0 MCM for the same period, with the amount varying from 17.2 MCM (Maximum) to 7.5 MCM (Minimum).

The feature of both rivers is almost similar with the rainfall pattern, and the runoff decreases from February to May and increases from June to January (see FIGURE 3-5).

c) Sediment Transport

There are no data available on the amount of sediment transported by the rivers in the project area.

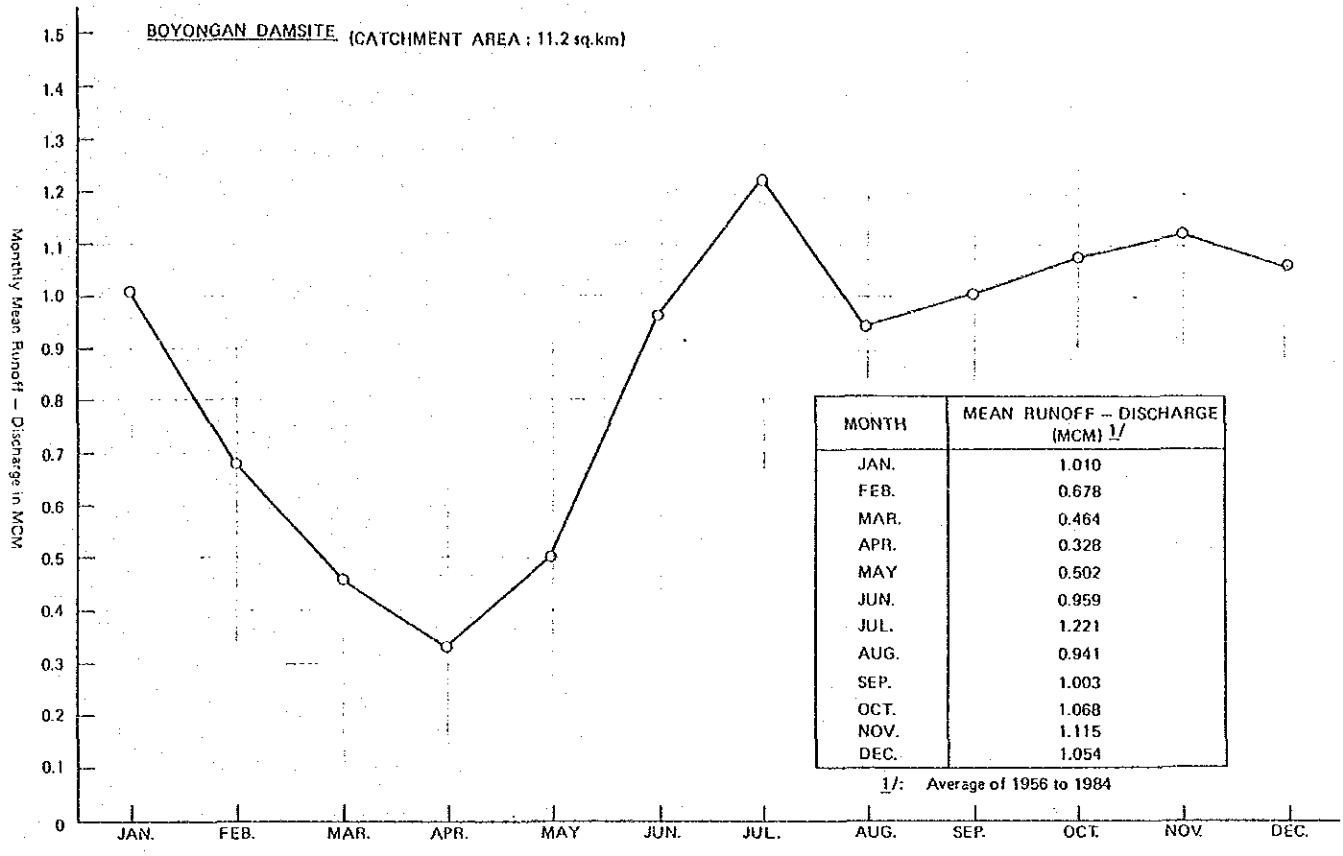
FIGURE 3-4 MONTHLY OBSERVED RUNOFF DISCHARGE FOR WAHIG-PAMACSALAN RIVER



* STATION --- WAHIG-PAMACSALAN (UNIT: cu.m/sec)

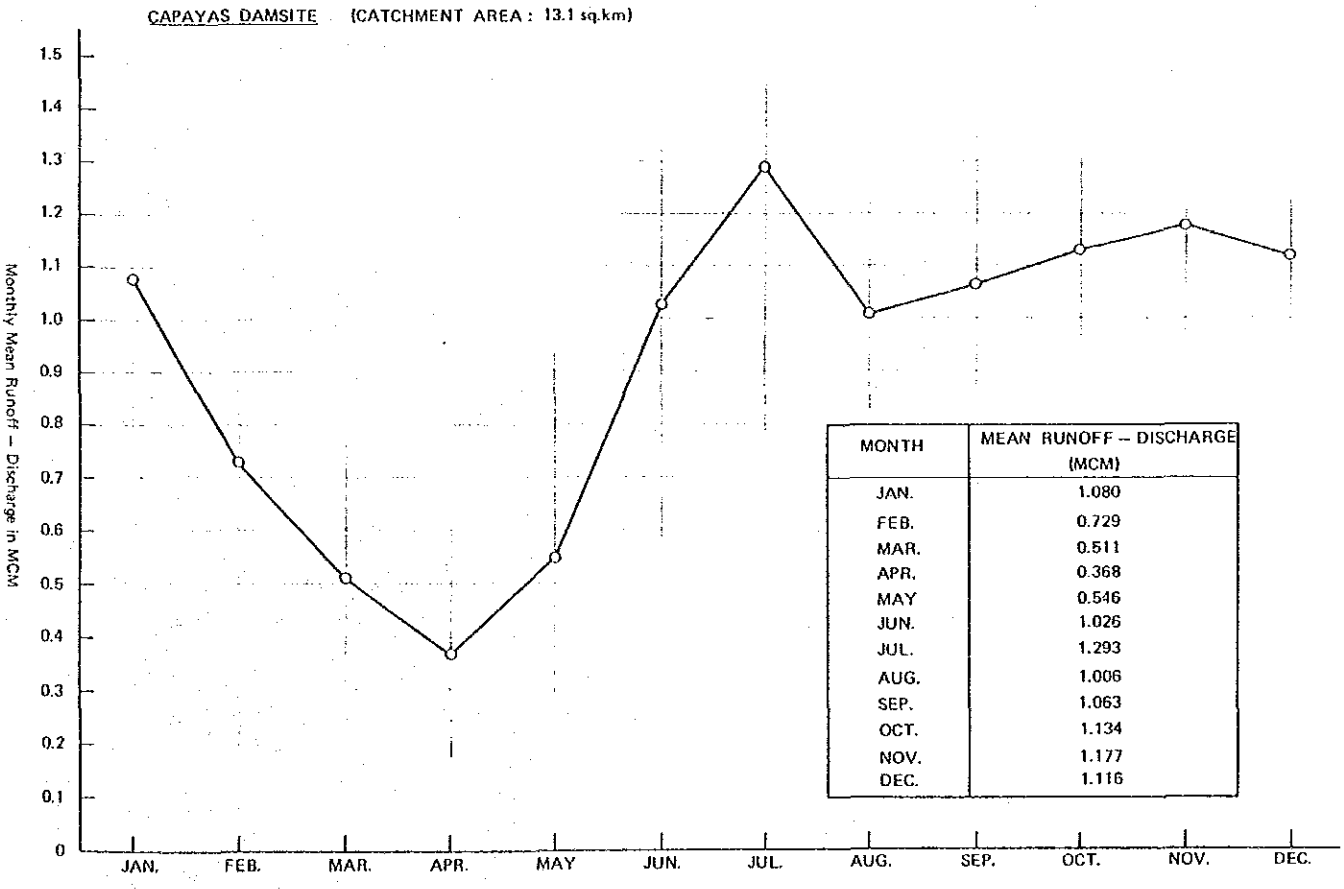
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1978	401.20	197.95	75.37	65.21	63.91	181.51	101.05	53.58	385.91	370.90	110.92	0.0	2,007.51
1979	144.73	52.63	40.90	35.29	52.78	241.41	170.49	63.42	64.88	95.37	73.66	143.36	1,178.93
1980	282.76	209.25	43.02	31.72	23.36	233.29	185.28	334.27	133.41	282.02	298.01	0.0	2,056.38
1981	565.93	211.43	71.50	41.62	23.57	30.87	67.81	23.76	30.68	157.61	135.50	319.26	1,679.53
1982	143.64	259.76	153.40	55.75	33.17	54.83	129.83	248.97	46.81	104.11	68.18	51.67	1,350.12
1983	39.07	11.00	6.08	4.55	5.56	8.21	119.14	215.24	170.79	192.11	94.83	313.01	1,179.62
1984	173.17	158.03	93.07	36.09	28.90	26.04	27.92	19.44	544.52	139.28	271.32	443.59	1,961.37
AVERAGE	250.07	157.15	69.05	38.60	33.04	110.88	114.50	136.95	196.72	191.63	150.35	181.56	1,630.49

FIGURE 3-5 ESTIMATED MONTHLY MEAN RUNOFF DISCHARGE



MONTH	MEAN RUNOFF – DISCHARGE (MCM) 1/
JAN.	1.010
FEB.	0.678
MAR.	0.464
APR.	0.328
MAY	0.502
JUN.	0.959
JUL.	1.221
AUG.	0.941
SEP.	1.003
OCT.	1.068
NOV.	1.115
DEC.	1.054

1/: Average of 1956 to 1984



MONTH	MEAN RUNOFF – DISCHARGE (MCM)
JAN.	1.080
FEB.	0.729
MAR.	0.511
APR.	0.368
MAY	0.546
JUN.	1.026
JUL.	1.293
AUG.	1.006
SEP.	1.063
OCT.	1.134
NOV.	1.177
DEC.	1.116

The catchment area of both reservoirs is composed of an alternation of almost sandstone and siltstone and present the stabilized geological conditions, so that no land sliding occurs, even if the water is stored in the reservoir.

