6–7 Matters of Implementation for Forest Management Planning

6–7–1 Total Input Necessary Requirement for the Management Plan

Work Volumes Based on Forest Management Plan

Program	Type of work	Volume	Remarks
Reforestation	New planting	10,055 ha	
	Tending	41,748 ha	
	Natural regeneration	86 ha	
	Natural regeneration (Selective cutting area)	3,306 ha	
Seedling production		unit: 1,000	
	New planting	19,400 ha	
	I. S. F.	2,343 ha	
Total		21,743 ha	
Timber production	Timber	17,195 m^3	
		38,318 m^3	
Total		55,513 m^3	
Forest road	Main forest road	44.6 km	
	Forest work road	110.4 km	
Total		155.0 km	
Soil conservation	Stream work	63 unit	
	Hillside work	8.5 ha	
Parks & recreation		255 ha	
Special forestry			
Forest protection	Forest fire	All areas	
	Disease	ditto	

6–7–2 Schedule for Implementation

A suggested schedule for activities proposed in this plan is given in Table 6-15. The schedule covers the first six years. (For years thereafter, the work volumes will be based on the average of those for the remaining area.)

Table 6-15. Scheduling (Example)

Year	Volume	Contents
Preparation		1. Assignment of agency and personnel 2. Preparation of implementation plan 3. Technical training 4. Arrangement of labor and materials 5. Setting of nurseries, seedling production (enough to supply first year)
First year	New planting 500ha	1. Harvesting survey (cutting location and volume) 2. Selection of reforestation (location, area survey) 3. Seedling production 4. Training of labor force 5. Forest road clearance
Second year	New planting 700ha	Similarly afterwards; necessary improvements to be made
3rd, 4th, 5th year	New planting 1,000ha	Same as above
6th–10th year	New planting 5,855ha	Necessary adjustments in work volume. Harvesting and thinning under G.1-1 to be considered

6–7–3 Manpower Requirement by Activity

Work force to meet the work volumes as described in 6–7–1 is anticipated in Table 6-16.

Table 6-16. Estimated Labor Force

Program	Type of work	Volume	Labor/unit	Labor volume	Remarks
Reforestation		ha.	person/ha.	persons	
	New planting	110,055	47.40	476,607	
	Tending	41,748	10.00	417,480	
Sub-total				894,087	
Seedling production		unit;1,000	person/1,000		
	Reforestation	19,400	5.93	115,042	
	I. S. F.	2,343	5.93	13,894	
Sub-total		21,743		128,936	
Timber production		m^3	person/m^3		
	Timber	17,195	0.02	344	Survey
	Fuelwood	38,318	0.02	766	
Sub-total		55,513		1,110	
Forest road		km	person/km		
	Main road	44.6	607	27,072	
	Forest work road	110.4	546	60,278	
Sub-total		155.0		87,350	
Forest Conservation		unit	person/unit		
	Stream work	63	300	18,900	
	Hillside work	8.5 ha.	150 ha.	1,275	
Sub-total				20,175	
Parks & Recreation	Facilities			7,560	
Special forestry				0	
Forest protection	Forest fire	3 Watch stations	person/per year		
		patrol	32,80	32,800	
Total				1,172,018	*
				* About 117,000 persons per year	

6–7–4 Yield Prediction

The anticipated yield upon completion of forestry proposed by this plan is estimated below in Tables 6-17 and 18, based on Indonesian data (a tentative yield table and other related documents).

Table 6-17. Timber Production Forest (Long-Term Tree Species)

Tree species	Maturity year	Volume m^3/ha.	Reforesta-tion area ha.	Total volume m^3	Remarks
Pinus kesiya	30	283	2,850	806,500	Indonesia: Merukushi Pine, Site quality III, 30 years, 189 pecies Dupax: P. kesiya (Reforestation)
Molave	40	380	1,188	451,400	Estimate
Mahogany	40	386	633	244,300	Indonesia: Provisional Harvest Table, site quality II, 40 years, 234 pecies
Narra	80	386	630	243,200	Estimate
Teak	80	319	643	205,100	Indonesia: Harvest Table, Site quality III, 80 years
Total			5,944	1,950,500	Average 328 m^3/ha.

Table 6-18. Fuelwood Production Forest (Early Maturing Types)

Tree species	Maturity year	Volume m^3/ha.	Refores-tation area ha.	Volumes by Parcel (m^3)					Total (m^3)
				I	II	III	IV	V	
Giant ipil-ipil	6	94	303				15,300	13,200	28,500
Acacia mangium	10	335	983	7,700	39,900		93,500	188,300	329,400
Acacia auriculiformis	10	335	161		16,400		37,500		53,900
Yamane	10	238	2,546	71,900	48,600	95,000	163,700	226,800	606,000
Eucalyputus camaldlensis	20	380	118		14,400		19,000	11,400	44,800
Total			4,111	79,600	119,300	95,000	329,000	439,700	1,062,600
								Average 258 m^3/ha.	

CHAPTER 1. INTRODUCTION

1-1 Background and Objective of Study

1-1-1 Background

Forest development in the Republic of the Philippines was rapid and extensive after its national independence in July 1946 contributing substantially to the rebuilding of the national economy in the form of lumber exports.

At the same time, cutting of forest trees intensified to meet increased demands for charcoal and firewood under pressures of growing population as well as traditional Kaingin while forest lands were turned into other uses like cropland and grazing lands.

In a Bureau of Forest Development (B.F.D.) survey of 1983, over 50% of the nation's total land area of approximately 300,000 km^2 is listed under Forest Land. However, the forest land as such continues to shrink in area year after year. Administrative efforts have been made to restrict exploitation of forests and monitor land conditions in an attempt to prevent indiscriminate destruction of forests but apparently with little success.

Consequently, in areas of aggravated forest felling, the balance of natural environment has been destroyed causing such hazards as soil erosion, draining of sand and gravel, and flooding to inflict considerable damages on human lives and properties.

To cope with these problems, and Philippine Government has taken measures to restrict forest felling and promote reforestation of denuded forest lands. At the same time, resettlement of kaingineros and more realistic land use classification of forest lands are being considered.

In the course of these efforts, it was realized that there was an urgent need for collection and analysis of data and information on the status of forest resources on a wide regional basis covering the river basin to help formulate forest control and management plans taking into account the public nature of forests.

Against this background, in June 1984, the Philippine Government requested the Japanese Government to undertake acquisition and analysis of data on forests covering the entire Cagayan River Basin (approximately 2.8 million ha.) in northern Luzon, and a study for formulation of forest management plans, one basic (for Wide Area) and another for the selected model area (approximately 50,000 ha.). In response, the Japanese Government dispatched a contact mission in January 1985 and the I/A mission in May of the same year to conclude the I/A for the study to be undertaken over a three-year period.

1–1–2 Objective

The objective of the study is to collect, analyse, and compile data and information on natural and social environment of the Cagayan River Basin located in northern Luzon to formulate the Forest Management Plan for Wide Area and the Forest Management Plan for Model Area with a view to conserving the natural environment as well as to stabilizing socio-economic conditions. In every phase of the study, necessary technology transfer to Philippine counterparts is to be implemented.

1–2 Study Periods, Study Team Members, and Philippine Officials

The study was undertaken over the three year period from 1985 to 1987 (FY). The study periods, study team members, and Philippine officials concerned with the study are listed for each year in the tables below.

(1) First Year (August 1985 – June 1986)

Table 1-1. Team Members and Periods

Task	Responsibility	Name	Period
Preliminary Study	Overall coordination	Iwao Nakajima	Aug. 7, 1985– Aug. 21, 1985
	Study planning & design	Seishiro Shojiguchi	Same
	Study instruction	Toru Kawasaki	Same
	Data compilation	Tetsuya Otsuki	Same
	Reconnaissance map & table compilation	Shoji Ando	Same
Wide Area Study	Overall coordination	Iwao Nakajima	Mar. 31, 1986– Apr. 29, 1986
	Study planning & design	Seishiro Shojiguchi	Same
	Study instruction	Toru Kawasaki	Same
	Data compilation & reconnaissance map/ table	Katsuyasu Yamaguchi	Same
		Tetsuya Otsuki	Same
		Shoji Ando	Same
		Fumitake Hashizume	Same
		Makoto Yoshida	Same
		Masahiko Hara	Same
		Toshiaki Udono	Same

(All the members belong to the consortium for the Forest Information and Management Planning for the Republic of the Philippines.)

Table 1-2. Philippine Officials

Task	Affiliation	Name
Preliminary study		
—Meetings	MNR	A.Y. Capay
	"	Teodora Haresco
	"	Arsenia Estrella
	"	Alan C. Salvador
	"	Salvador
	BFD	Rodolfo Leal
	"	Alex M. Lauricio
	"	N.B. Dalangin
	"	Jose Cabanayan
	"	M.C. Caisip
	"	Mariano Farrales
	"	Allan L. Gonzales
	NRMC	Danny Guerrero
	"	Marcial C. Amaro Jr.
	"	Danny Guevarra
	"	Frances N. Dayrit
	MND	M. Lara
	BMG	Capt. Guillermo Wong
	BL	Nestor P. Punsal Jr.
	BCGS	Mamerto Infante
	NRMC	Com. Renato Feir
—Aerial photo interpretation	MND	Col. Agustin Q. Ariora
	"	Lt. Ramon E. Adea
	BFD	Jose Cabanayan
—Wide Area Study (Counterparts in field survey)	BFD	Virgilo Basa
	"	Jose Cabanayan
	"	Mariano Farrales
	"	Edward Baustista
	"	Region II Staff

(2) Second Year (August 1986 – March 1987)

Table 1–3: Team Members and Periods

Task	Responsibility	Name	Field Survey Period
Second year work plan/ basic data compilation	Overall coordination	Iwao Nakajima	Aug.14–Aug. 23, 1986
	Study planning & design	Seishiro Shojiguchi	Same
	Study instruction	Toru Kawasaki	Same
	Data compilation/ analysis	Shoji Ando	Same
Study of survey findings	Overall coordination	Iwao Nakajima	Nov. 25–Dec. 9, 1986
	Data compilation/ analysis	Shoji Ando	Same
Aerial photographing, Model Area	Supervisor	Daikichi Nakajima	Nov. 25–Dec. 24, 1986
Aerial photo interpretation	Study planning & design	Seishiro Shojiguchi	Jan. 20–Feb. 8, 1987
	Data compilation/ analysis	Tetsuya Ohtsuki	Same
	Same	Shoji Ando	Same
	Same	Masahiko Hara	Same
Field survey, Model Area	Study planning & design	Seishiro Shojiguchi	Feb. 9–Mar. 10
	Data compilation	Katsuyasu Yamaguchi	Same
	Data compilation/ analysis	Tetsuya Ohtsuki	Same
	Same	Shoji Ando	Same
	Same	Fumitake Hashizume	Same
	Same	Masahiko Hara	Same
	Same	Toshiaki Udono	Same

(All the members belong to the Consortium for the Forest Information and Management Planning for the Republic of the Philippines.)

Table 1-4: Philippine Officials

Task	Name	Affiliation
Second year work plan/ basic data compilation	Irenao Domingo	Director, BFD
	Mariano Valera	Assist. Director, BFD
	Jose L. Lechoncito	Reforestation Division, BFD
	Virgilo Basa	Chief, L.C., BFD
	Jose Cabanayan	L.C., BFD
	Wilfrido S. Pollisco	Regional Director Region, II, BFD
	Domingo Bonnit	LC Coordinator Region II, BFD
	Briccio Tamparong	Executive Assist., MNR.
	Alan Salvador	FAPMO, MNR
	Dorie Salvador	"
	MNR, BFD, Region II Staff	
Study of survey findings	Ciriro B. Serna	Acting Director, BFD
	Jose L. Lechoncite	Acting Asst. Director, BFD
	Virgilo Basa	Chief, L.C., BFD
	Jose Cabanayan	L.C., BFD
	Dicacio T. Iglesia	BFD
	Carros V. Centario	BFD
	Romeo T. Acosta	BFD
	Wilfrido S. Pollisco	Regional Director, Region II, BFD
	Domingo Bonnit	LC Conductor, Region II, BFD
	Briccio Tamparong	Executive Assist. MNR.
	Virgilio S. Santos	NRMC, MNR
	Alan Salvador	FAPMO, MNR
	Dorie Salvador	"
	MNR, BFD, Region II Staff	
Aerial photo interpretation	Virgilo Basa	Chief, L.C., BFD
	Jose Cabanayan	L.C., BFD
	MNR, BFD, L.C. BFD Staff	
Field survey Model Area	Ciriro B. Serna	Acting Director, BFD
	Virgilo Basa	Chief, L.C., BFD
	Jose Cabanayan	L.C., BFD
	Mariano Farrales	"
	MNR, BFD, REGION II Staff	

(3) Third Year

Table 1-5: Study Team Members and Field Survey Period

Task	Responsibility	Name	Period
Forest land classification analysis · Data analysis for model area	Forest management plan (model area)	Seishiro Shojiguchi	Aug. 10–Sep. 8, 1987
	Forest management plan (wide area)	Toru Kawasaki	Same
	Forest management	Katsuyasu Yamaguchi	Same
	Forest land classifications and zoning for forest management	Tetsuya Ohtsuki	Same
	Data analysis for model area	Shoji Andoh	Same
	Forest management	Fumitake Hashizume	Same
	Socio-economic analysis	Kota Shimokawa	Same
Field verification	Overall coordination	Iwao Nakajima	Febl 7–Feb. 26, 1988
	Forest management plan	Seishiro Shojiguchi	Same
	Forest management	Katsuyasu Yamaguchi	Same
	Forest land classification and zoning for forest management	Tetsuya Ohtsuki	Same
	Data analysis for model area	Shoji Andoh	Same

(All the members belong to the Consortium for the Forest Information and Management Planning for the Republic of the Philippines.)

Table 1-6: Philippine Officials Concerned

Task	Name	Affiliation
Forest land classification analysis · Data analysis for model area, and Field verification	Ricardo M. Umali	Undersecretary, DENR
	Victor O. Ramos	Undersecretary, DENR
	Ciriro B. Serna	Director, FMB
	I. D. Esteban	Assist. Director, FMB
	Rogelio B. Bagayan	Director, Region II
	Antonio G. Principe	Regional Tecunical Director, Region II
	Domingo Bonnit	LC Coordinator, Region II, FMB
	Rodolfo Yambao	Head Executive Assistant, NAMRI NAMRIA
	Ananias Batilaran	Duputy Administrator, NAMRIA
	Virgilio F. Basa	OIC Director, NAMRIA
	Jose Cabanayan	OIC Division Chief, NAMRIA
	Virgilio Santos	OIC Division Chief, NA
		DENR, FMB, NAMRIA
		Region II, Staff

1--3 Supervising Commission

In accordance with the Guideline for Creation of Supervising Commission, the Supervising Commission on the Forest Information and Management Planing for the Republic of the Philippines has been established under the International Cooperation Agency. The Commission is comprised by the following members.

