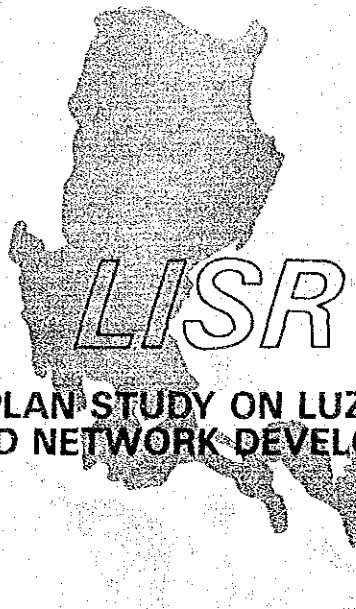
社会開発調査部報告書 L COOPERATION AGENCY (JICA)

No. 62

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES



MASTER PLAN STUDY ON LUZON ISLAND STRATEGIC ROAD NETWORK DEVELOPMENT PROJECT

FINAL REPORT

MAIN TEXT

JULY 1993

KATAHIRA & ENGINEERS INTERNATIONAL
NIPPON KOEI CO., LTD.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Master Plan Study on Luzon Island Strategic Road Network Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Kunihiko Sawano, Katahira & Engineers International and composed of members from Katahira & Engineers International and Nippon Koei Co., Ltd., twice between March 1992 to March 1993.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

July, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

July 15, 1993

Mr. Kensuke Yanagiya
President,
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Yanagiya,

Letter of Transmittal

We are pleased to submit to you the Final Report of the Master Plan Study on Luzon Island Strategic Road Network Development Project. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above mentioned master plan.

This report presents a master plan for major road network development in Luzon Island to support the balanced regional development in the island. The master plan consists of 91 road projects. Taking into account the priority of the projects and the possible investment amount, the implementation schedule is developed for three six-year programs and recommendations to facilitate the implementation are made.