In addition, the catchment area presents the following features;

- The Bayongan catchment area is composed of a little steep slope topography and covered with cultivation area and cogon land.

- The Capayas catchment area is formed with a gentle slope topography and covered with cogon land.

Taking into consideration the topographical, geological and vegetation conditions in the catchment area, and amount of annual rainfall and size of the catchment area, the sediment amount flowing into reservoir is assumed as 1,000 cu.m/sq.km/year for the Bayongan reservoir due to steep slope and as 500 cu.m/sq.km/year for Capayas reservoir due to gentle slope.

d) Water Quality

Water quality of the Bayang river nearby the Capayas damsite is analized as shown below. In accordance with this water quality analysis, the water of the Bayang river will be suitable for domestic water of Ubay without any particular treatment.

Water Quality of Bayang River

Description	Quality
PH (units)	7.9 - 8.0
Alkalinity (mg/L as $CaCo_3$)	68 - 118
Chloride (mg/L)	7.4
Ammonia (mg/L, N)	0.064 - 0.093
Nitrate (mg/L, N)	0.024 - 0.016
Phosphate (mg/L, P)	0.012 - 0.04
Chemical Oxygen Demand (mg/L)	<4
Conductivity (mmhos/cm)	0.0682 - 0.1833
Total Solids (mg/L)	127 - 171
Total Dissolved Solids (mg/L)	111 - 152
Total Suspended Solids (mg/L)	9 - 3

Note: 1. Ammonium nitrogen is detectable but its concentration is too low to be hazardous for health.

2. Chemical oxygen demand more than ten mg/L indicates some organic contamination. This water shows value less than four and has no problem for drinking.

3. Other analytical items present ordinary value for the drinking water, so that the water will be used for drinking purpose without any particular treatment except chlorination.

3.2.4. General Geology and Seismology

a) General Geology

Bohol province consists of igneous rock in the eastern and western portions of the island with vast expanse of sedimentary rock on the center called the Ilihan formation, a very extensive well bedded sequence of sandstone, shale, mudstone and siltstone. Common materials of these units are volcanic accumulation from the weathered country rocks in the surroundings. Intrusive and extrusive igneous rocks represent about 30 percent of rock type in the province particularly in the north-eastern part of the island. Uplifted reef limestone facies of considerable height later fringed the core of mainland Bohol. Sedimentary rocks occupy almost 70 percent of the island. There are ten sedimentary formations and six volcanic units. Ten sedimentary formations are: Metasediments

(ks), Wahig Limestone (N11s), Ilihan Formation (N2), Tubigon Conglomerate (N2Cg), Carmen Formation (N2Ml), Sevilla Formation (N2Cl), Sierra Bullones Limestone (N2Ls), Candijay Clay (N3), Maribojoc Limestone (N3Ls), and Alluvium (R). On the other hand, six volcanics units are: La Victoria Volcanics (N1V), Diorite (N1), Ultrabasics (UC), Malibalibod Volcanics (UV), Metavolcanics (KV), and Basement Complex (BC).

Extensive sequence of sandstone, siltstone and shale forms the project area having many alluvial deposits in river bed. The clastic materials constituting of the sequence are primarily volcanic in nature as originating from igneous flanks of the surroundings of sedimentary rock in the project area and are almost flat lying to sub-horizontally stratified. The project area is totally overlain by Ilihan Formation (N2) formed by an interbed of sedimentary clastics consting of sandstone, shale, silstone and conglomerate.

Sandstone bedding is medium grained and moderately indurated grayish to light gray in color and limited in exposures in the area. Shale beddings are grayish in color, fine-grained relatively friable when dry, very soft when wet and susceptible to weathering when exposed to surface condition. Water enhances the slaking propensity of these materials. Siltstone is gray to grayish in color with relatively same characteristics and property of the shale bedding.

Outcrops are well observed on river banks, however, soil mantle blankets in the whole area covering the underlying formation. Soil type is predominantly clay to silty clay with admixture of uncomplete weathered materials with an average thickness of two to three meters. Soil in the project area is a product of in-situ weathering of the underlying formation prevalently.

The project area is moderately undulating and rolling with high to low relief hills, as it is attributed to softness and susceptible to weathering.

b) Seismology

Since Bohol island is located in a part of the Circum Pacific Earthquake Zone, it is naturally required to consider carefully an effect of earthquake. The earthquake around Bohol island may almost be occured by the tectonic movement along Visayas and Mindanao Blocks, and the epicenters should be located on the above mentioned blocks. The major structure lines are BB and CC lines according to the report of PAGASA.

Line BB- this line has been recognized by allas major fault zone of the Philippines. Beginning from the Lingayen Gulf, it follows the conspicuous fault scarp crossing Central Luzon, Pollilo island, Ragay Gulf, the elongated island of Ticao, Burais, and Masbate, northwestern Leyte. In Leyte, the "Master Fault" seems to have split into three legs. The westernmost leg starts at a western point on Camotes Island and comes down through Mindanao.

Evidences both seismic and geologic for the existence of this zone are very strong. Along this zone some of destructive earthquakes are originated.

Line CC- this line is inferred from the epicenters between Cebu and Negros islands and those of the western coast of Zamboanga (see Annex C, FIGURE C3-1).

3.2.5. Soil and Land Classification

a) Soil

1) Soil Survey

The soil survey for the area of about 12,700 ha covering the project service area was carried out for about one month from

January to February 1985. Observations of 51 test pits with a depth of one meter and an area of one square meter were planned on the detailed reconnaissance basis with a density of one pit per 250 ha.

The test pit locations provided in the surveyed area are shown in FIGURE 3-6.

Soil horizons of profile were sampled and the analysis of gravel content, pH, and EC (electrical conductivity) was carried out together with quick chemical reagent tests.

Water samples taken from various sources of streams and groundwater were also analyzed.

41 soil samples were selected and sent to the Soil and Water Laboratory Services of NIA to carry out the detailed physical and chemical analysis.

2) Soil Characteristics

The soil surveyed area is composed of two distinct physiographic land forms of undulating terrain and alluvial valley. (Land System 13); the dilluvial terrain had been eroded and dissected, occupying most of the area, and the alluvial valley is only developed in narrow areas along several streams flowing down from south to north.

The soils are mainly derived from sedimentary deposits of sale, sandstone, siltstone and mudstone including some deposits of conglomerates. The profiles are characterized as follows;

- Top soil consists of coarse to medium texture having a colour of light gray to dark yellowish brown.

- Subsoil consists of medium to fine texture but includes many gravel layers mostly underlaid by strongly weathered shale layer.

The soils are compacted and present high acidic character such as pH-H_2O (1:2.5) of 5.4 and pH-1N Kcl of 3.8. Available phosphorous is mostly marginal, and exchangeable potassium is almost deficient.

In addition, available soil depth is restricted to 10 to 40 cm due to a high gravel content which occasionally exceeds 60 percent in the sub-horizons.

The groundwater presents very low EC values less than 0.1 milli-mho at 25°C, and stream water also shows a low value of 0.1 to 0.2 milli-mho. This fact indicates the supply of plant nutrients through irrigation is very scarce in the project area.

3) Soil Classification

Ubay Soil Series is dominant and covers 99 percent area in the project service area in accordance with the largest group soils in Bohol island map prepared in 1974.

Ubay Soil Series is classified into two soil types, Ubay Sandy Loam (USL) and Ubay Loam (UL) based on the dominant texture of top soil. The latter series is further divided into two types, UL-1 and UL-2.

UL-1 has a shallow top layer of sandy loam but is underlaid by rather thick loamy or clayey subsoil, which is intermediate type between USL and UL-2. Typical profiles of soils at test pits are illustrated in FIGURE 3-7.