(1) First Year

Table 1-7: Commission Members

Responsibility	Name	Period
Overall Coordination	Masaaki Kuwabara Research Planner, Forestry Agency, Ministry of Agriculture, Forestry and Fisheries	May 12–21, 1986
Data Analysis	Itsuhito Ohnuki Chief, Forest Remote Sensing Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisherels	Same
Management	Seigo Sakaguchi Chief, Management Research Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries	
Development Planning	Masao Mabuchi Chief, International Cooperation in Forestry, Ministry of Agriculture, Forestry and Fisheries	

(2) Second Year

Table 1-8. Commission Members

Responsibility	Name	Period
Overall Coordination	Masaaki Kuwabara Research Planner, Forestry Agency, Ministry of Agriculture, Forestry and Fisheries	Mar. 1–10, 1987

Responsibility	Name	Period
Data Analysis	Itsuhito Ohnuki Chief, Forest Remote Sensing Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries	
Management	Seigo Sakaguchi Chief, Management Research Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries	Mar. 1–10, 1987
Development Planning	Masao Mabuchi Chief, International Cooperation in Forestry, Ministry of Agriculture, Forestry and Fisheries	

(3) Third Year

Table 1-9. Commission Members

Responsibility	Name	Period
Overall Coordination	Masaaki Kuwabara Research Planner, Forestry Agency, Ministry of Agriculture, Forestry and Fisheries	
Data Analysis	Itsuhito Ohnuki Chief, Forest Remote Sensing Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries	
Management	Seigo Sakaguchi Chief, Management Research Lab., of Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries	Feb.11–19,1988
Development Planning	Shigeru Yokoi Assistant Manager, Soil Conservation, Ministry of Agriculture, Forestry and Fisheries	Feb.11–19,1988

CHAPTER 2. STUDY PLAN

2–1 Basic Policy for Implementation of Study

This study was undertaken in line with the Implementing Arrangement (I/A) concluded between the government of the Republic of the Philippines and the Japan International Cooperation Agency. The objective of the study was to prepare the Forest Management Plan for Wide Area covering the entire Cagayan River Basin (approx. 2.8 million ha.) in Luzon Island and the Forest Management Plan for Model Area to be selected from the above area (up to 50,000 ha.). Due consideration was given so that the methodology employed in this study and the study result can apply to other areas and possibly serve as a standard approach for nationwide forestry management in the future. The study was conducted over the three year period from August 1985 to June 1988.

The study items for each year are as follows.

(1) First Year (August 1985 – June 1986)

Data Collection

Base Map and Reconnaissance Map Production

Field Survey (checking of Reconnaissance Map, collection of additional information)

Selection of Model Area

(2) Second Year (August 1986 – March 1987)

Basic Data Compilation

Geographical Characteristics Analysis by Computer

Forest Land Classification Analysis by Computer

Aerial Photography of Model Area

Aerial Photo Interpretation of Model Area (collection of existing data, Reconnaissance Map production)

Field Survey of Model Area (checking of Reconnaissance Map, collection of additional information)

(3) Third Year (August 1987 – June 1988)

1. Forest Land Classification Analysis
2. Model Area Data Analysis
3. Field Survey of Model Area (checking of analysis data, collection of additional information, questionnaire survey)
4. Preparation of Draft Forest Management Plans for Wide Area and Model Area
5. Field Verification
6. Presentation of Final Drafts
7. Delivery of Final Products

2–2 Study Contents

Figure 2–1 is a flow diagram of the study as a whole. The study consists of two parts, one for the Wide Area (covering the entire Cagayan River Basin) and the other for the Model Area. The respective steps of the study and their relationships with each other are described below.

(1) Study of Wide Area (entire Cagayan River Basin)

1 Initially, to collect information on forest land use in the study area from existing data, aerial photos, Landsat imagery, and prepare the reconnaissance map.

2 To check the reconnaissance map in the field, supplement it with additional data, and finalize the base data.

3 Based on the findings, to select an area most typical of forest lands in the region for the Model Area.

4 To input these data in a computer (in grid cells and polygons) to create a data base for the Wide Area. Using the data base, to perform forest land analyses in terms of their natural environmental characteristics and beneficial public functions, and uses in smaller units of land area (approx. 1,000 ha.).

5 Based on the analysis results, to formulate a well-balanced forest management plan for the Wide Area taking socio-economic factors into account.

6 And to produce a report describing the methodology, results, and future problems.

(2) Study of Model Area

1 To undertake aerial photography of the Model Area (scale 1/20,000).

2 Based on the Wide Area study findings, to collect additional information from existing data.

3 To prepare the Reconnaissance Map by interpreting the newly taken aerial photographs, check the map in the field, supplement it with additional data, and finalize base data.

4 To set the forest blocks of parcel, compartment and sub-compartment.

5 To input these basic data in a computer to analyse forest lands as done for the Wide Area, namely, in terms of natural environmental characteristics and beneficial public functions and uses of forests in the unit of sub-compartment which is classified by the boundary of catchment area and vegetation & land use.

6 To poll Barangay Captains and residents of the study area on forests as their living environment.

7 Based on the study findings, to formulate a well-balanced forest management plan for the Model Area to meet the future social needs and help the growth of economy.

8 And to produce a report describing the methodology, results, and future problems.

2–3 Scope of Report

This report was prepared primarily from the technical perspective based on the understanding of natural and social environments of Philippines' forestland (forests) while having an outlook on the future of forestland in the Philippines.

1) The Forest Management Plan for Wide Area attempts to envision the forestland as desired for the future and consider major requirements for forest management from a broad viewpoint with respect to the Cagayan River Basin (approx. 2.8 million hectares) based on the understanding of the existing condition and analysis and evaluation of related matters.

2) In the Forest Management Plan for Model Area, a model area (approx. 50,000 ha) was selected as an area which typifies the environment, both natural and social of the Cagayan River Basin. The size of the model area was determined with the actual implementation in mind. In addition to the studies undertaken for the same subjects as covered for the Wide Area, a questionnaire survey was conducted to find out about the local residents, their way of living and attitudes towards forests. Covering a wide ranging subjects related to forest management, the plan attempts to provide a guideline for effective forest management.

3) Implementation of the Plans will require further study of social needs, economic effects, and funding, and the implementation plan needs to be worked out.

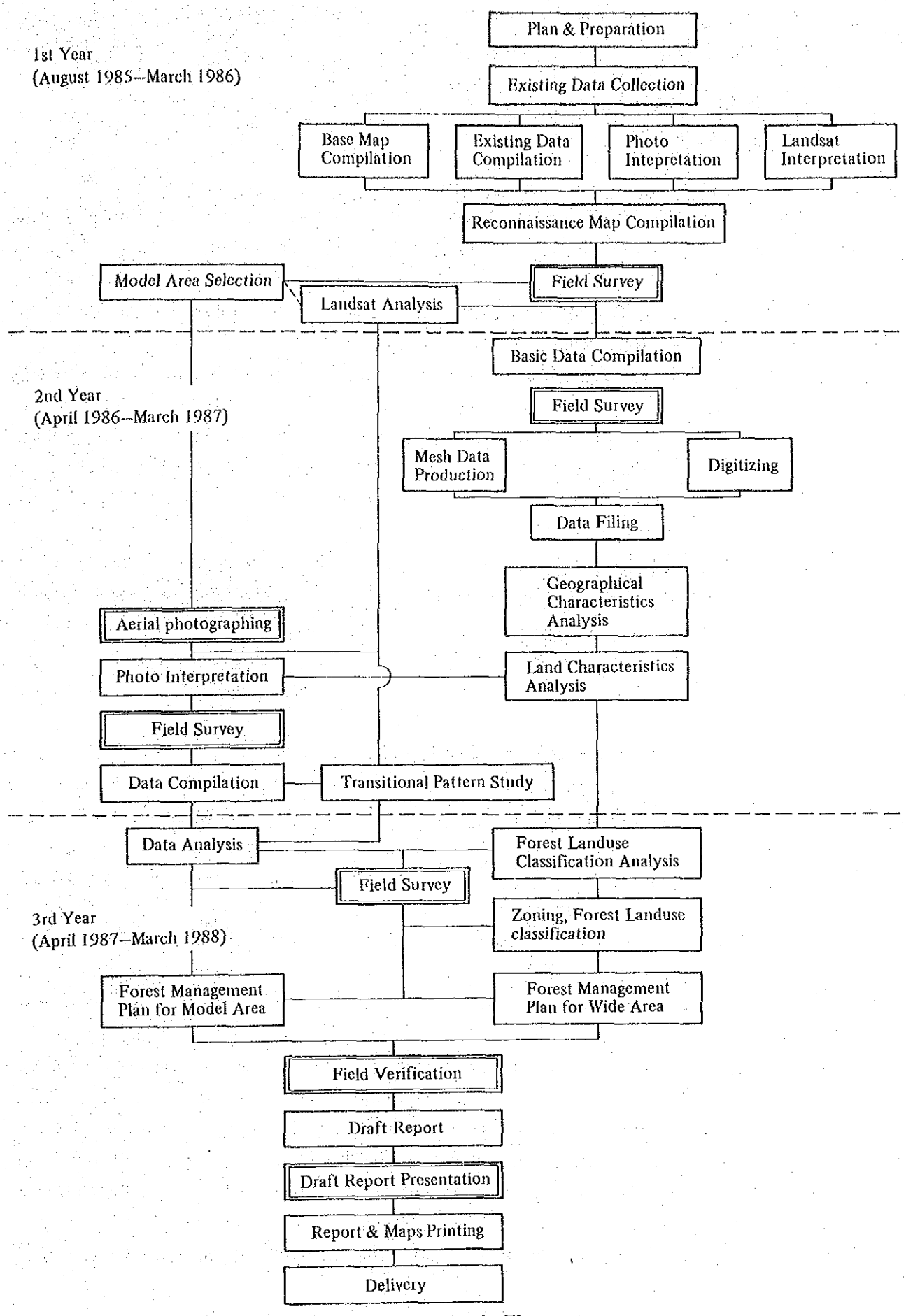


Fig. 2-1. Study Flow

CHAPTER 3. DISCRIPTION OF STUDY AREA

3–1 Outline of Philippines

3–1–1 Natural Environment

(1) Location and Area

The philippine Islands are located between latitudes 5° North and 21° North and longitudes 116° East and 127° East, with Taiwan to the north across the Bashi Channel and, to the south, Sulawesi, the Sulu Islands, and further Borneo across the Celebes Sea. They face the Pacific through the Philippine Sea to the east and the South China Sea to the west.

The Philippine Islands consist of some 7,100 islands of varying sizes with a total land area of 300,000 km². Luzon and Mindanao, the only islands having a land area of more than 90,000 km², together with such smaller islands as Samar, Negros, Palawan, Panay, Mindoro, Leyte, Sebu, Bohol, Mabate, account for about 95% of the total land area. The entire country is divided into 12 administrative regions, i.e., Region I to Region XII.

The study area, the Cagayan River Basin, is located in the northeast of Luzon Island, the largest island of the Philippines, covering eight provinces encompassing some 28,000 km² in total land area. Except for Mountain Province (Region I), the study area falls in Region II.

Figure 3–1 shows the location of the Philippines.

(2) Geomorphology

The Republic of the Philippines consists of some 7,100 islands lying between latitudes 4°23′ North and 21°25′ North and longitudes 116° East and 127° East over distances of about 1,850 km north-south and about 1,062 east-west, adding up to a total land area of approximately 300,000 km². These islands are divided into three groups: Luzon, Mindanao, and Visaya.

Luzon is the largest single island with an area of approximately 105,000 km², followed by Mindanao with about 95,000 km². The Visaya Islands are comprised by the islands of Leyte, Sebu, Bohol, Masbate, Samar, and Negros, each with an area of less than 15,000 km².

Luzon Island has half of its land occupied by rising mountains of over 500 m in elevation. The east coast of the island facing the Pacific is laced by the Siera Madre Range with mountains ranging 1,100 m – 1,400 m in elevation which contain some small tracts of falt land inside. Along the west coast run the mountains of the Ilocos Range rising 500 m – 1,000 m. In between is the Cordillera Central Rnage with mountains of 1,200 m – 2,900 m in height.

In Central Luzon there are large expanses of alluvial plains forming an agricul-

Fig. 3-1. Location of Philippines

tural zone of major importance, and the majority of population is concentrated in this region. On the west coast, the Zambales Range of 100 m – 1,388 m in elevation is located. The southern part of the island is a peninsula extending southeast and featuring Mayon Volcanos.

The Visayas Island Group and Mindanao are both dominated by mountain ranges of over 500 m above sea-level running in the north-south direction.

Located in northern Luzon, the Cagayan River Basin as our study area is surrounded by mountains encompassing an elongated area about 193 km long in the north-south direction and an average of 64 km wide with a catchment area of approximately 28,000 km^2.

In the Cagayan Basin, except for the mountainous parts of over 400 m in height, moderate footslopes are developed in the south on the left bank side of the Cagayan River, followed by extensive hills, uplands/terraces developed originally from lifted fans, and fans.

As far as these areas are concerned, major land uses include rice fields and other agricultural uses for flat low lands and grazing land for hills. Forests are developed in the mountainous areas but at the footslopes they remain low quality secondary forests.

In the hills and uplands, including footslopes, of the Cagayan Basin, Kaingin, tree felling and grazing are practised extensively causing deterioration in the water retaining function of forests, and thereby threatening such hazards as soil erosion, draining of sands and earth, and flooding areas along Magat and Chico Rivers.

Figure 3-2 shows Elevation Map of the Philippines.

(3) Geology and Soils

The Philippines constitute northeastern island parts of the volcanic zone that surrounds the continent. Geologically, the islands in general are comprised of igneous rocks such as volcanic and pyroclastic rocks, old metamorphic sedimentary rocks, Tertiary sedimentary rocks like sandstones and shale.

Luzon Island consists of the Malaya Mountains, Baguio Highland, Cagayan Basin, Central Plain, and volcanic areas in the south-east and west. The Cagayan Basin is an alluvial anticlinal basin. The Central Plain is mainly of igneous rocks and deltas are extensively developed along the Agno and Pampanga Rivers. The southeast and west are volcanic areas composed of tuff, andesite and pyroclastic rocks.

The Siera Madre Range rises to over 1,000 m above sea level on the east side of the study area and there are observed outcrops of volcanic intrusive. Tertiary sedimentary rocks are observed at the foot of the mountains forming slopes on the western side.