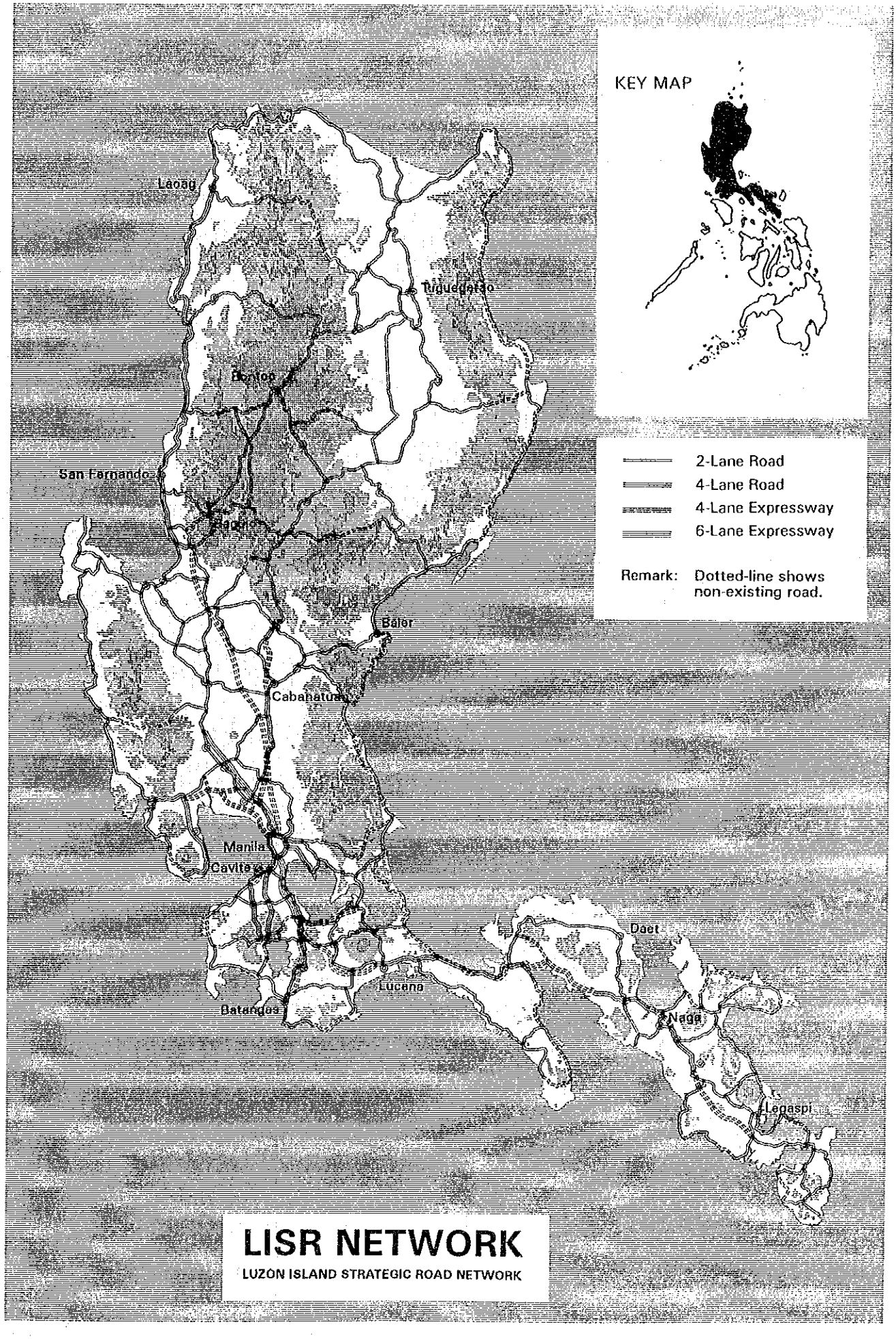
In view of the urgency of developing the strategic road network and the need for socio-economic development in Luzon Island as a whole, we recommend that the Government of the Philippine materializes this plan as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency, Ministry of Foreign Affairs and Ministry of Construction. We also wish to express our deep gratitude to the Department of Public Works and Highways and other authorities concerned of the Government of the Philippine for the close cooperation and assistance extended to us during the course of the Study.

Very truly yours,

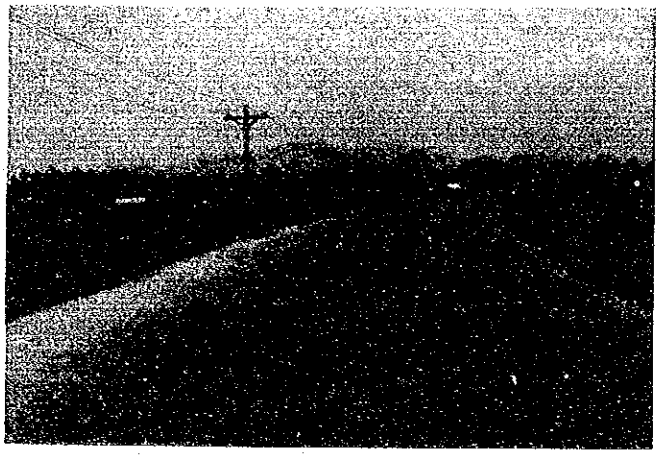
Kunihiko Sawano

Kunihiko Sawano
Team Leader,
Master Plan Study on Luzon
Island Strategic Road Network
Development Project