Types of Ubay Series were sub-divided into four Phases (slope classes), A, B, C and D, and its area was measured on the project service area map with scale of 1:4,000 (see TABLE 3-4).

Four types of distribution in total surveyed area are shown in FIGURE 3-8 and their areas are summarized as follows:

	Hydrosol	Ubay Sandy Loam	Ubay Loam Type 1	Ubay Loam Type 2	Total
Area (ha)	150	4,570	2,690	5,290	12,700
Percentage	1.2	36.0	21.2	41.6	100

b) Land Classification

The land classification is made from soil characteristics and land slope taking into consideration land reclamation. The land slope is also evaluated with A, B, C and D Phases.

The land is classified into six class groups for lowland rice under irrigation system as shown in TABLE 3-4.

In the TABLE 3-4, land evaluation criteria in Philippine Council Agricultural Resources Research (PCARR), 1R shows the most suitable land for cultivation, 2R is moderately suitable land, and 3R is marginally suitable land. There is no 1R in the project service area and almost belong to 2R.

The land belonging to A and B Phases is generally classified as Land Class Group of I and II, respectively. Some lands belonging to A and B from the viewpoint of land slope however, are evaluated less than Class Group I and II, in case such lands are located at some narrow area and ridges of hilly area surrounded by C and D Phases lands, because such lands will consist of top soil with a shallow depth less than 20 cm, and/or soil with a high content of gravels and high acidity.

Out of total project area of 12,700 ha, Class Group I and II lands are 7,056 ha and 2,715 ha, respectively. These lands of about

9,800 ha, of course, includes the existing cultivation land of about 6,000 ha such as paddy, upland crop and coconut fields. About 3,800 ha excluding the existing crop fields is presently covered with natural grasses but has a possibility to be converted to paddy or upland crop fields.

From the viewpoint of land reclamation to paddy field, only Class Group I land is recommendable to convert it to the paddy field from upland field and grass land, because the land leveling cost for Class Group II is high due to steep slope for the paddy field preparation.

Class II land will be available only for upland crop field with contour farming, because plot-levelling work for rice cultivation is not needed.

Similarly, about 2,900 ha belonging to Class Group III to VI will not be available for cultivation lands but only for grass land.

Such land use plans mentioned above are summarized in TABLE 3-4.

The lands in the project area have several problems to be solved in future, even in the Class Group I land. The lands, especially those to be reclaimed, will be carefully improved for cultivation taking into account erosion control to keep top soil, gravel disposal, liming to improve acid soil, supply of green manure, etc.

3.3. Present Agriculture

3.3.1. Land Use

a) Present Land Use

The present land use has been studied based on the field reconnaissance level, using a map at the scale of 1:4,000 prepared by JICA and analyzing the result of farm survey.

TABLE 3-4 AREAS OF LAND CLASSES IN THE PROJECT AREA WITH SOIL TYPE AND PHASES

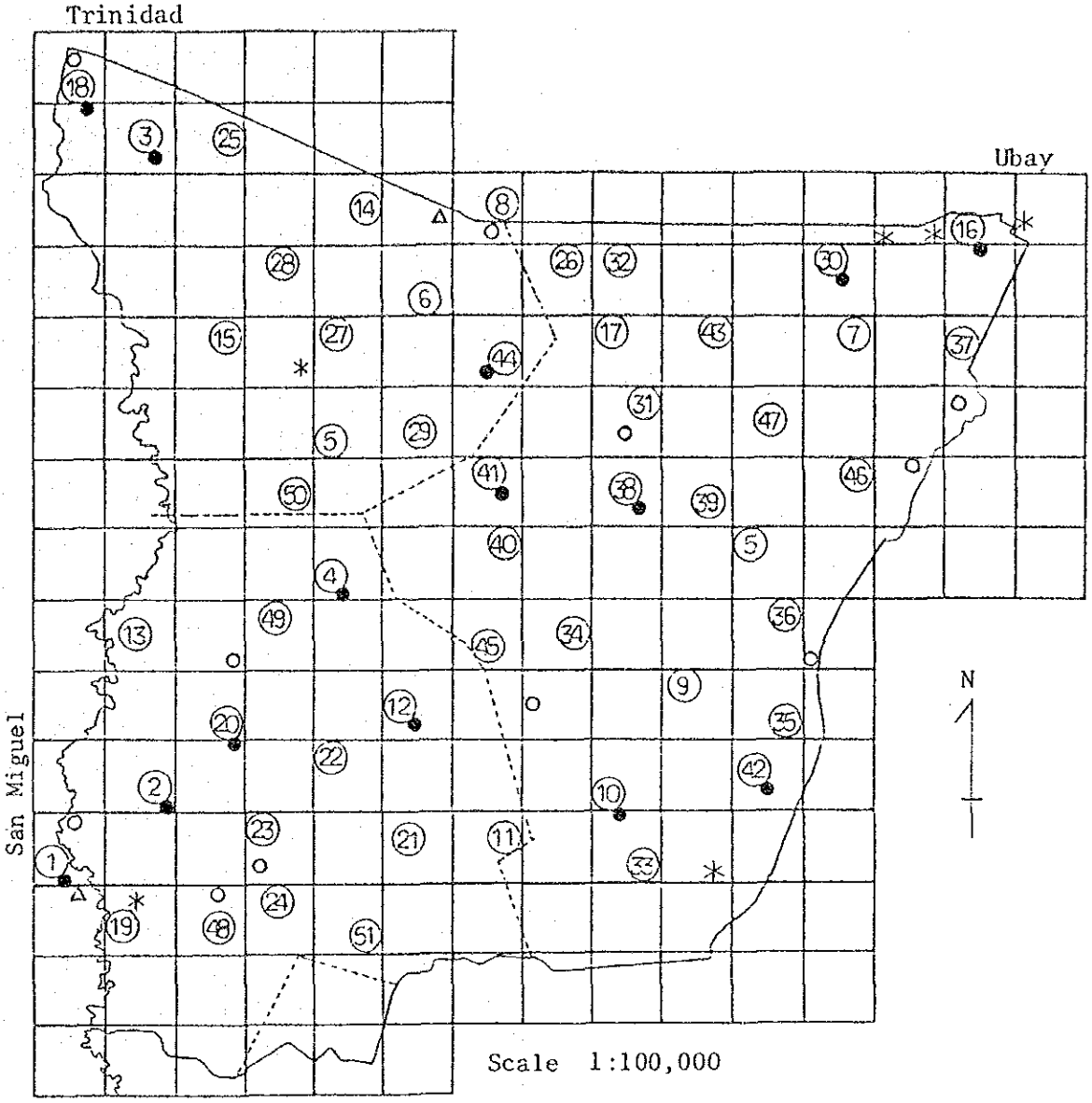
(Unit: ha)

Land Class Group	Hydrosol Ubay Sandy Loam						Ubay Loam Type 1					Ubay Loam Type 2					Grand Total	%
	A	A	B	C	D	Sub-Total	A	B	C	D	Sub-Total	A	B	C	D	Sub-Total		
I	-	2,611	-	-	-	2,611	1,444	-	-	-	1,444	3,001	-	-	-	3,001	7,056	55.5
II	-	37	1,008	-	-	1,045	82	481	-	-	563	105	1,002	-	-	1,107	2,715	21.4
III	-	21	84	-	-	105	11	116	-	-	127	42	142	-	-	184	416	3.3
IV	-	-	-	452	-	452	-	-	234	-	234	-	-	308	-	308	994	7.8
V	-	-	-	-	357	357	-	-	-	322	322	-	-	-	690	690	1,369	10.8
VI	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	1.2
Total	150	2,669	1,092	452	357	4,570	1,537	597	234	322	2,690	3,148	1,144	308	690	5,290	12,700	100
%	1.2	21.0	8.6	3.6	2.8	36.0	12.2	4.7	1.8	2.5	21.2	24.8	9.0	2.4	5.4	41.6	100	

Note; Soil Phase (Slope Grade): A (0 - 3%); B (3 - 5%); C (5 - 8%); D (> 8%)

Land Class Group	Land Class	Soil Type - Phase
I	2Rs/21 AY.y - /21 BY.y	UL-A, USL-A
II	2Rs/22 AY.y or BY.y - 2Rst/22 AY or By.gy	UL-A,B, USL-A,B
III	3Rs/31 AY.y or BY.y - 3Rst/32 AY.gy or BY.gy	UL-A,B, USL-A,B
IV	3Rst/33 AY.gjy - /33BX.gjy	UL-C, USL-C
V	4Rst/33 AY.gjky - /33BX.gjky	UL-D, USL-D
VI	6st	Hydrosol

* Refer to the Philippines Recommends for Irrigation Water Management 1978, Vol. 1 Lowland Rice Conditions, page 98-102.