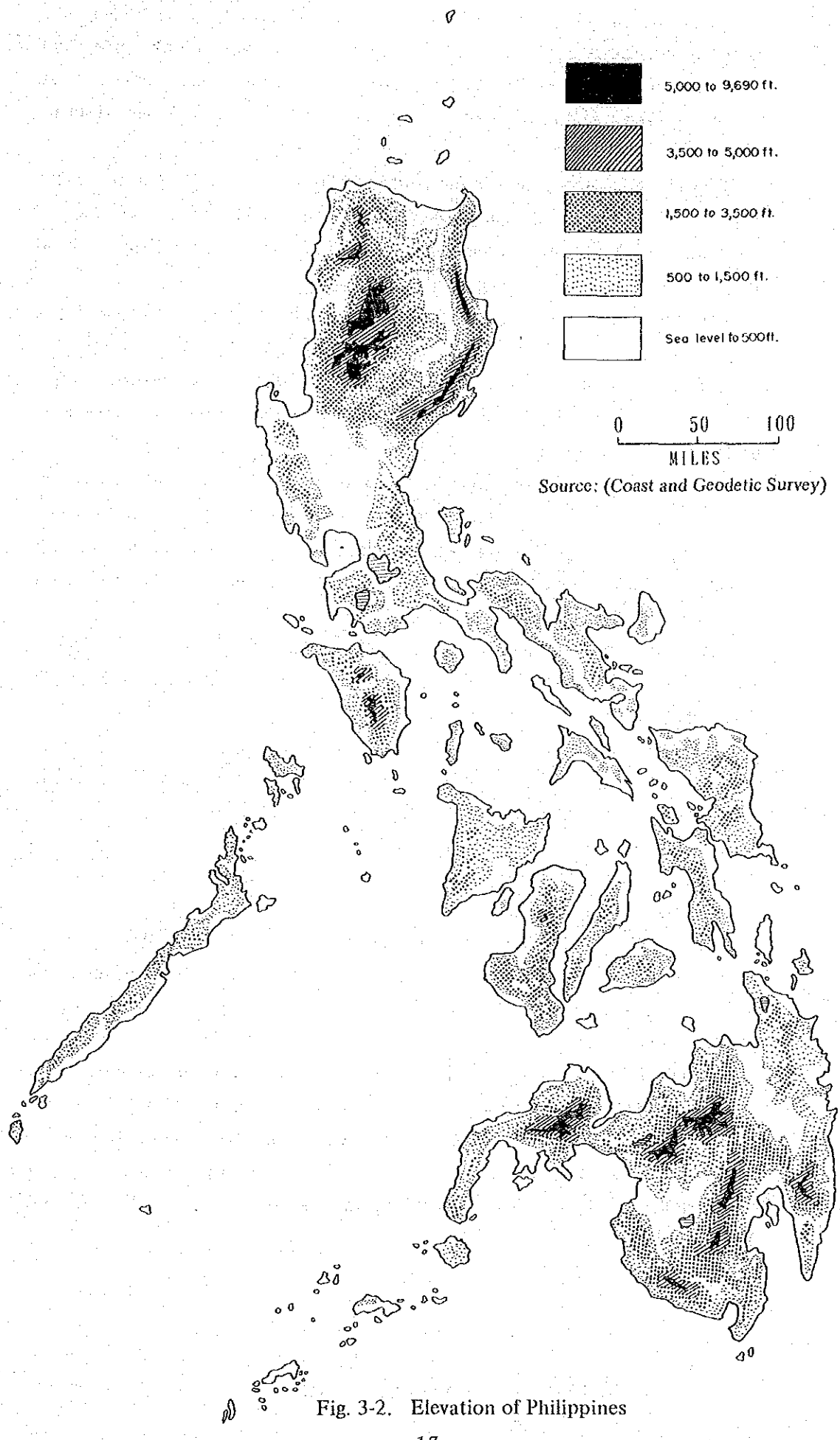


Fig. 3-2. Elevation of Philippines

The Cordillera Central Range is characterized by mother rocks of older metamorphic sedimentary rocks and volcanic rocks mixed with younger formations of intrusive rocks and eruptive rocks. The Tertiary sedimentary rocks forming the slopes on the eastern side went through repeated folding and faulting resulting in sharp facies changes.

The Caraballo Mountains to the south, where mother rocks are also metamorphic rocks, have elevations of over 1,500 m above sea level. The range of mountains constitutes the watershed separating the Central Luzon Plain from the Cagayan Basin.

There are four major types of parent rocks for Philippine soils: shale, lime stone, alluvial, and volcanic ashes. Volcanic ash soils are either of volcanic ejects (tuff, volcanic sands) or of igneous rocks, forming reddish brown lateritic acid soils. Soils that are attributable to volcanic activity account for approximately 15% of the total land area.

Alluvial soils are of two types, old and new, which make up most of the intensively cultivated land and represent about 15% of the total land area.

Soils derived from limestone as mother rock are relatively fertile, soft and permeable but vulnerable to erosion. This type of soils amount to approximately 13% of the total land area.

Shale-based soils are relatively soft and fairly permeable but amenable to lateritization and erosion. This type constitutes approximately 10% of the total land.

The study area has extensive distributions of alluvial and deluvial soils (silt – clay, loam) mainly in the Cagayan Valley, volcanic forest soils (loam – silt, sand – gravel), and sedimentary soils (silt – loam).

Figure 3–3 shows Geological Map and Soil Map.

(4) Climate

The Republic of the Philippines consists of over 7,000 islands lying between latitudes 5° North and 21° North. Its climate is under the strong influence of the ocean, namely, high temperature and high humidity, typical of tropical marine climate.

The average temperatures are 27.0°C for nationwide (average of those at 44 locations across the country), 26.8°C for Luzon to the north, 27.3°C for Visaya at midway and 26.9°C for Mindanao to the south, with little difference between north and south. In most parts of the country, the range of annual temperature variance is less than 3° and daily temperature variances average 7°C – 8°C for all the islands.

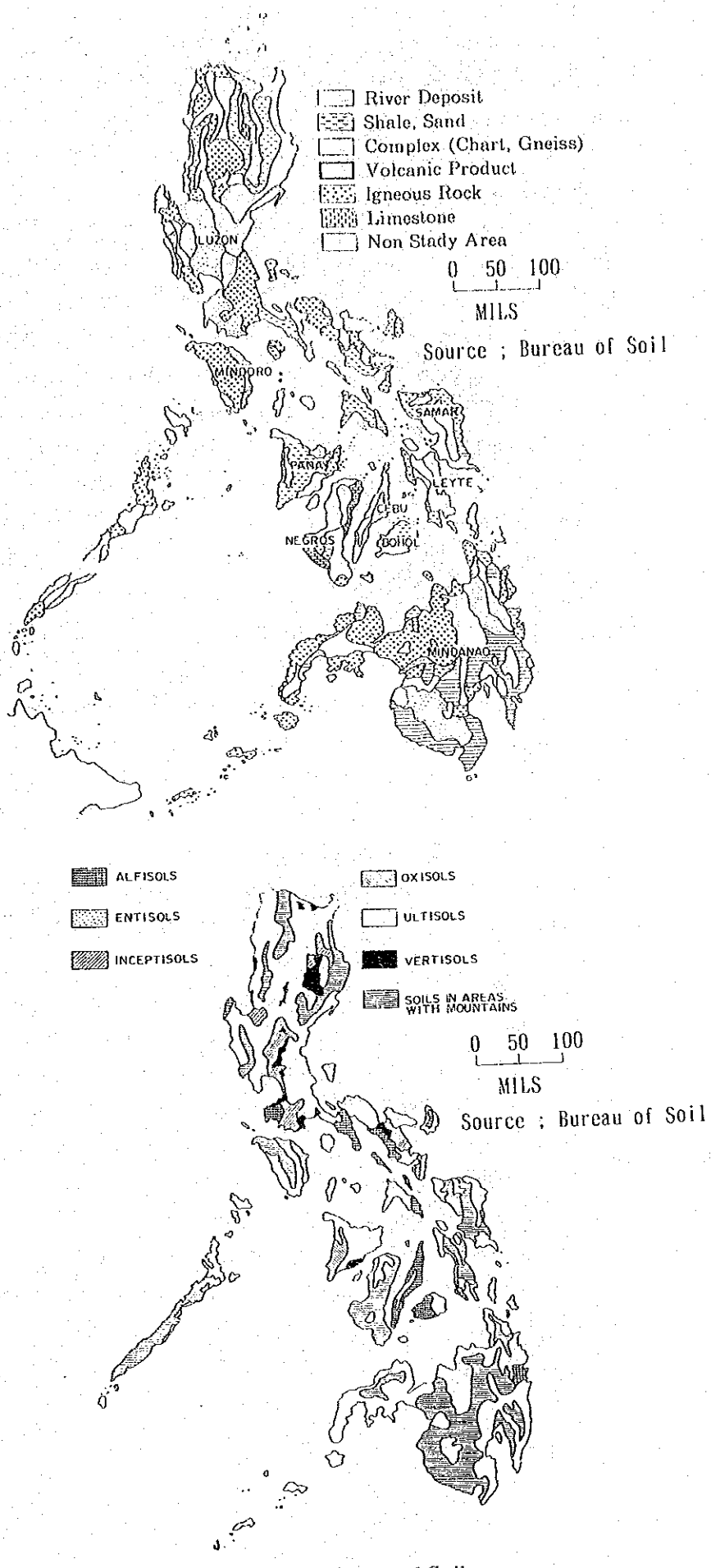


Fig. 3-3. Geology and Soil

The annual rainfall is 2,533 mm on the nationwide average with the maximum of 4,300 mm on the east coast of Mindanao and minimum of 930 mm in the south of the same island. Overall, it varies substantially between areas. In some areas, there is a distinction of dry and rainy seasons and, in the dry season, water shortage is experienced from time to time.

The country can be classified into the following four zones by climate in terms of seasonal (dry and wet) characteristics and rainfall.

Type I. Areas that have distinct dry and wet seasons. The dry season lasts from November to April the rest of year being wet. Average annual temperature 27.0°C; average annual rainfall 2,555 mm.

Type II. Mostly wet and there is no dry season. Rainfall is maximal in the months from November through January. Average annual temperature 26.8°C; average annual rainfall 3,279 mm.

Type III. There are no distinctive seasonal changes. Relatively dry from November to April, the other months being wet and humid. Average annual temperature 27.2°C; average rainfall 1,962 mm.

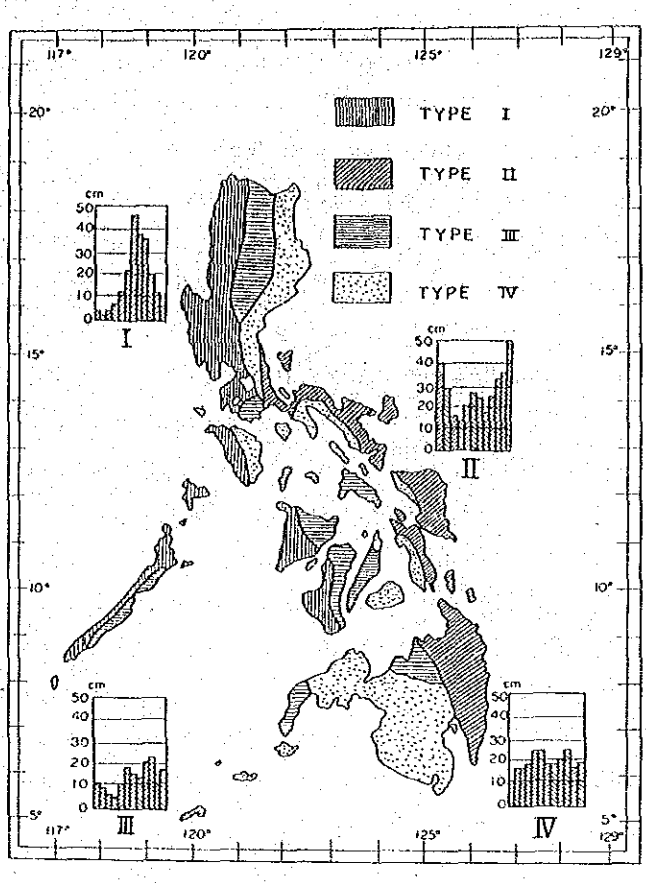
Type IV. Steady rainfall throughout a year. Average annual temperature 26.8°C; average annual rainfall 2,587 mm.

The Cagayan River Basin falls in Type III since it has no distinct rainy season though there is a short spell of dry season. Average annual temperatures are 26.7°C at Aparri on the northern coast and 26.0°C at Bayombong in the southeast, which compare 1°C more or less than that of Zamboanga or the southern tip of Mindanao Island.

Average annual rainfalls are 2,318 mm at Aparri and 1,540 mm at Bayombong varying substantially from below 2,000 mm in the flat lands in the central and northern parts of the valley to more than 3,000 mm in the mountain areas. Monthly rainfalls change significantly from year to year. In fact, there were some months in which standard deviations exceeded 100% as found in the records of 1951 to 1970, indicating the extent of uneveness in the rainfall pattern.

The impact of tropical cyclones has been considerable on the local agriculture. The Cagayan Basin also has experienced many such cyclones. Based on the records covering 89 years from 1984 to 1972, the area has been hit by an average of 19.2 cyclones annually (including tropical storms). The numbers of cyclones that hit the area are highter in the months of July to November, i.e., 2 or 3, or more monthly. On the other hand, the Southern Philippines represented by Mindanao are least subject to tropical cyclones.

Figure 3–4 presents Climatic Charts of the Philippines.



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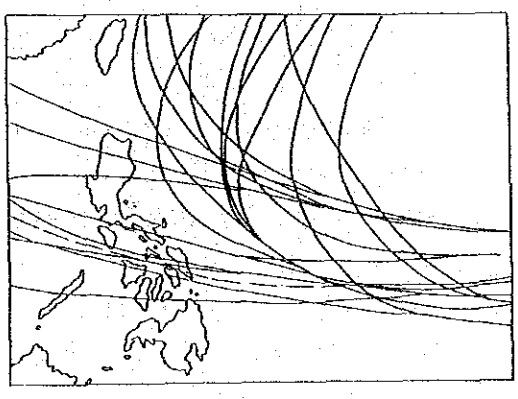


Tropical Cyclone Route

Fig. 3-4. Climatic Charts of Philippines

(5) Vegetation

The fauna and flora of the Philippine Islands (not including Palawan) is defined by the New Wallace Line which extends north between Borneo and Sulawesi, and the Weber Line which runs windingly between Sulawesi and Halmahera into the Bashi Channel. They are basically of Continental Asia by origin and extremely inferior in strength allowing the intrusion of Australian elements. Coming between Weber Line which constitutes the eastern limit of Asian fauna and flora on the one hand and the New Weber Line forming the western border of the Australian on the other, the area has a mixture of both. About 2,000 are recognized as indigenous and some 5,500 considered as local species that can be found only in the Philippines. Figure 3-5 presents Biological Regions of Southeast Asia.