LISR NETWORK

LUZON ISLAND STRATEGIC ROAD NETWORK



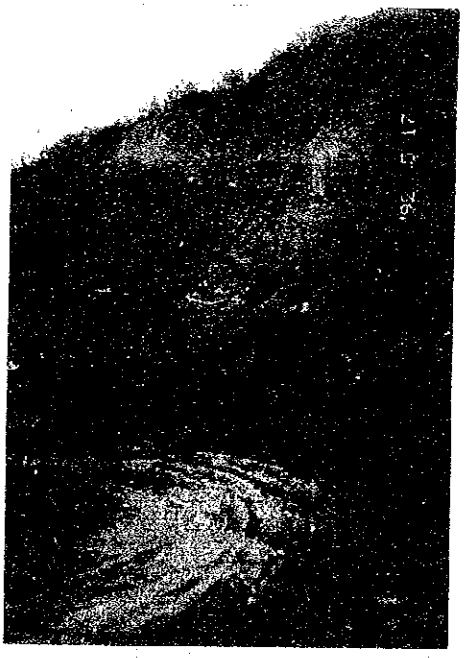
Pan-Philippine Highway, Camarines Norte
PCC pavement in good condition

Quezon - Batangas Road, Quezon
PCC pavement in bad condition

Calauag - Buenavista Road, Quezon
Gravel road in fair condition

Baguio - Bontoc Road, Benguet
Gravel road in bad condition

Ariman Jct. - Bulusan Lake Road, Sorsogon
Earth road in flood potential section



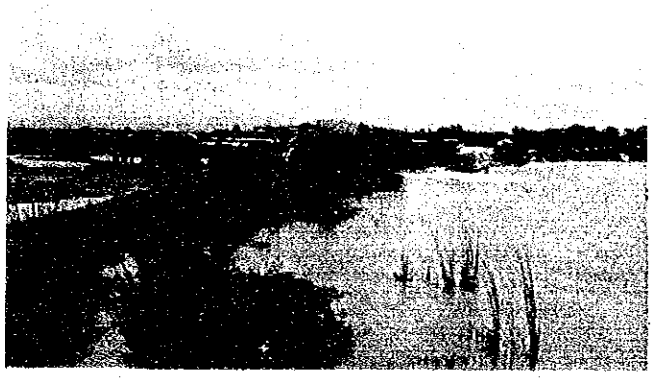
Baguio - Itogon - San Miguel Road, Benguet
Earth road in very bad/impassable condition

Road Conditions

Aritao - Dupax - Kasibu Road, Nueva Vizcaya
Bailey bridge

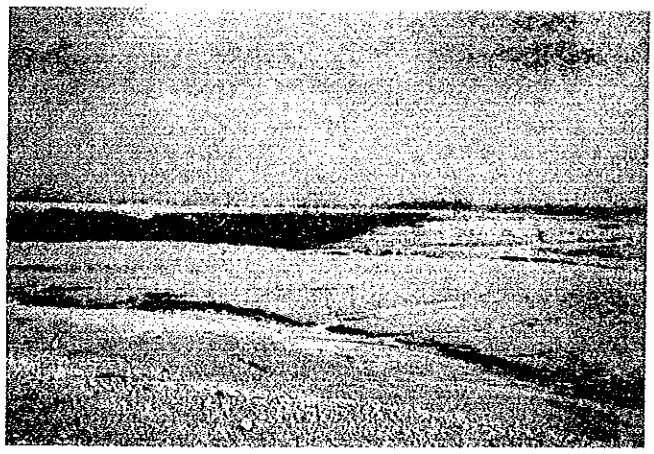
Bagong - Silang - Capalonga Road, Camarines Norte
Timber bridge

Tiwi - Legaspi City Road, Albay
Spillway



Cabatuan - Enrile Road, Isabela
Ford crossing at Magat River

San Fernando - Olongapo Road, Pampanga
Sta.Cruz Bridge stricken by lahar from Mt.Pinatubo