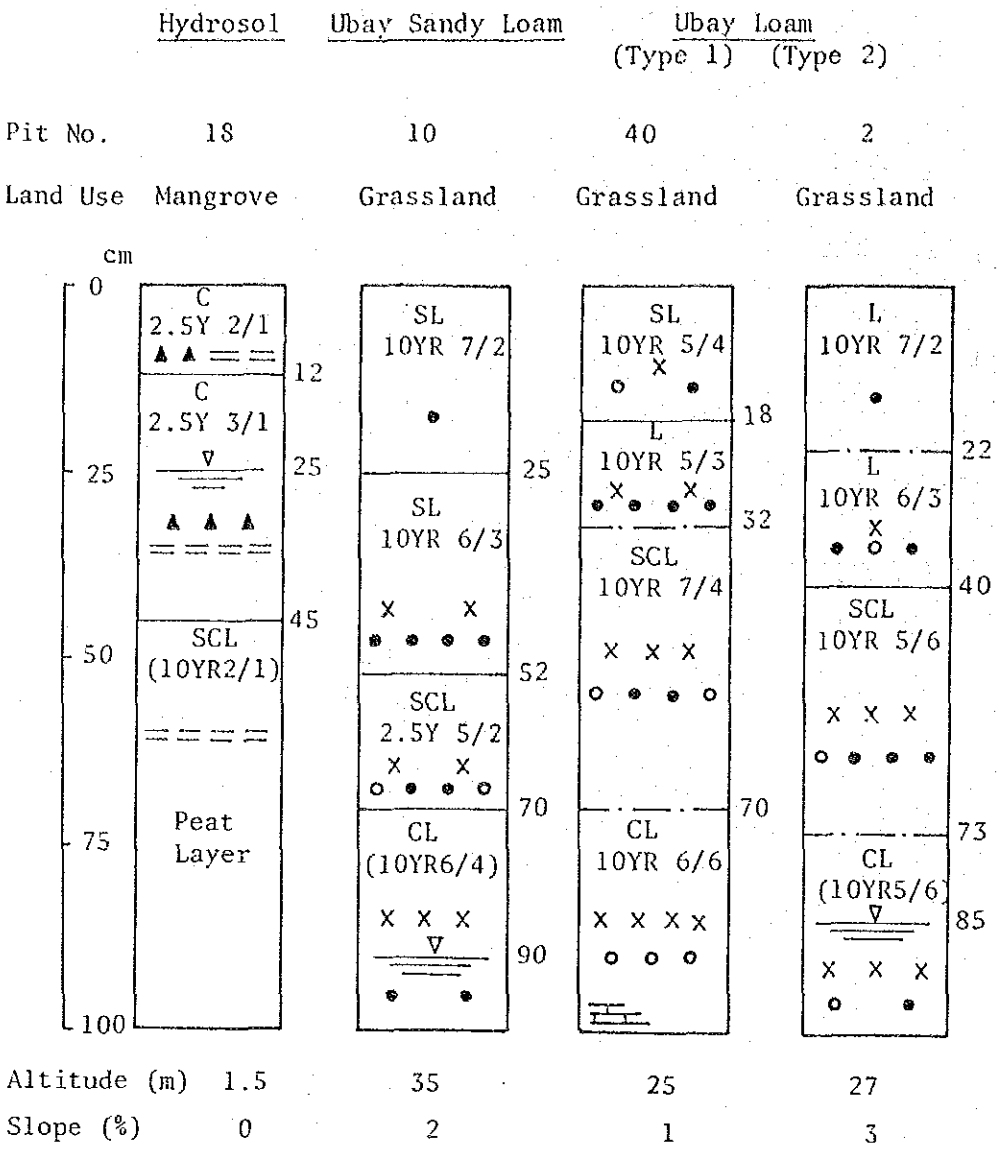


LEGEND: Map Symbols

(5) Soil Pit Number

● Groundwater
○ River Water
△ Pond or Marsh Water
✳ Well Water

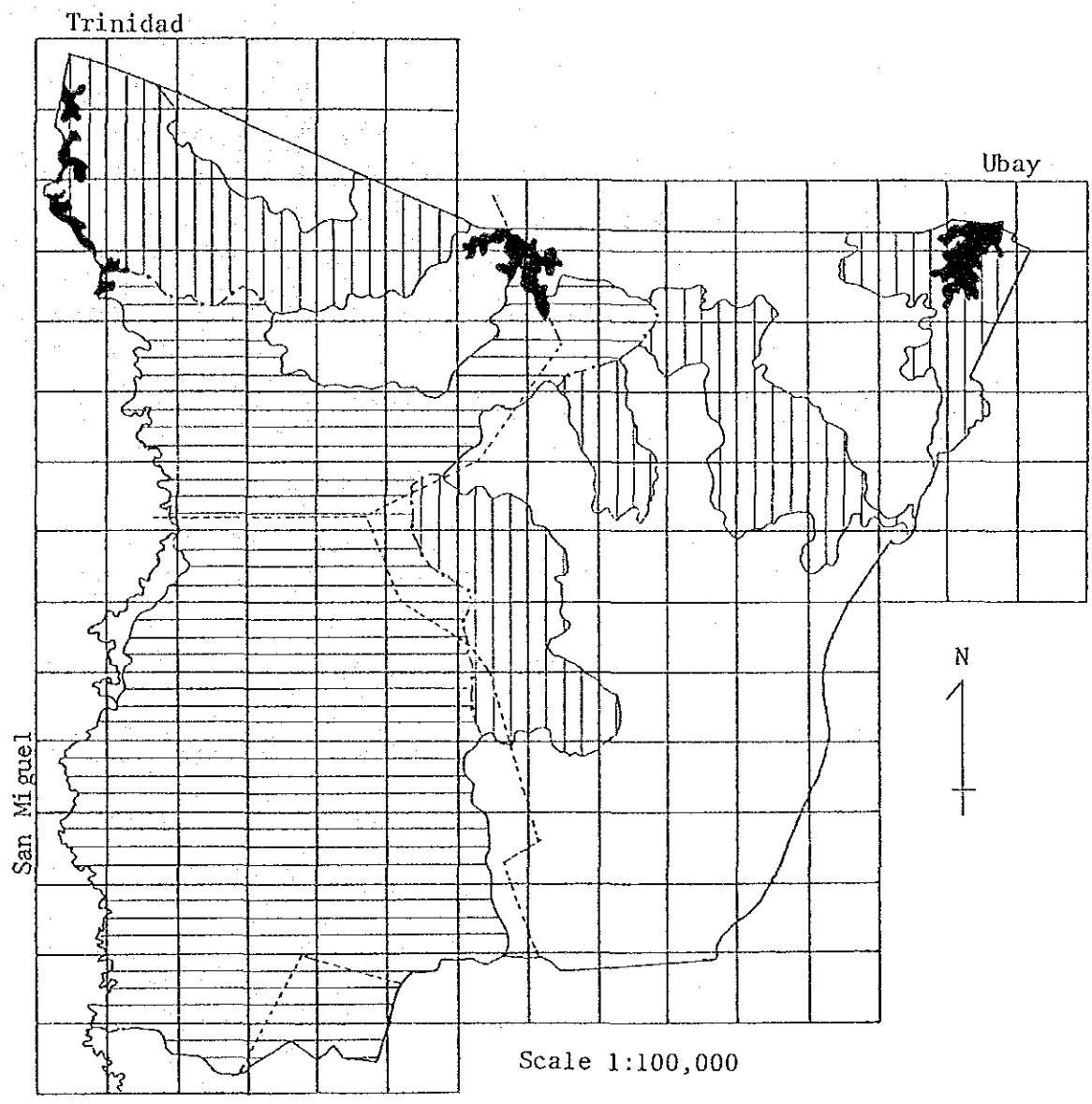
FIGURE 3-6 SITES OF SOIL PIT EXAMINATION AND WATER SAMPLING IN THE PROJECT AREA



Legend:

Color mottlings:		Gravels:	
X	Few (<2%)	o	Very few (<5%)
X X	Common (2-20%)	o o	Few (5-15%)
X X X	Many (20-40%)	o o o	Frequent (15-40%)
X X X X	Abundant (>40%)	o o o o	Very frequent (>40%)
▲	Peat	o	Soft particles
= = = =	Gley Layer	●	Hard particles
	Weathered Shale Layer	▽	Groundwater Level

FIGURE 3-7 COLUMNAR DIAGRAM OF TYPICAL SOIL PROFILES OBSERVED IN THE PROJECT AREA



LEGEND: Map Symbol	Order	Suborder	Sub-Group	Series - Type
■	ENTISOLS	Aquents	Typic Hydraquent	Hydrosol
□	ULTISOLS	Udults	Typic Tropudults	Ubay Sandy Loam
▥				Ubay Loam Type 1
▤				Ubay Loam Type 2

FIGURE 3-8 GENERAL SOIL MAP OF THE PROJECT AREA

The paddy land lies generally on the hilly foot area with a slender shape along streams and rivers. Farmers have cultivated the paddy field levelling a land on hilly foot with some slope and providing a high ridge to keep rain water.