Forests are mostly tropical rain fall forests comprised characteristically by complex mixtures of multiple stories of vegetation of numerous species including more than 2,000 species of trees of 30 cm or more in diameter. To indicate their relationship to the Asian Continent are pines. Benquet pines (Pinus insularis) for example are a dominant species in the Cordillera Central Mountains of Luzon while there are Mindoro pines (Pinus merkusii) in Mindoro Island. Those supposedly of Australian origin include Zanthostemon, Disbormia, Camptostemon, Eucaryptus, Casuarina.

Forests in the Philippines are generally classified into four types by elevation, i.e., Dipterocarp Forest, Pine Forest, Mangrove Forest, and Mossy Forest. Each type is briefly described below.

★ Dipterocarp Forest:

Distributed in areas ranging in elevation from low lands upward to nearly 800 meters, this is a dominant form of forests and high in economic value. Upper story trees are over 65 meters in height and mostly those of Dipterocarpaceae in kind. Underneath them are middle story trees of other kinds than Dipterocarpaceae and further below are shade-bearing trees of 12 meters or so in height and with relatively small volumes of leaves forming the lower story. This type of forests feature three large vine type vegetations. Close to the ground surface, there are many types of ferns and shrubs forming a complex cover. Major species include: Pentacme contorta(white lauan), Dipterocarpus grandiflorus (Apitong), Shorea ploysperma (Tangile), Shorea squamata (Mayapis), Shorea negrosensis (Red lauan).

★ Pine Forest:

Distributed in highlands and mountains, they range 300 – 1,500 meters in height. In the Cordillera Central mountains, there are Pinus insularis (Bequet pines) as a dominant species forming pure uniform forests or growing as single trees among broad-leafed trees. In the Zambales mountains that run

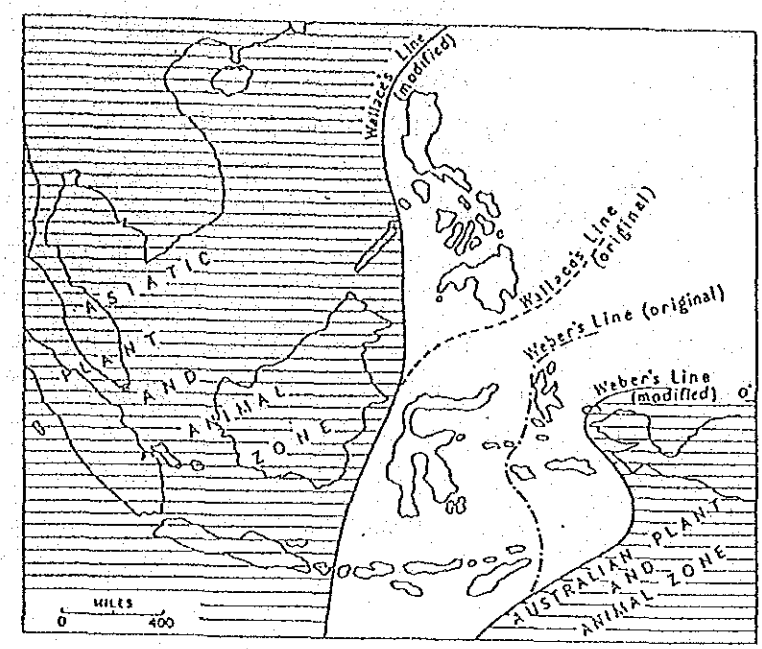


Fig. 3-5. Biological Regions of Southeast Asia

from Lingayen Bay to Manila Bay, there are distributed two types of pines, i.e., Pinus insularis and Pinus merkusii (Mindoro pines). In Mindoro Island, there are Pinus merkusii in pure forests or as single trees.

★ Mangrove Forest:

Distributed at estuaries and littoral areas. A little further inland from estuaries, there appear Nipas (Nipa palum, Nipa fruitcans). Major species are of Phizophoraceae including Phizophora spinculata, R. muscronata, Ceriops tagal, C. roxburgiana, Bruguiera gymmorrhiza, B. Parviflora, B. cylindrica, B. sexangula, and, further inland, Heritiera littoralis.

★ Mossy Forest:

Distributed in humid highlands. Trees are about 5 meters in height with boughs and branches covered with ferns and mosses. Conifers of Dacrydium and Podocarpus or broad leaves of Eugenia, Decaspermum, Lithocarpus, Myrica.

3–1–2 Socio-Economic Environment

The Philippine National Assembly (Batasang Pambansa) adopted the 1983 – 1987 development plan on January 19, 1982, as Resolution No. 66. Former President Marcos signed it on February 26, 1982, and issued Presidential Decree No. 2166 ordering the agencies concerned to take necessary steps for implementation planning and budgeting.

However, the global recession triggered by the second oil crisis of 1979 – 1980 coupled with declines of international commodity prices resulted in increased short term international debts. The Philippine Government tried to stimulate economic growth but efforts failed simply to deteriorate further the foreign exchange situation rapidly.

Furthermore, political instability resulted in capital outflow. While there was some growth in the agricultural sector over the years of 1984 – 1985, the outputs declined sharply in the manufacturing, mining and construction sectors.

As a result, the real term economic growth was minus 5.3% in 1984 and minus 4% in 1985, the economy as a whole tending to diminish in size. At the same time, both prices and unemployment went up. Consumer prices went up 49.3% in 1984 and 20.7% in 1985, and unemployment and underemployment rates for the fourth quarter of 1986 were 10.2% and 32.1% respectively.

Much is expected of the new government for economic reconsturction and stabilization of people's livelihood but, as it stands, private investment is yet to be activated enough with the real term economic growth for 1986 estimated at 0.5 – 0.8% over the previous year.

(1) Medium Term Development Plan (1987–1992)

The new government embarked on the economic reconstruction by starting a 6-year development plan, the Medium Term Development Plan 1987 – 1992.

The goals envisioned by the plan are:

(1) Eradication of poverty

(2) Creation of productive employment opportunities

(3) Promotion of equality and social justice

(4) Sustained economic growth

In short terms, economic reconstruction is first and foremost in priority focusing on creation of employment through small scale infrastructure development under the Community Employment and Development Programme (CEDP) being implemented with urgency and intensity during 1986 and 1987 aiming at agricultural villages and local communities.

In medium and long terms, it is expected to put a system in place which ensures the complete process of creating employment opportunities, increased incomes, expanded demand, expanded production, expanded investment, and further increase and expansion of employment, thus leading to sustained growth of economy.

With respect to forestry, this development plan sees to it that farm workers with no land holdings and highland farmers will be the first to use the forestland and places emphasis on increased employment by industrial afforestation.

In view of the rapid decline in forest resources and the need for environmental conservation, exports of logs were banned in 1982 and since 1984, logging permits have become increasingly difficult to obtain.

(2) Outline of Regional Economy

GNP's and GDP's by administrative region for 1980 – 1982 are given in Table 3–1, and Table 3–2. The administrative regions are as shown in Figure 3–6.

The tables show that the real term economic growth rates in Region II, which covers the bulk of the study area, were below the national average for both 1981 and 1982 and that this region was the 12th of the 13 Regions in terms of its shares for 1980, 1981 and 1982 accounting for about 2.5% of GDP. In other words, Region II is among the least productive regions.

With respect to GNP, real term economic growth rates in the combined sector of agriculture, fishery, and forestry were less than other sectors with 3.6% for 1980 – 1981 and 3.8% for 1981 and 1982, but in terms of its shares, it accounted for 25.6% or more than a quarter of GNP in 1980.

Table 3-1. Gross National Product by Expenditure and Industrial Origin, 1980–82

Item	Constant level (billion pesos)			Average annual real growth rates		Current level (billion pesos)		
	Actual		Estimate	Actual	Estimate	Actual		Estimate
	1980	1981	1982	1980-81	1981-82	1980	1981	1982
Personal consumption expenditures	59.3	61.6	64.2	4.0	4.2	178.0	205.6	239.9
Government consumption expenditures	8.4	8.7	8.7	4.1	(0.5)	21.4	24.6	27.1
Gross domestic capital formation	2.6	27.2	27.5	2.3	1.1	81.2	93.3	105.1
Fixed capital formation	22.7	23.5	24.1	3.5	2.3	68.0	79.3	90.5
Construction	11.1	12.0	12.3	8.3	2.2	37.4	46.0	52.3
Government	4.9	5.2	4.9	7.9	(6.2)	16.3	20.0	20.9
Private	6.3	6.8	7.4	8.6	8.6	21.0	26.0	31.4
Durable equipment	11.6	11.5	11.8	(1.0)	2.5	30.6	33.3	38.2
Increase in stocks	3.9	3.7	3.4	(5.0)	(6.8)	13.2	14.0	14.6
Exports of goods and nonfactor services	18.1	18.4	19.4	1.6	5.0	54.2	58.5	68.2
Imports of goods and nonfactor services	1.4	18.9	19.5	(2.9)	3.4	68,9	74.0	85.3
GROSS NATIONAL PRODUCT	92.6	96.1	100.0	3.8	4.1	265.0	305.5	352.7
Agriculture, fishery and forestry	23.7	24.6	25.5	3.6	3.8			
Industry	33.5	35.1	36.6	4.7	4.3			
Mining and quarrying	2.2	2.3	2.3	1.7	3.0			
Manufacturing	23.2	24.0	25.0	3.4	4.2			
Construction	7.1	7.8	8.1	9.7	3.8			
Electricity, gas and water	0.9	1.0	1.1	7.8	13.1			
Services	35.5	36.6	38.1	3.0	4.3			
Transportation, communication and storage	4.8	5.0	5.3	4.4	5.9			
Commerce	19.3	19.7	20.4	1.8	3.8			
Other Services	11.3	11.8	12.4	4.3	4.6			
GROSS DOMESTIC PRVDUCT	92.7	96.2	100.2	3.8	4.2			

Source: RDS–NEDA

3-2. Gross Regional Domestic Product 1980–82

(Unit: millions of pesos at 1972 prices)

Region	Actual	Estimates		Growth Rates (%)	
	1980	1981	1982	1980–81	1981–82
Philippines	92,694 (100.0)	96,189	100,222 (100.0)	3.8	4.2
NCR	29,940 (32.3)	31,347	32,983 (32.9)	4.7	5.2
Region I	3,337 (3.6)	3,436	3,549 (3.5)	3.0	3.3
II	2,410 (2.6)	2,448	2,490 (2.5)	1.6	1.7
III	7,508 (8.1)	7,781	8,096 (8.1)	3.6	4.0
IV	12,977 (114.0)	13,375	13,831 (13.8)	3.1	3.4
V	3,244 (3.5)	3,408	3,595 (3.6)	5.1	5.5
VI	7,323 (7.9)	7,543	7,794 (7.8)	3.0	3.3
VII	6,767 (7.3)	6,983	7,242 (7.2)	3.3	3.6
VIII	2,318 (2.5)	2,341	2,366 (2.4)	1.0	1.1
IX	3,244 (3.5)	3,380	3,537 (3.5)	4.2	4.6
X	4,264 (4.6)	4,473	4,717 (4.7)	4.9	5.5
XI	6,303 (6.8)	6,515	6,759 (6.7)	3.4	3.7
XII	3,059 (3.3)	3,154	3,263 (3.3)	3.1	3.5

Source: RDS-NEDA ( ) = %

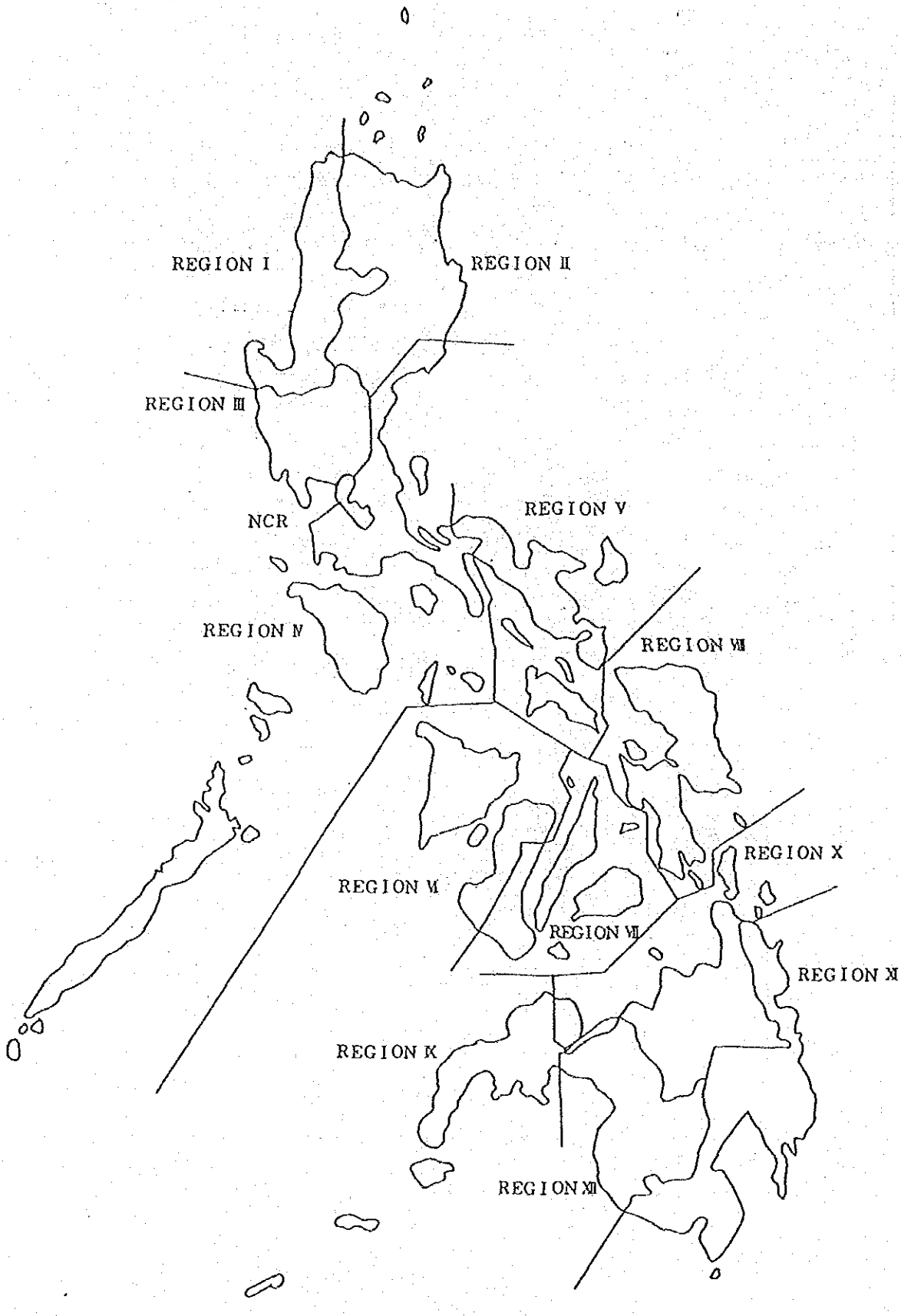


Fig. 3-6. Administrative Regions of Philippines

(3) Population

According to the national census, the total population of the Philippines was 42.1 million in 1975, which increased at an annual rate of 2.7% to reach 48.1 million in 1980. Population/Population Density by Administrative Regions for 1980 is given in Tables 3-3. The past movements of population migration are as shown in Table 3-4.