Manila North Road, Pampanga
Bamban Bridge washout by the lahar

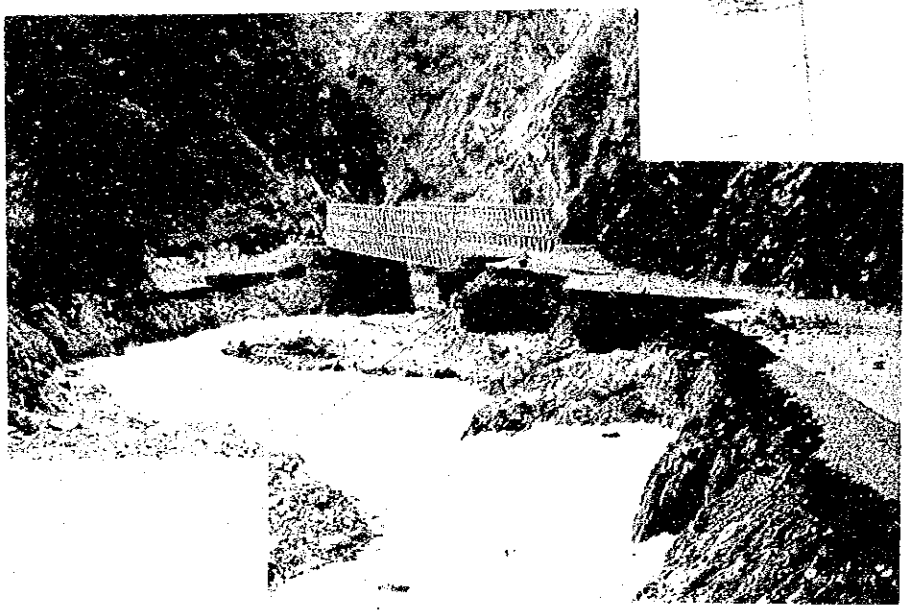
Bridge Conditions

Kennon Road, Benguet
Cut Slope Failure

Baguio - Nueva Vizcaya Road, Benguet
Debris Flow

Baguio - Bontoc Road, Benguet
Embankment Slope Failure

San Fernando - Olongapo Road, Pampanga
Flood



Kennon Road, Benguet
Scour/Washout of Roadbed

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PART II FUTURE DEVELOPMENT PLANS AND TRAFFIC DEMAND

PART III LUZON ISLAND STRATEGIC ROAD (LISR) NETWORK DEVELOPMENT PLAN

ABBREVIATIONS

ACEL : Associated Construction Equipment Lessors, Inc.
AFAP : Approved Foreign-Assisted Project
ATO : Air Transportation Office
BAS : Board of Agricultural Statistics
BOI : Board of Investment
CLBU : Central Labor Based Unit
DA : Department of Agriculture
DENR : Department of Environment and Natural Resources
DOT : Department of Tourism
DOTC : Department of Transportation and Communications
DPWH : Department of Public Works and Highways
DTI : Department of Trade and Industry
EMB : Environmental Management Bureau
HPG : Highway Patrol Group
IACEP : Inter-Agency Committee on Environmental Protection
JICA : Japan International Cooperation Agency
LGU : Local Government Unit
LTO : Land Transportation Office
MICT : Manila International Container Terminal
NCR : National Capital Region
NCSO : National Census Statistics Office
NEDA : National Economic Development Authority
NEPC : National Environmental Protection Council
NIA : National Irrigation Administration
NSCB : National Statistical Coordination Board
PAL : Philippine Airlines
PNOC : Philippine National Oil Company
PNP : Philippine National Police
PNR : Philippine National Railways
PPA : Philippine Ports Authority
PTA : Philippine Tourism Authority

AADT : Annual Average Daily Traffic
ADT : Average Daily Traffic
ANF : Air Navigation Facilities
ANRN : Arterial National Road Network
DF : Daily Factor
ECA : Environmentally Critical Area
ECC : Environmental Compliance Certificate
ECP : Environmentally Critical Project
EDC : Estimated Direct Cost
EIA : Environmental Impact Assessment
EIS : Environmental Impact System
EMK : Equivalent Maintenance Kilometer
GAA : General Appropriate Act
GDP : Gross Domestic Product
GNP : Gross National Product