Farmers, however, have always cultivated land suffering from a shortage of irrigation water, because the project service area has no guaranteed water resources except for unstable rainfall and a few stream flows that appear only in wet season.

Upland crops such as cassava, sweet potato and coconut are also found in the project service area, but their yields are considerably low due to shallow available soil depth, strong acidity, water shortage and deficiency of plant nutrients.

The present land use based on each crop in the surveyed area of 12,700 ha is summarized as follows;

	Area (ha)	Percentage (%)
Paddy Field	2,180	17.2
Upland Crops	2,330	18.3
Coconut	1,560	12.3
Grass Land	6,280	49.4
Forest	210	1.7
Mangrove & Nipa	130	1.0
Waste Land	10	0.1
Total	12,700	100

Diagraphic land use category in the project area is illustrated as shown in FIGURE 3-9.

b) Land Ownership

The number of full-owner occupies comparatively larger portion of total farmers in three municipalities concerned with the project.

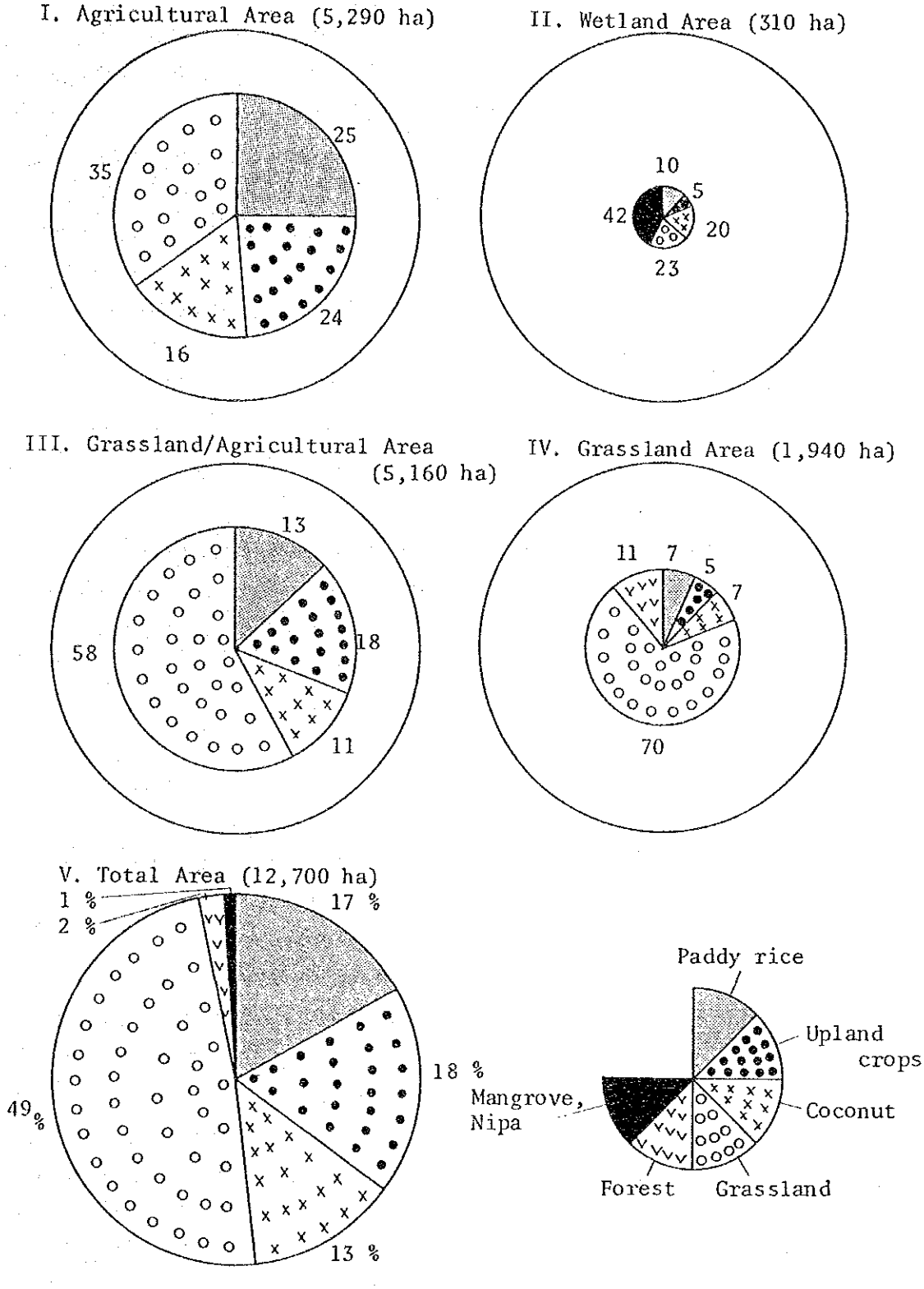


FIGURE 3-9 **DIAGRAPHIC LAND USE CATEGORIES AND THEIR PERCENTAGES IN THE PROJECT AREA**

NIA has made sampling survey on the land ownership for 4,275 ha managed by 1,613 farmers living in three municipalities. Average size is estimated at 2.65 ha per farm household.

The composition of farmers by type of land ownership is classified as follows;

-	Full-Owner	:	68.9%
-	Share Tenant	:	16.4
-	Lease Holder	:	3.4
-	Part Owner Share Tenant	:	6.5
-	Part Owner Holder	:	1.1
-	Others	:	3.7
			100% (1,613 farmers)

With regard to the area coverage by type of land ownership, full-owner over 7.6 ha amounts to only 2.1 percent of total number of full-owner and occupies about 11.2 percent of total area of full-owner. It is considered that the concentration of land holding had been undeveloped on an individual farm base.

Average size of farm is different by type of land ownership. Full-owner and share tenant are 2.61 ha and 2.32 ha respectively. Lease holder, part ownershare tenant and part owner-lease holder are larger than other two types, that is, 3.23 ha, 3.68 ha and 3.25 ha respectively. It is considered that farmers can select the way to enlarge their arable land through tenantship. But the high share rate as 30 to 50 percent shall be still constraint to farmers.

Aside from the above said land ownership of individual farms, there are three estate farms in the project area, which are Biduya, Bulilis and Alvares. Their land areas are estimated at 1,070, 740 and 96 ha respectively.

The Biduya estate was foreclosed by the Development Bank of the Philippines (DBP) on January 31, 1985. By provision of law, one year period was given by January 31, 1986 for the redemption of the

property. If this estate fails to redeem the property within the redemption period, the property will be set for public bidding. However, some properties cultivated by tenants will be transferred to the Ministry of Agrarian Reform (MAR), so that these properties can be given to the respective tenants. The rice and corn land under tenancy in the Beduya estate are going to be identified by MAR. If nobody is interested in buying at the public bidding, DBP will take necessary measures to distribute the land excluding under tenancy to landless farmers by extending credit to them.

The Bulilis estate has released about 300 ha as the Certificate of Land Transfer (CLT) with 148 farmers under Land Reform Program.

The Alvarez estate owned about 220 ha formerly and has released about 123 ha as CLT with 69 farmers.

3.3.2. Water Use

a) Water for Agricultural Use

In the project area of 12,700 ha, there are paddy fields of about 2,180 ha, which are located in the lower depression area between hilly lands. All of these existing paddy fields have no irrigation systems and are relying upon rainfall. In addition to these rainfed paddy fields, about 2,330 ha of upland fields are existing with such crops as corn, sweet potato and cassava under the rainfed conditions.

One of the water resources for the existing crops is groundwater and stored water in the small scale ponds, which have been constructed by farmers themselves for irrigation and domestic uses.

Under the present conditions, waters in the field are kept as long as possible with relatively high levee, and surplus water flows down to the lower fields from plot to plot in case water being available enough. On the other hand, in case of dry month even in the wet season, such rainfed paddy and upland fields are damaged by drought, so that irrigation water supply for the crops is essential at present in the area.

b) Water for Domestic Use

The inhabitants living around the project area are getting their drinking water from shallow wells provided by themselves. However, during the dry season, its quantity is not adequate to meet the demand due to the lowering of groundwater table. Furthermore, sometimes they suffer from its quality.

Ubay Poblacion, which is located on lower reaches of the project area with the population of about 2,300 is the largest poblacion around the project area, but it has been suffered from absolute shortage of drinking water and its quality throughout the year.

Under the prevailing conditions, proper countermeasures for domestic water supply especially for Ubay Poblacion, should be taken in the project.

3.3.3. Population, Agricultural Households and Farm Labor Force

a) Agricultural Households and Population

The project area is located in three municipalities of San Miguel, Trinidad and Ubay in Bohol province. These municipalities are composed of 82 barangays in total. All barangays in the three municipalities are not covered by the project. Besides 82 barangays, 22 barangays are located within the project area,

including such barangays being partially included in the project area. The total area of the three municipalities amounts to about 39,300 ha or 9.6 percent of the total area of Bohol province. Gross project area is 12,700 ha or 32.3 percent of the three municipalities (see Annex G, TABLE 2-1).