The population of Region II (approx. 3.64 million ha. in area) was 2.2 million in 1980 accounting for 4.6% of the total population and the population density 60.9 persons per km^2, both being the lowest among all of the 13 Regions. The past movements of population migration indicate there were more people going out than those coming in Region II during the two five-year periods of 1970 – 1975 and 1975 – 1980.

According to the Cagayan Valley Water Resources Framework Plan by the National Water Resources Council (NWRC), the Valley population will be increasing at 2.6% annually to reach 3.55 million by 2000 with urban population of 520,00 or 15% of the total population and the remaining 3.03 million or 85% living in the outlying areas.

(4) Major Infrastructure

1) Roads

Table 3-5 shows the existing roads by Region. Region II has approximately 12,444 km of roads in total length or 8% of the nationwide total. More than half of the roads are Barangay roads with national and provincial roads accounting for about 18% and 16% respectively. The ratios are more or less similar among Regions. Region II, however, is the lowest in terms of the length of roads per unit land space with 0.3 km/km^2.

2) Ports

-Region II is surrounded by the Cordillera Central Mountains to the west and the Caraballo Mountains to the south. With Siera Madre Mountains in the east extending to the sea coast, the Aparri area in the north is the only part of the region that opens up onto the sea coast facing the Babuyan Channel. Thus the region as a whole is industrially underdeveloped. (Table 3-6). There are ports but only three of them have customs, extremely few compared with the other regions.

Table 3-3. Population and Land Area, by Region, 1980

Region	Population		Area		Density
	Number	Percent	Sq. Km.	Percent	(Persons/Sq. Km.)
Philippines	48,098,460	100.0	300,000.0	100.0	160.3
NCR	5,925,884	12.3	636.0	0.2	9,317.4
I	3,540,893	7.4	21,568.4	7.2	164.2
II	2,215,522	4.6	36,403.0	12.1	60.9
III	4,802,793	10.0	18,230.8	6.1	263.4
IV	6,118,620	12.7	46,924.2	15.6	130.4
V	3,476,982	7.2	17,632.5	5.9	197.2
VI	4,525,615	9.4	20,223.1	6.7	223.8
VII	3,787,374	7.9	14,951.4	5.0	253.3
VIII	2,799,534	5.8	21,431.7	7.1	130.6
IX	2,528,506	5.3	18,685.1	6.2	135.3
X	2,758,985	5.7	28,327.8	9.5	97.4
XI	3,346,803	7.0	31,692.8	10.6	105.6
XII	2,270,949	4.7	23,293.2	7.8	97.5

Source: National Census and Statistics Office.

Table 3-4. Number of In-and Out-Migrants, by Region, 1970–1975 and 1975–1980

(Persons)

Region	1970–1975			1975–1980		
	In Migrants	Out Migrants	Net Migrants	In Migrants	Out Migrants	Net Migrants
Philippines	8,887,910	887,910	–	1,136,953	1,136,953	–
NCR	263,058	195,860	67,198	378,878	202,169	176,709
I	29,739	70,739	(41,070)	35,588	85,329	(49,741)
II	24,070	28,218	(4,148)	33,259	36,041	(2,782)
III	99,210	72,279	26,931	90,504	92,257	(1,753)
IV	94,113	73,730	20,383	183,095	113,071	70,024
V	35,517	67,102	(31,585)	36,939	98,359	(60,420)
VI	39,909	55,788	(15,879)	33,523	104,781	(71,258)
VII	51,081	89,787	(38,706)	51,757	114,211	(62,454)
VIII	44,664	49,706	(5,042)	27,605	96,912	(69,307)
IX	17,993	40,860	(22,867)	28,143	36,956	(8,813)
X	81,935	45,950	35,985	92,319	56,477	35,842
XI	77,385	49,850	27,535	89,017	61,853	21,164
XII	29,306	48,041	(18,735)	56,326	38,537	17,789

Source: National Census and Statistics Office.

Table 3-5. Existing Roads, by Category and by Region, 1983 (Kilometers)

Region	Total		National		Provincial		City		Municipality		Barangay		Density km/km²
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Philippines	155,700,401	100.0 (100.0)	24,140,181	100.0 (15.5)	29,724,922	100.0 (19.1)	3,718,131	100.0 (2.4)	12,269,753	100.0 (7.9)	85,847,414	100.0 (55.1)	0.5
NCR	2,647,049	1.7 (100.0)	674,961	2.8 (25.5)	124,597	0.4 (4.7)	1,117,815	30.1 (42.2)	530,712	4.3 (20.1)	198,964	0.2 (7.5)	4.2
I	17,728,419	11.4 (100.0)	2,159,336	8.9 (12.2)	3,015,219	10.1 (17.0)	309,720	8.3 (1.8)	1,405,533	11.4 (7.9)	10,838,611	12.3 (61.1)	0.8
II	12,443,613	8.0 (100.0)	2,283,872	9.5 (18.3)	2,048,452	6.9 (16.5)	—	— (—)	1,122,570	9.2 (9.0)	6,988,719	8.1 (56.2)	0.3
III	12,835,225	8.2 (100.0)	1,660,016	6.9 (12.9)	2,402,459	8.1 (18.7)	258,553	6.9 (2.0)	941,306	7.7 (7.4)	7,572,891	8.8 (59.0)	0.7
IV	18,663,294	12.0 (100.0)	3,594,810	14.9 (19.3)	4,259,712	14.3 (22.8)	286,183	7.7 (1.5)	1,383,193	11.3 (7.4)	9,139,396	10.7 (49.0)	0.4
V	8,440,813	5.4 (100.0)	1,644,609	6.8 (19.5)	2,035,521	6.9 (24.1)	230,418	6.2 (2.7)	776,408	6.3 (9.2)	3,753,857	4.4 (44.5)	0.5
VI	13,029,749	8.4 (100.0)	2,406,930	10.0 (18.5)	2,455,499	8.3 (18.8)	223,483	6.0 (1.7)	689,620	5.6 (5.3)	7,254,217	8.4 (55.7)	0.6
VII	10,968,388	7.0 (100.0)	1,659,916	6.9 (15.1)	2,385,262	8.0 (21.8)	302,139	8.1 (2.8)	892,443	7.3 (8.1)	5,728,628	6.7 (52.2)	0.7
VIII	9,064,564	5.8 (100.0)	1,883,646	7.8 (20.8)	1,[illegible],779	5.1 (16.6)	70,595	1.9 (0.8)	645,111	5.3 (7.1)	4,958,433	5.8 (54.7)	0.4
IX	8,291,385	5.3 (100.0)	905,932	3.7 (10.9)	1,993,624	6.7 (24.0)	121,954	3.3 (1.5)	680,390	5.5 (8.2)	4,589,485	5.7 (55.4)	0.4
X	15,642,299	10.1 (100.0)	2,099,116	8.7 (13.4)	2,634,724	8.9 (16.9)	218,239	5.9 (1.4)	1,097,008	8.9 (7.0)	9,593,212	11.2 (61.3)	0.6
XI	14,749,733	9.5 (100.0)	1,939,308	8.0 (13.1)	2,826,695	9.5 (19.2)	450,332	12.1 (3.1)	1,246,116	10.2 (8.4)	8,287,282	9.6 (56.2)	0.5
XII	11,195,870	7.2 (100.0)	1,227,729	5.1 (11.0)	2,036,379	6.8 (18.2)	128,343	3.5 (1.1)	859,343	7.0 (7.7)	6,943,719	8.1 (62.0)	0.5

( ) = %

Source: Ministry of Public Works and Highways.

Table 3-6 Number of Ports by Category and by Region, as of March 1984

Region	Total	Ports of Entry	Sub-Port of Entry	Other National Ports	Numicipal Ports	Private Ports
Total	542	38	14	24	226	240
NCR	3	3	—	—	—	—
I	6	1	—	1	2	2
II	3	2	1	—	—	—
III	16	1	2	—	—	13
IV	110	3	1	4	58	44
V	26	5	1	2	12	6
VI	74	3	—	3	19	49
VII	68	2	3	3	29	31
VIII	19	4	—	3	7	5
IX	47	2	4	3	30	8
X	81	4	1	3	23	50
XI	37	6	—	—	10	21
XII	52	2	1	2	36	11

Source:Philippine Ports Authority.

Table 3-7 Distribution of National Airports, by Region, 1983

Region	Total	International	Feeder	Secondary	Trunk line
Total	84	6	29	38	11
NCR	1	1	—	—	—
I	6	1	2	2	1
II	6	—	1	5	1
III	3	—	2	1	—
IV	15	1	8	5	1
V	7	—	1	5	1
VI	6	—	1	2	3
VII	6	1	2	2	1
VIII	9	—	5	3	1
IX	9	1	4	4	—
X	7	—	3	3	1
XI	6	1	—	4	1
XII	3	—	—	2	1

Source: Ministry of Transportation and Communications.

3) Airports

There are six airports in Region II but no international airports. Distribution of National Airports by Region, 1983 are as shown in Table 3-7.

4) Schools

There are 2,215 primary schools, 273 junior high schools, and 318 senior high schools, totaling 2,526 in Region II. Though simple comparison is difficult since the basis such as residential distributions and school sizes is different, Region II has 1 school for every 1,000 persons which compares with 0.8 for nationwide. Overall, including Region II, schools are distributed fairly evenly across the country.

Table 3-8 shows Distribution of Schools by Level of Education Offered, and by Region, School Year 1981–1982.

5) Hospitals

There are 127 hospitals in Region II. In terms of the number of beds per 1,000 persons, Region II ranks third with 1.41 beds, though below the national average, among the regions excepting Metropolitan Manila. Again it is difficult to compare in simple terms, but in terms of the number of hospitals per 1,000 persons, Region II tops the list with 0.054 which compares with 0.033 for the nationwide average.

Table 3-9 shows Hospital and Hospitals Beds: Number and Ratio to Population, by Region, 1982.

Table 3-8 Distribution of Schools, by Level of Education Offered, and by Region, School Year 1981–1982

Region	Total Public & Private	Percent %	Elementary			Secondary			Tartiary			
			Total	Public	Private	Total	Public	Private	Total	Public	Private	
Total	38,169 (1000)	100.0	31,729 (83)	30,561	1,168	5,354 (14)	3,298	2,056	1,086 (3)	316	770	0.8
NCR	1,310	3.4	754	440	314	366	128	238	190	13	177	0.2
I	3,679	9.6	2,933	2,836	97	671	460	211	75	19	56	1.0
II	2,526	6.6	2,215	2,164	51	273	164	109	38	17	21	1.0
III	3,007	7.9	2,473	2,335	138	445	253	192	89	26	63	0.6
IV	4,740	12.4	3,823	3,676	147	772	447	325	145	44	101	0.7
V	3,286	8.6	2,800	2,733	67	412	282	130	74	26	48	0.9
VI	3,816	10.0	3,163	3,057	106	544	397	147	109	56	53	0.8
VII	2,959	7.8	2,564	2,498	66	337	170	167	58	19	39	0.7
VIII	3,434	9.0	3,029	3,008	21	350	277	73	55	40	15	1.2
IX	2,212	5.8	1,937	1,899	38	229	160	69	46	18	28	0.8
X	2,686	7.0	2,269	2,237	32	350	213	137	67	16	51	0.9
XI	2,506	6.6	2,055	2,002	53	351	199	152	100	13	87	0.7
XII	2,088	5.3	1,714	1,676	38	254	148	106	40	9	31	0.9

Source: Ministry of Education, Culture and Sports.

Table 3-9 Hospital and Hospitals Beds: Number and Ratio to Population, by Region, 1982

Region	Total Population	Total Hospitals	Hospitals		Hospital Beds	Hospital Beds		Hospital Beds/ 1,000 Population
			Govern-ment	Private		Govern-ment	Private	
Total	50,783	1,672	494	1,178	83,137	43,485	39,652	1.64
N C R	6,345	162	24	138	27,751	15,871	11,880	4.37
I	3,682	144	46	98	5,617	2,820	2,797	1.53
II	2,340	127	48	79	3,300	2,175	1,125	1.41
III	5,070	188	53	135	6,274	3,672	2,602	1.24
IV	6,516	220	70	150	8,182	4,205	3,977	1.26
V	3,658	153	37	116	4,913	2,060	2,853	1.34
VI	4,755	71	38	33	4,405	2,025	2,380	0.93
VII	3,951	92	33	59	4,876	1,992	2,884	1.23
VIII	2,910	73	45	28	2,818	2,057	761	0.97
IX	2,671	76	28	48	2,720	1,891	829	1.02
X	2,931	125	28	97	4,661	2,075	2,586	1.59
XI	3,551	153	26	127	4,557	1,417	3,140	1.28
XII	2,403	88	18	70	3,063	1,225	1,838	1.27

Source: Ministry of Health.

(5) Present Status of Land Use and Forest

The Republic of the Philippines has a total land area of 30,000,000 hectares, of which 14,467,600 hectares of 48.2% are alienable & dispensable (A/D) and 15,532,400 hectares or 51.3% forest lands. Regional II accounts for 12.1% in total land area, 8.2% in A/D, and 15.2% in forest lands.

Compared with other regions, Region II with a total land area of 3,640,300 hectares is the lowest in the share of A/D with 32.4% but the highest in the percentage of forest lands with 67.6% (Table 3-10).

Table 3-11 shows the classification of forest lands. As shown in the table, of the total forest land area of 2,460,000 hectares in Region II, 71% or 1,736,000 has been classified. The percentage breaks down to 63% for protective forests, 27% for productive forests, 7% for conservation forests, and 3% for military and other purposes. Compared with other regions (Table 3-12), Region II has the third largest share of protective forests following Region I and IX, with 44.5%. Another characteristic of Region II is the ratio of productive forests being among the lowest next only to Region I, with 19.2%.