Of the project municipalities, the population of San Miguel is 12,200 (the population density is 133/sq.km), of Trinidad 15,100 (160/sq.km) and of Ubay 38,300 (185/sq.km) respectively. Average of the annual population increase rate is 2.0 percent with the range from 1.6 percent to 2.9 percent in the project municipalities (see Annex, TABLE G2-2).

Total population of the 22 barangays in the project area is 10,870 or 16.7 percent of that of the three municipalities with 2,117 households, which is estimated on the basis of area coverage in the project area for the partially involved barangays. Out of 2,117 households, farm households are 1,826 corresponding to 86.3 percent in total. The remained household consists of non-farm and land less farm.

b) Farm Labor Force

The potential farm labor force for the project area in 1984 is estimated as follows;

Projected Farm Labor Force (1984)

Item	1980	1984 2/
1. No. of farm households and landless farm laborer households	2,011 1/	2,172
2. Farm labor force 3/		
- Male	2,661	2,874
- Female	1,998	2,158
Total	4,659	5,032

Note: 1/ See Annex G, TABLE G2-6.
2/ Projected on the basis of annual population increase at 2.0 percent.
3/ Converted to man power

The labor force per household is estimated at 2.3 in 1984 (For further details, see Annex G).

c) Farm Labor Balance

Based on the above said available farm labor force, the labor force per month in the project area is estimated at about 125,000 man-day (5,032 man x 30 days x 25 days/30 days).

The total number of working carabao in the project area is estimated at about 1,450 heads. Thus the available draft animal power per month is counted at 44,000 heads.

The total farm labor force requirement is calculated on the basis of existing cropping pattern and number of raised livestock and poultry. The peak labor force requirement occurs at transplanting time of wet season rice in June with a rate of 53 percent of the total available labor force. The peak draft animal power requirement occurs in June with a rate of 56 percent of total available draft animal power.

d) Farm Size

In the proposed service area, the average farm size is estimated as follows;

Rice Field	0.9 ha
Upland Field	1.0 ha
Coconut	0.6 ha
Total	2.5 ha

Note: Above figures are estimated from the total number of farm exclusive of land less farm laborer households in 1984 (1972 farms = 1,826 farms x 1.08).

3.3.4. Agricultural Production

a) Crops and Cropping Pattern

The major crops planted in the project area are rice, cassava and sweet potato, according to the NIA agro-economic survey conducted in 1985.

The rice cultivation is prevailing in the wet season and also in the dry season under the rainfed condition, expecting residual soil moisture and uncertain rainfall. The rice harvesting areas have been changed considerably year by year in accordance with the rainfall conditions of the year. However, based on the rice production data for past 11 years in Bohol province, the average planted and harvested area ratio to the total of physical rice field is as follows;

Average Area of Rice Planted and Harvested by Season

(Unit: %)

Season	Physical Rice Field	Planted Area	Harvested Area
Wet	100	90	76
Dry	100	75	64
Total	200	165	140

Source: Rice production data for past 11 years prepared by BAEcon, Bohol.

The above figures present that the farmers are not able to cultivate fully his land due to a shortage of irrigation water.

Naturally, the rice cropping calendar varies in the range of two to three months according to the rainfall patterns, while land preparation followed by transplanting of wet season rice starts at the onset of rainy season, usually in May to June, and the rice is harvested about three months after transplanting. The dry season rice is transplanted immediately after harvesting of the wet season rice so far as enough water is available.

Sweet potato and cassava can be planted at any time, but the prevailing cropping season of sweet potato is from late rainy season to March or April, and the cassava is planted mainly in May and June in parallel with the harvesting of rice in the late dry season. The present cropping pattern is shown in FIGURE 3-10.

The present cultivation lands in the project service area of 7,100 ha are estimated as follows in accordance with the land use survey.

Rice Field	:	1,780 ha (25.1%)
Upland Field	:	1,900 ha (26.5%)
Grass Land	:	3,420 ha (48.1%)
Total		7,100 ha (100 %)

The cropping intensity of paddy field is estimated at 165 percent. And also it is estimated that 430 ha (23.0 percent of the total upland field) is cultivated with sweet potato, and 570 ha (30.0 percent) with cassava. The remaining 900 ha are left temporarily as fallow land (see TABLE 3-5).

The farmers in the project service area prefer to plant rice so far as the land are topographically suitable for raised rice growing, because rice is suitable crop for marketing and is easily grown than upland crop due to prevalent poor soil conditions like acidic soils, low content of available nutrients, thin top soils, etc.

b) Cultivation Method

Both rice and upland fields are extensively cultivated, following traditional method with negligibly small amounts of farm inputs.

TABLE 3-5 PRESENT CROPPING PATTERN AND CROP PRODUCTION

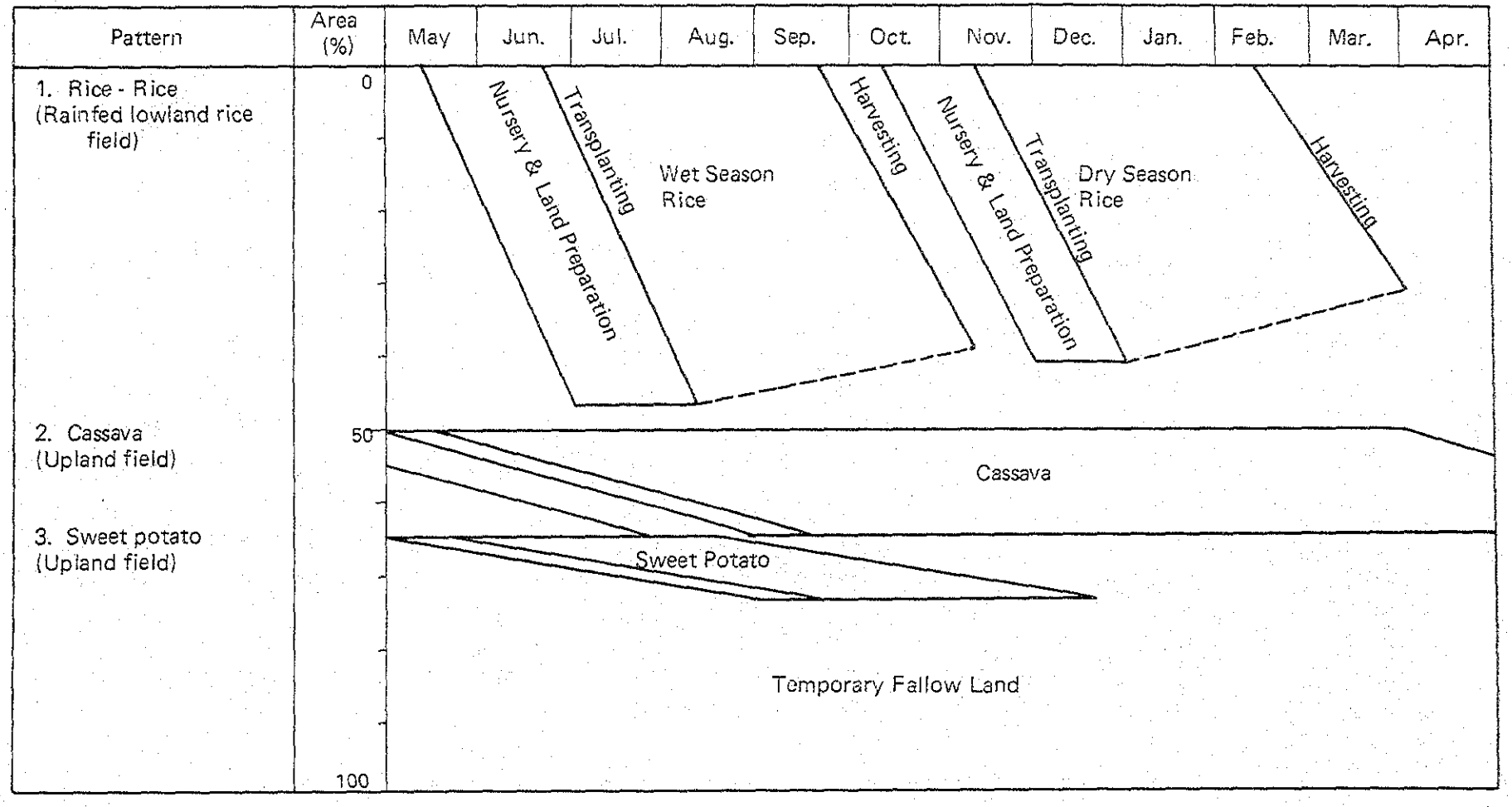
Land/Crop	Physical (ha)	Cropping Intensity (%)	Planted Area (ha)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
1. Paddy Field	1,780	165	2,930	2,490	1.32 1/	3,286
- Wet Season Rice	-	90	1,600	1,350	1.37 1/	1,850
- Dry Season Rice	-	75	1,330	1,140	1.26 1/	1,436
2. Upland Field	1,900	53	1,000	1,000		3,554
- Sweet Potato	-	23	430	430	2.02 2/	869
- Cassava	-	30	570	570	4.71 3/	2,685
Total	3,680	107	3,930	3,490		6,540

Note: The planted area and the harvested area are estimated on the basis of the following figures (Physical area = 100%)

Crop	Planted Area	Harvested Area	Referred Data
Wet Season Rice	90%	76%	BAEcon crop production data in Bohol (1974-84)
Dry Season Rice	75%	64%	- do -
Sweet Potato	23%	23%	NIA Farm Management Survey, 1985
Cassava	30%	30%	- do -

Source: 1/ BAEcon crop production data (Bohol, 1974-84). The yield data in the NIA Farm Management Survey was not used directly because the data include the yield in the irregular years.
2/ BAEcon crop production data (Central Visayas, 1974-83)
3/ NIA Farm Management Survey, 1985.

FIGURE 3-10 PRESENT CROPPING PATTERN IN THE AREA



The paddy field is prepared within a short period, about one to three days by farmers cooperation collecting labor forces and animal power, because the farmers can prepare the land only when the rainfall sufficient for the field satulation is available. The fields are prepared with one to two times plowing and two to three times puddling by using carabaos. The nursery of flat wetbed is applied to raise seedlings. With unpredictable rainfall, the seedlings are made extensively with low quality seeds, usually for a long time more than 25 days, due to poor tillering capability of the seedlings. The farm management to supply fertilizer and weed the grass is not made sufficiently and carefully. The harvesting works are generally made with man power with a long periods.

Sweet potato and cassava are cultivated on the hilly land without deep cultivation and only preparing the furrows. The farm management is very primitive without any fertilizer and weeding operation.

Mechanized farming can not be found in the project area except only a few area.

c) Crop Production

The crop production in the project area is estimated as shown in TABLE 3-5. The average yield of rice on the basis of harvested area is estimated at 1.37 ton/ha in wet season and 1.26 ton/ha in dry season. The total rice production in the project service area is about 3,290 tons. The total production of cassava and sweet potato is respectively estimated at about 2,680 tons with a yield of 4.72 ton/ha and 870 tons with a yield of 2.02 ton/ha, respectively.

The yield of rice in the project area is as low as about 65 percent of the national average. The yield of sweet potato and cassava are also as low as 50 percent of the national average level.

Following damages took place for crop production recently.

i) Severe drought occurred in last 1983 brought in the considerable low products of rice, cassava and other crops;

ii) Two typhoons hit the island in the following year, 1984 and damaged almost all agricultural crops inclusive of fruit crops, and

iii) In succession to the typhoon damages, rats and lizards attacked rice and other crops, thus the production of crops dropped down considerably.

Significant correlation between rainfall and rice production in Bohol province is identified. The rice production varies to a great extent year by year, depending upon rainfall amount (see Annex G).

Under the humid climatic condition of almost even distribution of rainfall except for a few dry months, upland crops are easily suffered from crop diseases, which is one of the problems of upland crop cultivation in Bohol province. As for rice disease, Agricultural Promotion Center (APC) has observed that even such resistant varieties to the tungro virus like IR-42 and IR-36 are very or moderately infested in the areas nearby the project area. Recently more than five tons of paddy per hectare are attained with new varieties like IR-58, 60, 62 at Ubay Experimental Farm of APC.

d) Demand and Supply Balance of Crops

Rice

Rice is planted with the biggest area coverage in both Bohol province and the project area, while rice planted area covers 61 percent of total planted area in the project municipalities. The share of rice harvested area in Bohol province is about 70 percent of the total harvested area in the Central Visayas and its rice production in Bohol province is about 63 percent of the total production in the Central

Visayas. Hence, Bohol province shows an important role as a major area of rice production in the Central Visayas. The Central Visayas is the most deficit area of demand and supply balance of rice.

The rice deficits in the regional and provincial levels are estimated at 118,000 tons and 30,000 tons per annum on the average respectively on the assumption of 130 kg consumption rate per capita. The severe damages to rice in the two successive calamity years of 1983 and 1984 have brought a great shortage of rice supply to Bohol and other provinces in the Central Visayas (see Annex K).

The supply-demand balance for rice is presently always negative in the Central Visayas and also in Bohol province. This negative balance for rice would be continuously increased in the future, if the development project to increase the rice productivity is not introduced urgently in the Bohol island.

Supply and Demand Balance for Rice Without the Project

(Bohol Province)

	1982	2000
1. Supply of Palay	104,455 tons	114,800 tons
2. Demand:		
Population	824,068 persons	966,400 persons
Rice eating Bohol area	593,300 "	695,800 "
103 kg rice per capita	107,380 tons	124,920 tons
120 kg "	124,150 "	144,580 "
130 kg "	134,000 "	156,140 "
3. Balance		
103 kg	-2,925 "	-10,120 "
120 kg	-19,695 "	-29,780 "
130 kg	-29,545 "	-41,340 "

Note: 1. 103 kg per capita is actual figure estimated.
2. Demand figures are converted to palay using 65%.
3. Rate of rice eating in Bohol people is 72%.
4. Annual growth rate of palay production is assumed at 0.5%.
5. Annual growth rate of population is assumed at one percent in 1980 to 1990 and 0.7% in 1970 to 2000.

Corn

Supply and demand balance for corn in Bohol province is also deficit as shown in the following table, taking into account the consumptive amount of 92 kg per capita on the actual basis. An introduction of corn plantation under the project would be necessary to reduce deficit balance and trading corn inward Bohol province.

Supply and Demand Balance for Corn without the Project
(Bohol Province)

Year	Production (tons)	Corn Eating Population (persons)	Consumption (tons)	Surplus/ Deficit (tons)
At Present				
Bohol Province	18,549 (1974 to '84)	230,739 (1982)	21,228 (92 kg/ capita)	-2,679
Three Municipalities	232 (1982)	18,483 (1980)	1,700 (92 kg/ capita)	-1,468
2000 Years				
Bohol Province	20,100 (rate 0.5%)	277,700 (rate 1%)	25,548 (92 kg/ capita)	-5,448
Three Municipalities	255 (rate 0.5%)	24,221 (rate 1%)	2,228 (92 kg/ capita)	-1,973

Mungbean

Supply and demand balance for mungbean in Bohol province is negative taking into account the consumption of 1.4 kg per capita on the national basis. This is due to low production in Bohol province. Balance without the project would grow worse as shown in the following table. An introduction of mungbean cultivation under the project would be necessary to reduce the deficit.

Supply and Demand Balance for Mungbean without the Project
(Bohol Province)

Year	Production (tons)	Population (persons)	Consumption (tons)	Surplus/ Deficit (tons)
At Present	406 (903 ha, 1981)	806,103 (1980)	1,129 (1.4 kg/capita)	-723
2000 Years	446 (rate 0.5%)	991,930 (rate 1%)	1,389 (1.4 kg/capita)	-943

Peanuts

Peanuts production in Bohol province are marketable in Cebu. According to the results of marketing survey conducted by MOA, 1980, nine peanuts dealers belonging to Cebu Central Market purchased peanuts of about 460 tons per year. Bohol peanuts occupied a share of about 40 percent of 460 tons.

The study on supply and demand balance also shows surplus in Bohol province as shown in the following table. The balance without the project would be expected to reduce the present surplus because of smaller growth rate of production than that of population.

In order to expand the more share of Bohol peanuts in Cebu market, peanuts have to be introduced in the cropping pattern in the project.

Supply and Demand Balance for Peanuts without the Project
(Bohol Province)

Year	Production (tons)	Population (persons)	Consumption (tons)	Surplus/ Deficit (tons)
At Present	669 (1,337 ha, 1981)	806,103 (1980)	403 (0.5 kg/capita)	+ 266
2000 Years	735 (rate 0.5%)	991,930 (rate 1%)	595 (0.6 kg/capita)	+ 140

Vegetable

Production of vegetable in Bohol province was 550 tons in 1981. This production corresponds to about 0.68 kg per capita (550,000 kg/806,000 persons), and is not sufficient to cover the inhabitants in Bohol province. Many vegetables in Bohol province are presently imported from the other provinces in the Philippines.

National plan on vegetable consumption per capita is reported at 7.04 kg. When this rate is used, balance of vegetable is estimated by large negative figure such as about 5,000 tons. Though the quantity transported inward Bohol is difficult to find, it is a clear fact that plenty of volume is transported from Cebu to Bohol as described in the Paragraph 3.3.8 Marketing. Hence, an introduction of vegetable in cropping pattern with the project would be necessary to reduce the trading inward and to increase vegetable consumption per capita for an improvement of nourishment.