Table 3-10 Land Classification, by Region, 1983

(Unit: 1000 ha)

Region	Total Land Area		Alienable & Disposable		Forestland	
	ha	%	ha	%	ha	%
Total	30,000.0	100.0	14,467.6	100.0	15,532.4	100.0
	(100.0)		(48.2)		(51.8)	
N C R	63.6	0.2	34.7	0.2	28.9	0.2
	(100.0)		(54.6)		(45.4)	
I	2,156.9	7.3	951.8	6.6	1,205.1	7.8
	(100.0)		(44.1)		(55.9)	
II	3,640,3	12.1	1,180.3	8.2	2,460.0	15.8
	(100.0)		(32.4)		(67.6)	
III	1,823.1	6.1	1,071.5	7.4	751.6	4.9
	(100.0)		(58.8)		(41.2)	
IV	4,692.4	15.6	2,138.6	14.8	2,553.7	16.4
	(100.0)		(45.6)		(54.4)	
V	1,763.2	5.9	1,292.9	8.9	470.4	3.0
	(100.0)		(73.3)		(26.7)	
VI	2,022.3	6.7	1,460.2	10.1	562.1	3.6
	(100.0)		(72.2)		(27.8)	
VII	1,495.1	5.0	903.4	6.2	591.8	3.8
	(100.0)		(60.4)		(39.6)	
VIII	2,143.2	7.1	1,027.9	7.1	1,115.2	7.2
	(100.0)		(48.0)		(52.0)	
IX	1,868.5	6.2	1,013.7	7.0	854.8	5.5
	(100.0)		(54.3)		(45.7)	
X	2,832.8	9.4	1,110.9	7.7	1,721.9	11.1
	(100.0)		(39.2)		(60.8)	
XI	3,169.3	10.6	1,244.2	8.6	1,925.1	12.4
	(100.0)		(9.3)		(60.7)	
XII	2,329.3	7.8	1,037.5	7.2	1,291.8	8.3
	(100.0)		(44.5)		(55.5)	

Note: Figures in parenthesis denote percentage distribution to total land area of a region.
Source: Bureau of Forest Development.

Table 3-11 Forestland, by Category, and by Region, 1983

(Unit: 1,000 ha)

Region	Total Forestlands		Unclassified Forestlands		Classified Forestlands											
					Total		Established Forest Reserved		Established Timberlands		Natural GRBS/WA[1]		Military & Civil Reservation		Fishponds	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%		%
Total	15,532.4	100.0	5,060.1	100.0	10,472.3	100.0	3,496.0	100.0	4,959.5	100.0	1,571.4	100.0	436.3	100.0	9.2	100.0
NCR	28.9	0.2	28.9	0.6	–	–	–	–	–	–	–	–	–	–	–	–
I	1,205.1	7.8	417.3	8.3	787.8	7.5	619.1	17.7	93.0	1.9	9.0	0.6	66.4	15.2	0.3	3.3
II	2,460.0	15.8	724.1	14.3	1,735.9	(100) 16.6	1,094.2	(63) 31.3	471.6	(27) 9.5	115.5	(7) 7.4	54.5	(3) 12.5	0.1	1.1
III	751.6	4.8	211.8	4.2	539.8	5.1	140.7	4.1	193.7	3.9	28.8	1.8	176.6	40.5	–	–
IV	2,553.7	16.4	427.6	8.4	2,126.1	20.3	276.0	7.9	567.8	11.4	1,212.0	77.1	69.8	16.0	00.3	3.3
V	470.4	3.1	27.6	0.5	442.8	4.2	52.9	1.5	364.5	7.3	25.3	0.6	–	–	0.1	1.1
VI	562.1	3.6	108.4	2.1	453.7	4.3	130.3	3.7	296.6	6.0	23.4	1.5	0.2	0.1	3.2	34.8
VII	591.8	3.8	229.5	4.5	362.3	3.5	53.0	1.5	289.1	5.8	18.7	1.2	–	–	1.5	16.3
VIII	1,115.2	7.2	769.0	15.2	346.2	3.3	51.5	1.5	292.3	5.8	2.1	0.1	0.3	0.1	–	–
IX	854.8	5.5	220.8	4.4	634.0	6.1	418.9	12.0	207.9	4.2	6.7	0.4	–	–	0.5	5.4
X	1,721.9	11.1	677.4	13.4	1,044.5	10.0	314.2	9.0	672.6	13.6	55.7	3.6	–	–	2.0	21.7
XI	1,925.1	12.4	575.9	11.4	1,349.2	12.9	217.8	6.2	1,016.3	20.5	53.6	3.4	60.4	13.8	1.1	11.9
XII	1,291.8	8.3	641.8	12.7	650.0	6.2	127.2	3.6	494.1	10.1	20.6	1.3	8.0	1.8	0.1	1.1

Source: Bureau of Forest Development. ( ) = Classified Forestlands in Region II

Table 3-12. Forestland, by Category, and by Region, 1983

(Unit: %)

Region	Total Forestlands	Unclassified Forestlands	Classified Forestlands					
			Total	Established Forest Reserves	Established Timberlands	Natural GRBS/WA	Military & Civil Reservation	Fishponds
Philippines	100.0	32.6	67.4	22.5	31.9	10.1	2.8	0.1
NCR	100.0	100.0	–	–	–	–	–	–
I	100.0	34.6	65.4	51.4	7.7	0.8	5.5	0.0
II	100.0	29.4	70.6	44.5	19.2	4.7	2.2	0.0
III	100.0	28.2	71.8	18.7	25.8	3.8	23.5	–
IV	100.0	16.8	83.2	10.8	22.2	47.5	2.7	0.0
V	100.0	5.9	94.1	11.2	77.5	5.4	–	0.0
VI	100.0	19.3	80.7	23.2	52.8	4.2	0.0	0.5
VII	100.0	38.8	61.2	8.9	48.9	3.1	–	0.3
VIII	100.0	69.0	31.0	4.6	26.2	0.2	0.0	–
IX	100.0	25.8	74.2	49.0	24.3	0.8	–	0.1
X	100.0	39.3	60.7	18.3	39.1	3.2	–	0.1
XI	100.0	29.9	70.1	11.3	52.8	2.8	3.1	0.1
XII	100.0	49.7	50.3	9.9	38.2	1.6	0.6	0.0

Source: Bureau of Forest Development

3–2. Outline of Study Area

3–2–1. Natural Environment of Study Area

(1) Location and Area

The Cagayan River Basin, the study area, is located in the northeast of Luzon Island, the largest island of the Philippines, encompassing the eight provinces of Cagayan, Kalinga Apayao, Isabela, Mountain, Ifugao, Nueva Vizcaya, Quirino, and Quezon. The area is enclosed by mountain ranges on three sides, namely the Siera Madre on the east, the Cordillera Central on the west, and the Caraballo on the south, and, on the north, it faces the Babuyan Channel. The study area has an area of approximately 2.8 million hectares involving the bulk of Region II, an administrative regin. Figure 3-7 shows the study area as defined on the map.

(2) Geomorphology

1) Classification

The geomorphology of the study area was compiled according to the classifications as shown in Table 3-13.

Table 3-13 Legend of Geomorphology

LEGEND OF GEOMORPHOLOGY	
LOWLANDS (under 100m)	
L 1	Coastal ridge, Sand bar,Sand dune
L 2	Back marsh (coastal・fluvial)
L 3	Natural levee
L 4	Flood plain
L 5	Valley bottom lowland
L 6	Fan
L 7	River bed
MIDLANDS (100~400m)	
M 1	Terrace
M 2	Colluvial slope,Talus
M 3	Dissected upland
M 4	Hill
M 5	Piedmont (rolling)
M 6	Piedmont (dissected)
HIGHLANDS (over 400m)	
H 1	Escarpment
H 2	Plateau
H 3	Low relief surface on mountain
H 4	Dissected slope on mountain
H 5	Gentle slope on mountain
H 6	Steeply dissected slope
MISCELLANEOUS	
Water body	Collapse
Cliff	Collapse (small size)
Landslide	Rock stream

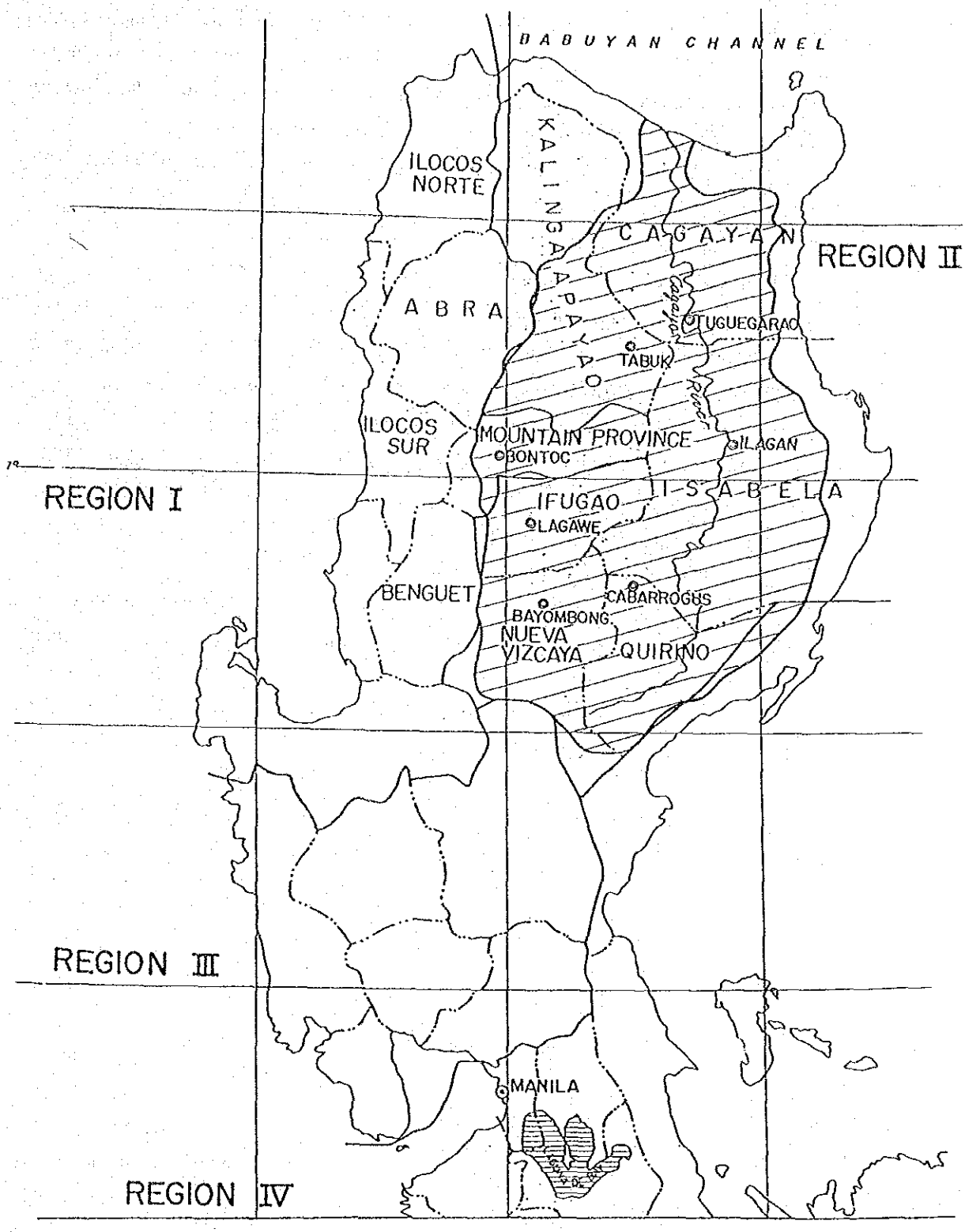


Fig. 3-7. Location Map of Study Area

The classifications generally applied to the nation's land as a whole are Lowland for under 100 m of elevation, Midland for 101 m – 300 m, and Highland for over 300 m. In the upper valley of the Cagayan River, however, agricultural land extends as high as 300 m – 400 m, and, therefore, the elavation of 400 meters was adopted for the boundary of Midland and Highland.

Figure 3-8 shows the Geomorphological Map compiled on the basis of the above classifications.

(3) Topography

1) Elevation

Low lands of under 100 m in elevation are extensively distributed in the mid- and down-stream of the Cagayan River while lowlands and hills of 100 m – 400 m are developed upstream. On the left bank side of the mid- and up-stream Cagayan River are formed Piemont which continuously extend to Hills, Lifted Fans, Terraces, and Fans, covering wide areas. Highlands of over 400 m are distributed in the east, south and the west of the area generally forming the steeply rising topography to enclose the river valley. In the south and west, there are scattered distributions of lowlands and gentle slopes.

Elevations as computed on the basis of grid cells were classified as shown in Table 3-14 and output in a gridded map in Figure 3-9. Elevations were computed in the unit of 10 meters allowing further categorization or classification in any ranges. For the immediate purpose of this study, they were classified as follows according to the geomorphology classification.

Table 3-14 Classification of Elevations

Elevation	Area (km^2)
0 ~ 100m	6,488
101 ~ 200m	3,604
201 ~ 400m	4,372
401 ~ 800m	6,264
801m ~	7,007
Total	27,735 km^2

In Figure 3-9, areas are shown in shades starting with those of 0 – 100 m in elevation in white getting darker in shade as they go higher in height. From the map, it is seen that low land of under 100 meters is distributed in elongated belts running south to north along the main stream of the Cagayan River accounting for approximately one fourth of the river basin. As if to surround it are flat lands ranging 101 – 200m in elevation distributed particularly extensively upstream of the river.

In the periphery of those lowlands are distributed hills of 201 – 400m and they are particularly extensive in the southwest. On the outer ridges of such hills are mountains of 401 – 800m. Mountainous areas of over 801m are distributed on the east, south, and west sides of the basin in a shape of horse shoe elongated in the north-south direction. Most of the Cordillera Central Range falls in this range of classification.

2) Slope

From elevation data, slopes were calculated for each cell and classified as shown in Table 3-15 and graphically presented in Figure 3-10.

From the table, it is seen that gentle slopes of under 6° represent some 9,700 km² or 35% of the study area and those in a medium range of 6° – 14° occupy about 6,800 km² or about 25%, whereas slopes of over 14° account for some 40% or approximately 11,200 km².

Table 3-15 Classification of Slope

Slope	Area km² (%)
0~ 3% (0~ 2°)	7,211 (26.0)
4~ 8% (2~ 6°)	2,456 (9.0)
9~18% (6~10°)	3,921 (14.0)
19~25% (10~14°)	2,912 (10.5)
26~50% (14~26°)	9,182 (33.0)
51%~ (26° ~)	2,053 (7.5)
Total	27,735 (100.0%)

3) Slope Aspect

The slope aspect is determined by the location of a surrounding cell which is at the steepest angle with a particular cell as found in computations of slopes. Slope aspects are defined in eight directions, i.e., N, NE, E, SE, S, SW, W, and NW. In addition, there are "pit" and "peak". Pit is defined as a cell whose height is lower than any of the surrounding cells. Conversely, peak is a cell that is higher in all directions. Therefore, slope aspects are classified into ten categories in total.

Figure 3-11 shows slope aspects. It must be noted, however, that in this particular output, slope aspects are represented in terms of six categories, instead of ten, namely, (1) pit, (2) N NE, (3) E SE, (4) S SW, (5) W NW, (6) peak, for the sake of distinction, since ten different shadings would make it rather difficult to distinguish them from one another.

In the figure there are seen many peaks and pits reflecting gentle undulations in the lowlands along the Cagayan River, while in the hills and mountains, where drainage patterns are highly developed, slope aspects are varying except for major tributary areas.

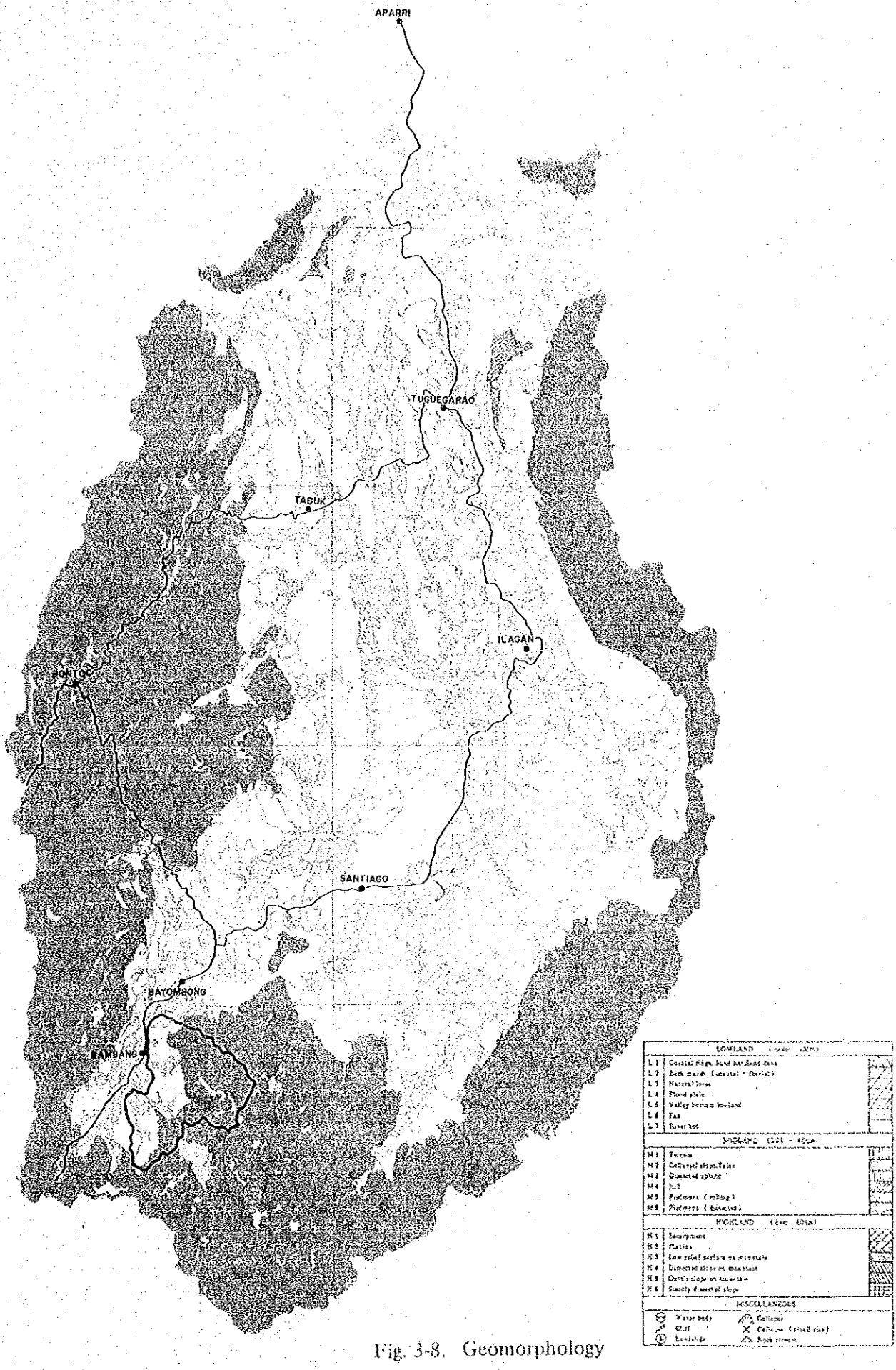


Fig. 3-8. Geomorphology

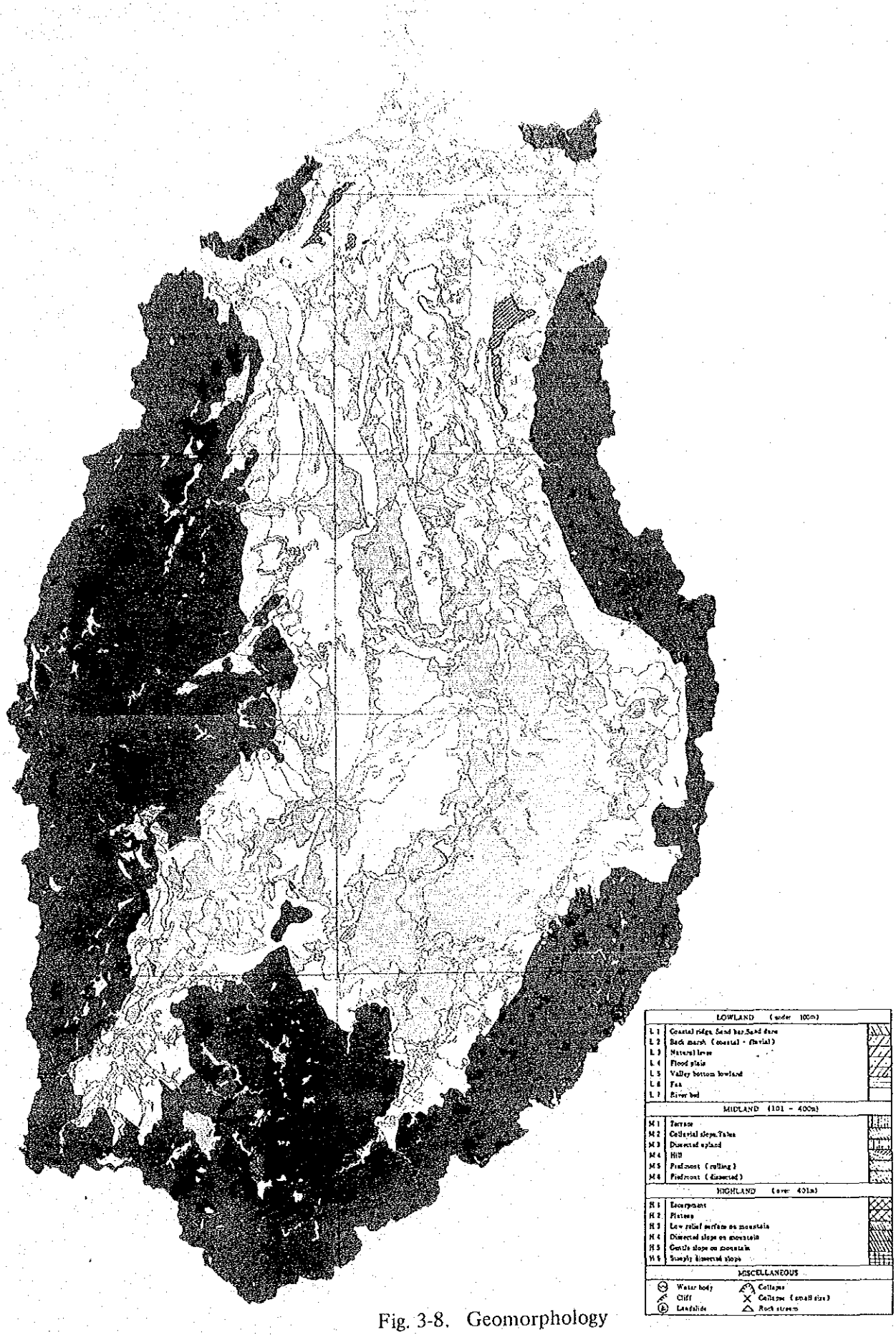


Fig. 3-8. Geomorphology

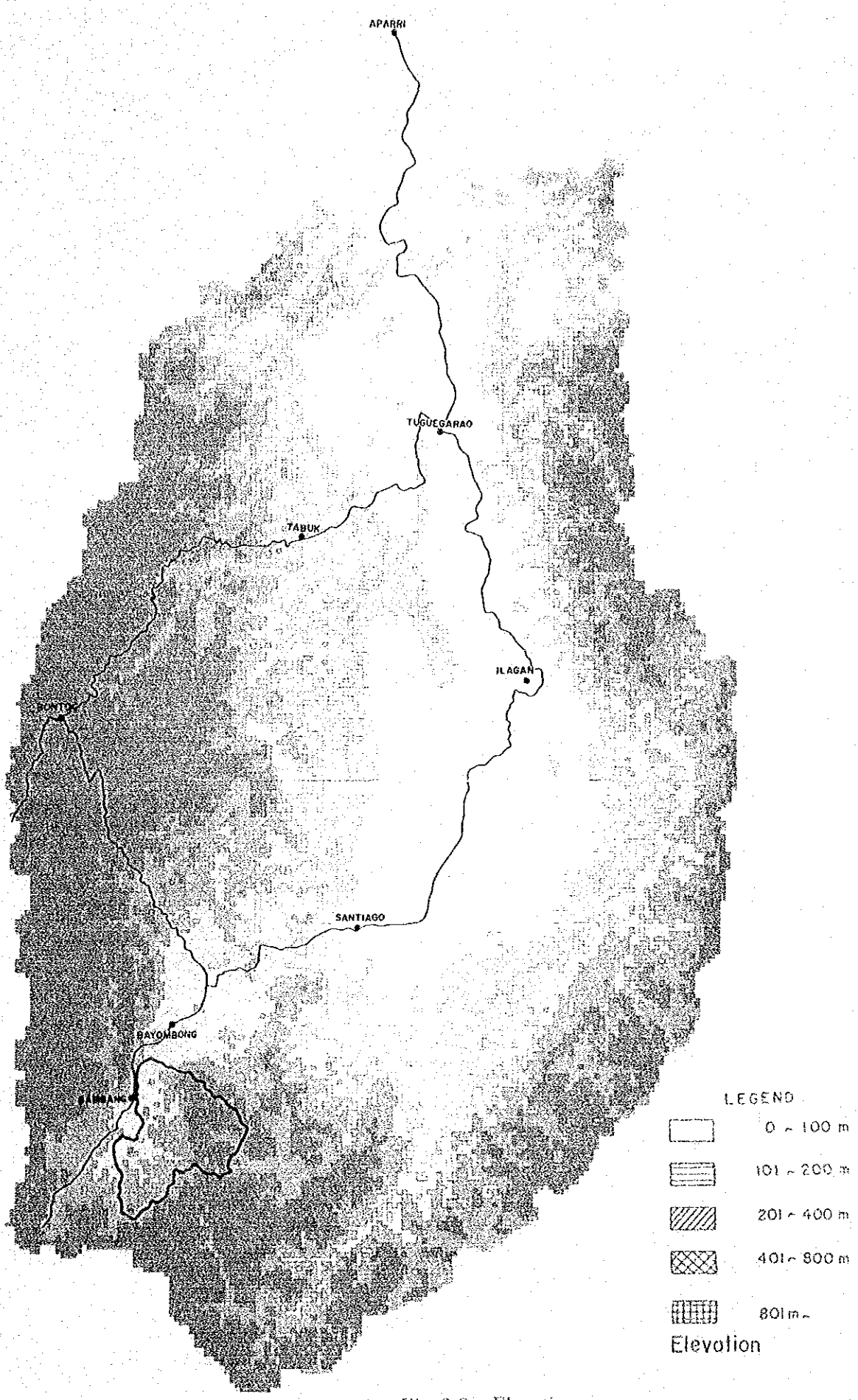


Fig. 3-9. Elevation

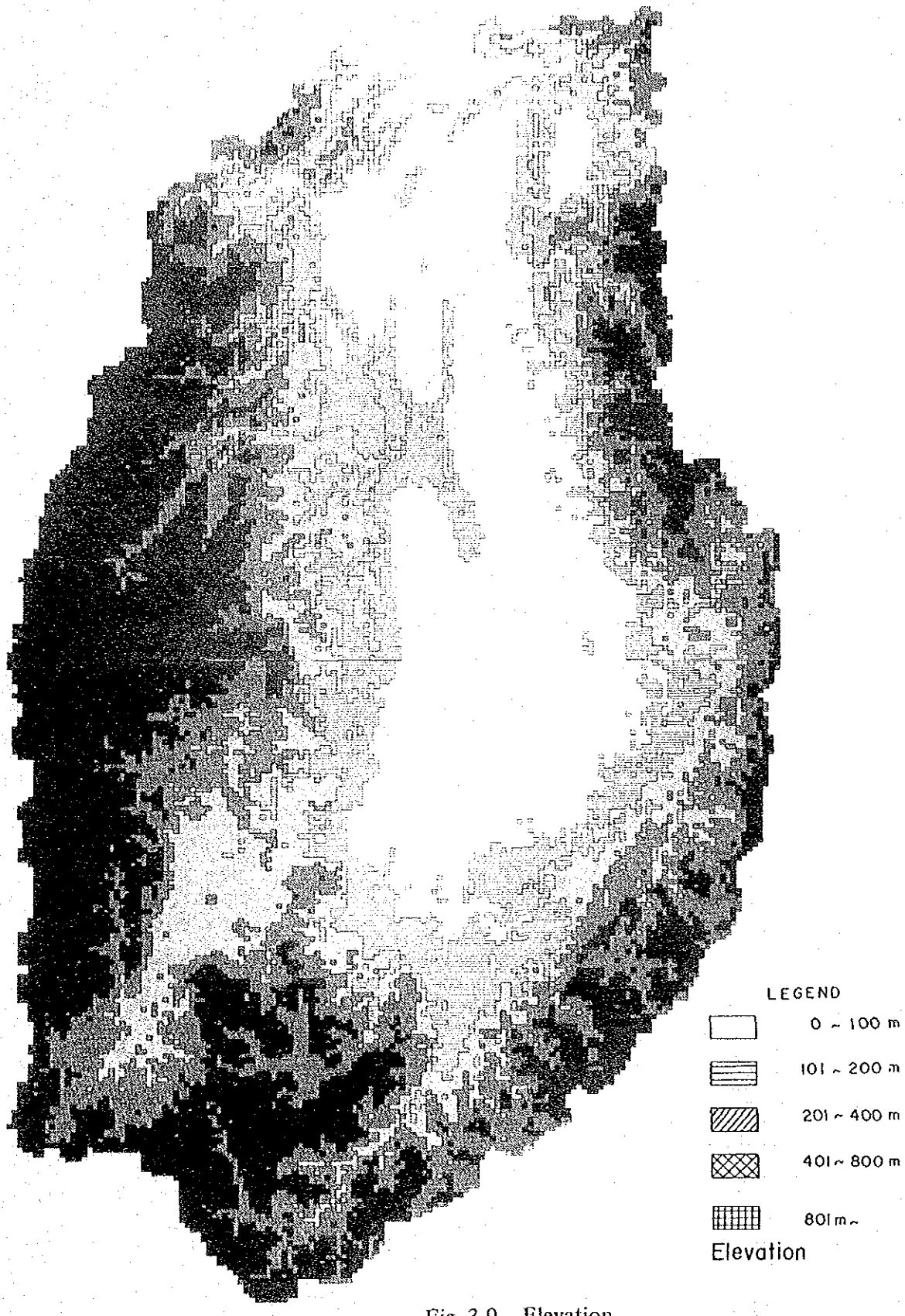


Fig. 3-9. Elevation

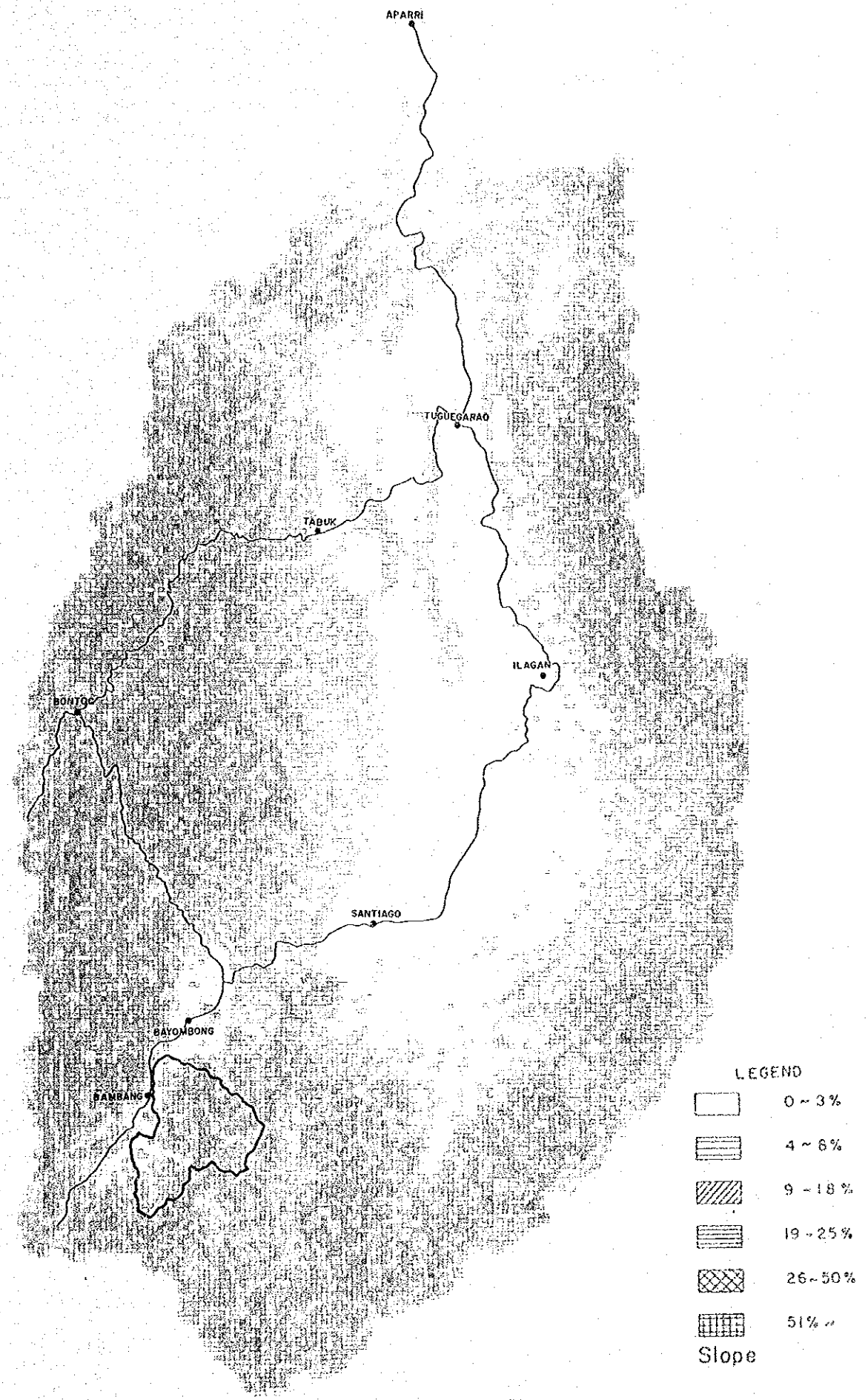


Fig. 3-10. Slope

Fig. 3-10. Slope

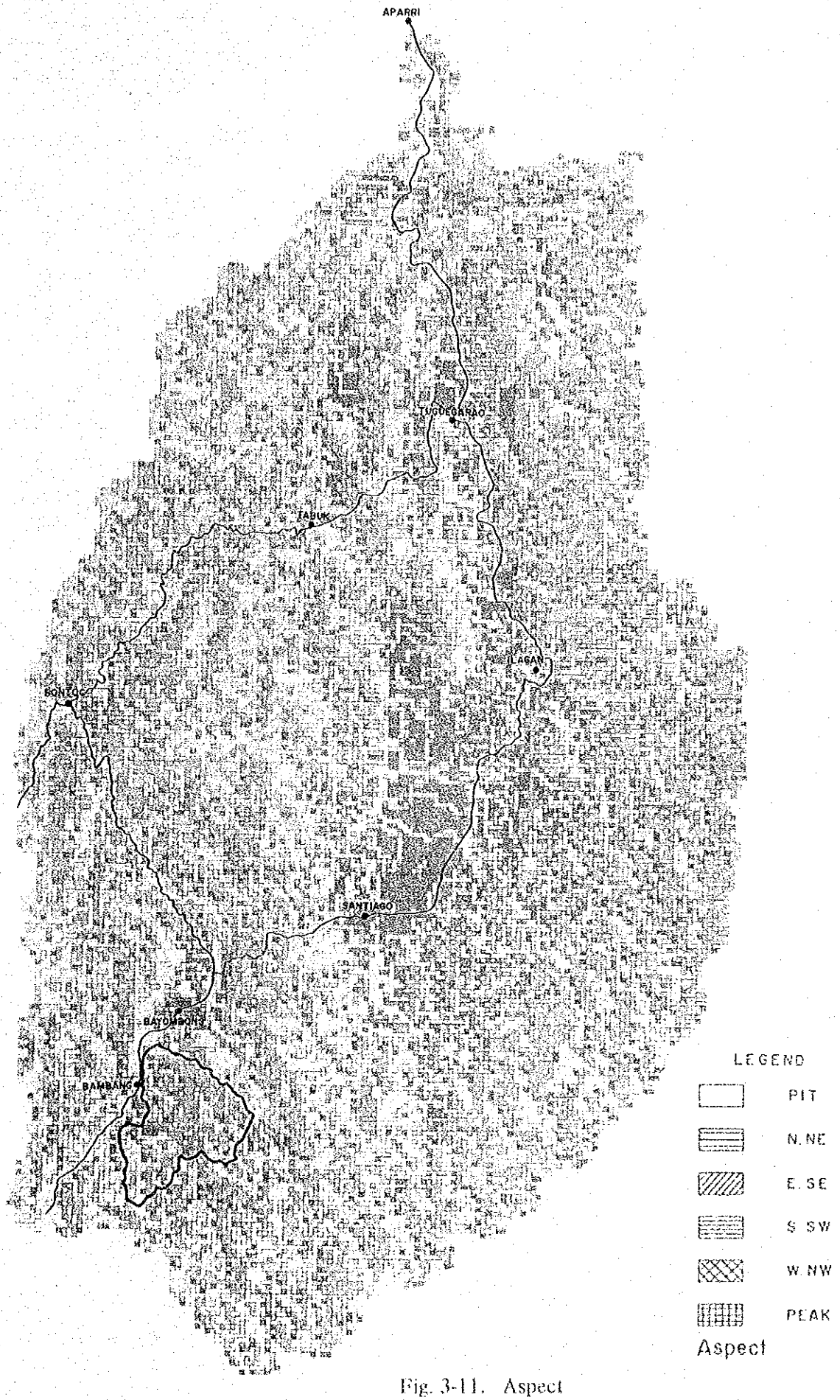


Fig. 3-11. Aspect

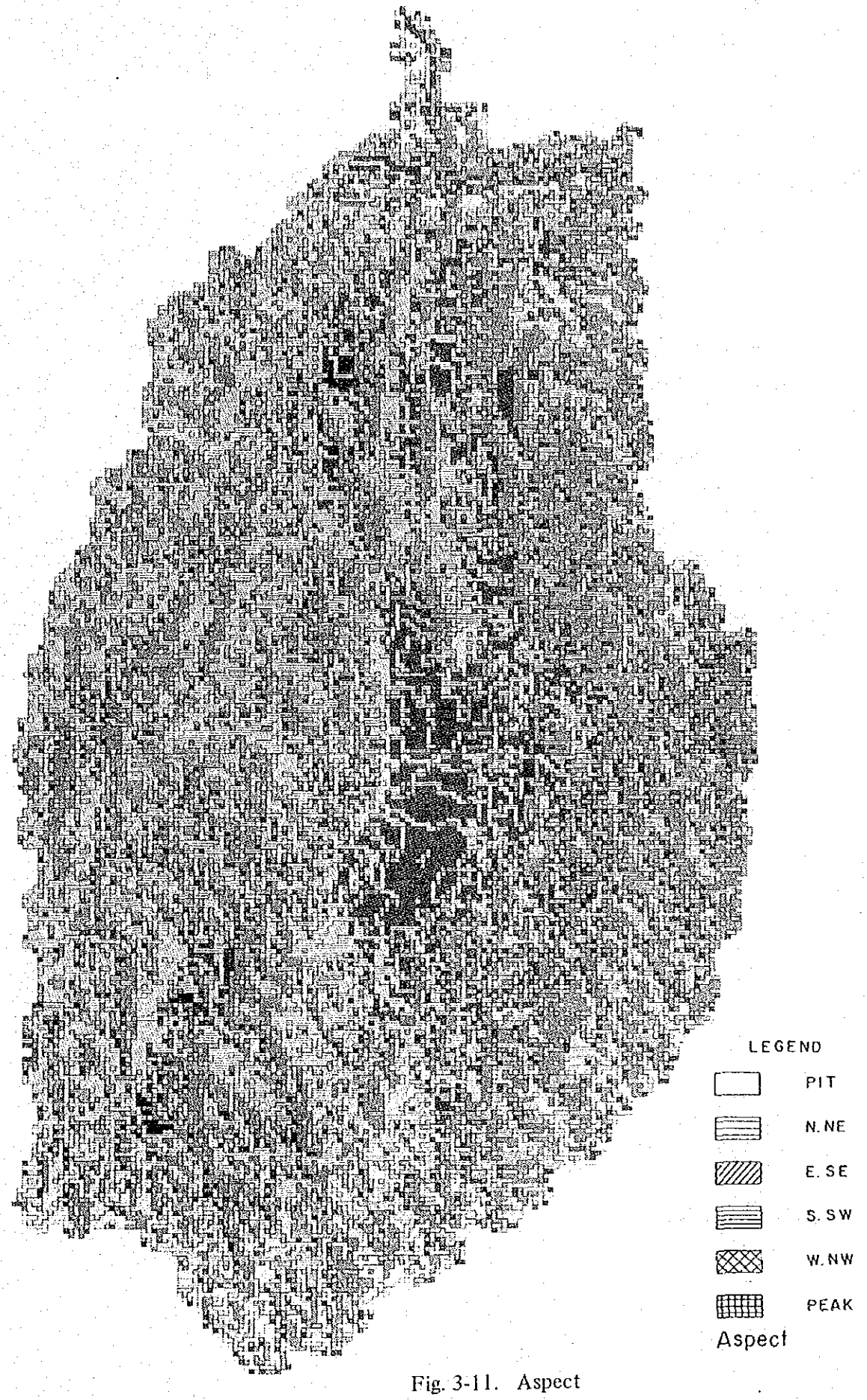
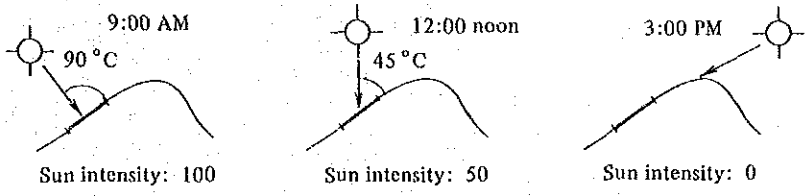


Fig. 3-11. Aspect

4) Sun Intensity

Sun intensity is computed for a given time and day, from elevation, slope aspect, and sun altitude data, assuming the weather is fine at all times.

For the purpose of this study, sun intensity was computed for 9:00 am, 12:00 noon and 3:00 pm for January 1, for each cell, and the results were added up to make the intensity for individual cells. Intensity is computed basically as follows.