Supply and Demand for Vegetable Without the Project
(Bohol Province)

Year	Production (tons)	Population (persons)	Consumption (tons)	Surplus/ Deficit (tons)	Produc./ per Capita (kg)
At Present	550 (1981)	806,103 (1980)	5,675 (7.04 kg/capita)	-5,125	0.68
2000 Years	605	991,930	6,983 (7.04 kg/capita)	-6,378	0.61

3.3.5. Animal Husbandry

Many farmers in the project service area have engaged in the animal husbandry as shown in the following table.

Number of Farms to raise Livestock and Poultry

Animal	Raising Farm (%)	No. of Head/ Farm (head/farm)
Carabao	67.1	2.0
Cattle	30.7	1.9
Hog	59.1	3.7
Goat	6.8	4.7
Chicken	84.1	24.9
Duck	4.5	9.5

Source: NIA Agro-Economic Survey, 1985
Number of sample farm : 88

Caraboa is used presently for cultivation purpose in Bohol province. Two heads of carabao will be sufficient to cultivate about 1.5 to 2.5 ha of paddy field. Cattle is the important livestock to obtain cash income, exported to the other provinces. Other livestocks are consumed in the self-consumption of Bohol province. However, animal husbandry is not active at present, because feeding food for livestocks is not sufficient except natural grasses (for the detail, see Annex G).

3.3.6. Fishery

Bohol province is one of the provinces with the fishery development potentials in Region VII. The province is surrounded by rich fishing grounds and endowed with inland bodies of water with vast mangroves and swamps suitable for fishpond and sea farming. There are three major fields of the fishing industry, namely, deep sea fishing, municipal fishing and inland fishing.

Fishery resources in Bohol province are classified by fishpond and marines resources. Fishpond resources have both of brackishwater and freshwater. Marine resources are managed by municipal and commercial fishings. Brackishwater resources in 1983 were composed of about 3,000 ha of developed fishponds and about 2,640 ha of undeveloped fishponds. Total number of fishpond operators amounts to 494.

In the two municipalities, Trinidad and Ubay, brackishwater fishculture has become popular, whereby bangus, sgpo, etc. are raised in about 860 ha of fishponds. Further expansion of the fishponds is planned in the long term development in the two municipalities. For instance, the Trinidad Comprehensive Development Plan formulates a target that the fishpond areas would be expanded from 274 ha in 1979 to 1,400 ha in 1990 (see Annex G).

Since these potential areas are located just downstream of the project area, adequate countermeasures to avoid any negative side effect of the irrigation project against fishculture will have to be taken.

Fresh water resources in Bohol province is reported that the total area of fishpond is 946 ha, of which developed and undeveloped areas are 731 ha and 215 ha respectively in 1973. Communal water resources for fishculture are extending over 42 rivers, ten springs, two dams, three irrigations, three lakes, 36 creeks and six impoundings.

According to the information obtained from the Tagbilaran District Office of the Bureau of Fisheries covering 25 municipalities, the development target of fish production in 1984 was 2,048 tons in total, of which municipal fisheries, commercial fisheries, aquaculture were 734, 178 and 1,136 tons respectively. A great part of aquaculture was 1,103 tons of brackishwater.

3.3.7. Agricultural Supporting Services

a) Agricultural Research Works

There are three agricultural research institutions in and around the project area, namely the BPI Bohol Experiment Farm, the BS Soil Water Research and Demonstration Project Farm and the BAI Ubay Stock Farm and Agricultural Promotion Center (APC).

The Bohol Experiment Station is located in the project area, established in 1974. This station aims to conduct specific research works for promotion of agricultural development in the Bohol province, especially in the north-eastern area of Bohol province where the project area is located. The past research activities are almost limited to the rainfed agriculture. However, the station is currently strengthened to initiate the research activities for the irrigated agriculture in the newly developed experimental farm by APC. The total area of the station and the number of researchers are 100 ha and ten persons respectively (For the further detail, see Annex G, TABLE G-24).

The Soil-Water Research and Demonstration Project Farm was established for the research activities and demonstration on the soil-water development and management. A reservoir by earth dam was constructed with the storage capacity of 0.22 MCM to irrigate 100 ha under the project. The reservoir, however, has a function presently to irrigate 20 ha due to the collapse of the dam intake gate.

The main works of Ubay Stock Farms are breeding of pure stock of cattle and carabao, extension activities on the livestock production and breeding, selection and propagation of newly introduced forage.

APC was established in 1985 to promote agricultural development through the generation and diffusion of the technology suited to Bohol condition. APC is located in the Tagbilaran having experiment fields in the three locations namely Dao, Bilar and Ubay. The research activities in the Ubay Experiment Field were just initiated in 1985.

b) Agricultural Extension Services

Extension services to the farmers in the project area are very limited due to lack of extension staff. Presently, one extension staff member consisting of the head of agricultural extension office and a plant protection officer covers about eight barangays or 900 farm households. The area coverage of farm per extension staff

member is about 1,800 ha (area planted with temporary and a permanent crops). This staffing is far from the standard which is 1,000 ha or 500 farm households per extension staff member at largest (see Annex G, TABLE G2-25).

In the Region VII Five-Year Development Plan (1983-1987), it is planned that at least one extension technician and one livestock inspector will be distributed in every three barangays throughout the region.

c) Farmer's Organization

The farmer's organizations in the Philippines are generalized as marketing cooperative, Samahang Nayon, compact farm and irrigation association, etc.

In the project municipalities, Samahang Nayon, farm marketing cooperative and communal irrigation system have been organized.

As for the major existing farmer's organization, there are 15 of Samahang Nayons and 13 of Farmer's Association in the project area. Main functions of Samahang Nayon are, i) to guarantee the amortization with land transfer on land reform movement, ii) to build up the capital in rural area, iii) to educate farmers on cooperative movements and iv) to channel the basic service to farmers. Only minority farmers in the project area are members of the Samahang Nayon, and the activity has been stagnant in the most organizations.

Some of members in 12 Samahang Nayon belonging to the San Miguel municipality have established the farm marketing cooperative in 1983 and Trinidad has a plan to establish a farm marketing cooperative in 1986. Ubay has no farm marketing cooperative but a fishery marketing cooperative.

The farm marketing cooperative of San Miguel is organized by 259 stockholders. Main functions are marketing contract, crop insurance and credit.

This cooperative purchases palay from members at the prevailing market prices not lower than the governorate support price, and sells to rice dealer or the Area Marketing Cooperative in Tagbilaran. Hulled rice and daily commodities are sold at the store in the cooperative office in San Miguel.

Aside from the above farmers' organizations, there are some groups of the rural youth club, the rural improvement clubs, the home makers clubs and Balikatan.

Number of communal irrigation system (CIS) amounts to 257 in Bohol province or 13 in three municipalities. The latter is one in San Miguel, three in Trinidad and nine in Ubay. The irrigated area controlled by these CIS is eight hectare in San Miguel, 184.5 ha in Trinidad and 308 ha in Ubay. Area served by gravity and pumps are 354.5 ha and 146 ha, respectively. These CIS do not exist in the project area.

NIA has been organizing the Irrigator Association (IAs) to achieve better cooperation between NIA and the farmers with regard to operation and maintenance of the national irrigation system. At present, in the nationwide, NIA has organized 1,014 IAs of which 334 IAs are registered with the Security and Exchange Commission (SEC). In Bohol province, though IAs has not been organized yet, the beneficialies in the Phase I area of Bohol irrigation project shall be organized in near future.

d) Credit

The project area has been economically specialized as the depression area in the Central Visayas. In general, farmers have been indebted to the governmental, commercial and private

banking, because of low income, calamity, high landrent and the limited opportunities to gain the non-farm income. The most popular government banking facilities in the project area are Rural Bank, Philippine National Bank and Cooperative Rural Bank.

According to the results of agro-economic survey conducted by NIA, about 35 percent of total samples of 88 were indebted during two crop seasons in 1984/85. Main debtors were not the smaller farmers not more than 1.0 ha but the larger farmers not less than 2.0 ha. About 75 percent of debtors were indebted to Rural Bank, 22 percent to Philippine National Bank and remainder to merchants, friends and relatives. The purpose of an indebtedness was mainly for paddy production in the wet season to provide fertilizer or livestock and to carry on farm improvement. Average amount granted from Rural Bank was ₱2,500 per debtor and Philippine National Bank of ₱4,900. Interest ranged from 12 percent to 14 percent.

The governmental banking for Masagana or Maisan loan is usually conducted through an activity of extension worker belonging to the municipality level office of the Ministry of Agriculture and Foods (MAF). According to the field survey conducted by JICA team member, MAF branch office in the three municipalities concerned with the project did not handle business on Masagana loan and Maisan loan except for only Cassava loan. This credit is conducted under the Pilot Cassava Development Plan. Interest is 15 percent, and credit period is not longer than ten months. Standard credit value amounts to ₱3,000 per farm including five or six bags of fertilizer. Though the results of farm management survey show comparatively high percentage on number of debtors, the general information collected from the Rural Bank in the project area exposes the fact that requirement for agricultural credit is not active, because the interest has been too high since last year.