In the above illustrations, the amounts of sun intensity at that particular location (cell) as indicated by — add up to 100 + 50 + 0 = 150. The same computation was repeated for every and all cells. The entire range of sun intensity as computed from minimum to maximum was divided equally into five levels and output in a printout as shown in Fig. 3-12.

The figure shows that the sun is medium in intensity in lowlands – mild slopes along the Cagayan River and there are scattered areas along the mountain valleys where the sun is weak, while the sun is intense in many parts on top of the mountains.

5) Exposure

Computed from elevations, viewshed defines areas (Grid cells) which are visible from a certain given location or a cell. In that instance, a viewpoint can be set arbitrarily at a given height (for example, at a height ten meters higher than the elevation, to provide a viewpoint at the top of an imaginary tower erected at that particular location).

This type of data are useful for siting of a watch station for forest fires, vista points for scenic mountain roads, or locating constructions in a manner to preserve visual quality of the environment for local residents. Viewpoints can be set as freely as need be. For our study, viewpoints were set, one at Tuguegarao and another at about the center of the Model Area. The output is shown in Figure 3-13.

6) Bird's Eye View

Computed from elevations, Bird's Eye View is a three-dimensional representation of a topographical site as viewed in a given direction and at a given height.

Figure 3-14 is a three-dimensional representation of the study area as seen from north of Aparri. This type of data along with viewsheds are useful for study of visual quality of environment.