GPDP	:	Gross Provincial Domestic Product
GRDP	:	Gross Regional Domestic Product
GVA	:	Gross Value Added
HF	:	Hourly Factor
I	:	Inbound
IEE	:	Initial Environmental Examination
LFP	:	Locally-Funded Project
LISR	:	Luzon Island Strategic Roads
LOI	:	Letter of Instructions
MC	:	Motorcycle
NRR	:	Net Reproduction Rate
NSO	:	National Statistics Office
NT	:	Net Value
NTCP	:	Nationwide Traffic Counting Program
O	:	Outbound
OCM	:	Overhead Expenses, Contingencies, Miscellaneous Expenses
OD	:	Origin-Destination
PC	:	Project Cost
PDO	:	Port District Office
PMO	:	Port Management Office
PCEF	:	Passenger Car Equivalent Factor
PCU	:	Passenger Car Unit
P.D.	:	Presidential Decree
PD	:	Project Description
PIPS	:	Project Identification and Programming System
PMO	:	Project Management Office
PPP	:	Philippine Population Projection
PTS	:	Philippine Transport Survey
PWA	:	Public Works Act
RCDG	:	Reinforced Concrete Deck Girder
RIC	:	Regional Industrial Center
RLBU	:	Regional Labor Based Unit
ROW	:	Right-of-Way
SL	:	Screen Line
TC	:	Tricycle (with engine)
U VEH	:	Utility Vehicle (Jeepney)
VAT	:	Value Added Tax

Remark: Exchange Rates are 1 US$ = ₱ 27.184 and ₱ 1 = ¥ 3.91 as of June 9, 1993.

TABLES

FIGURES

INTRODUCTION

INTRODUCTION

BACKGROUND OF THE STUDY

Transport system of the Philippines relies highly on road transport which handles 89% of the country's passenger movement and 53% of freight movement. In recognition of its importance, transport sector investment of the Government of the Republic of the Philippines has been focused on the road network development.

The systematic development of the road network started in the early 1970's and focused initially on improving national roads of importance in Luzon and Mindanao serving priority production areas and population centers. This emphasis, which was later expanded to cover the national roads in the Visayas, was based on recommendations of the Philippine Transport Survey (PTS) completed in 1970, and continued through the 1970's and the early 1980's. Since the middle of 1980's, the Government has been according an increasing importance to improving the rural road network with the objective of distributing the benefits of improved transport services to the segments of population that had not been fully integrated into the mainstream of economic activity. Road network in the Philippines was substantially improved due to the above Government's efforts, however, even the major road network still suffers serious problems as identified in Luzon Island as follows:

- Present major road network has been developed in such a pattern that most of the regions are provided with only one major road which becomes oftenly impassable with the occurrence of road disasters, resulting in complete isolation of the area for many weeks.

- Due mainly to topographical constraints, north-south links are in general well developed, however, east-west links are still underdeveloped. Thus, interlinkages between major roads are not realized yet and each major road is functioning independently. As most of major roads have no alternative routes in case of emergency, present major road network is still unreliable and unstable.

- Weakness of major road network impedes the sound regional development, especially in Cagayan and Bicol districts which have a high potential of agricultural development, needing the provision of high accessibility to help in realizing the targets of their development plans.

- Many major roads are seriously deteriorated as a result of initial substandard design, substantial increases in traffic volumes, loads over the years, extra heavy axle loads and insufficient road maintenance efforts.

- Some major roads, particularly those located near Metro Manila, suffer traffic capacity problems, resulting in traffic congestion due to the growing traffic demand.

It is now the time to re-evaluate the present major road network and to formulate a master plan for the forthcoming decades aiming at the development of more flexible, reliable and efficient major road network in order to soundly support national development objectives and goals.

With this view, the Government of the Republic of the Philippines (GRP) through the Department of Public Works and Highways (DPWH) sought a technical assistance from the Government of Japan (GOJ) for the conduct of the Master Plan Study on Luzon Island Strategic Road Network Development Project (the Study).

In response to the request of GRP, GOJ decided to conduct the Study. Japan International Cooperation Agency (JICA), which is the official agency responsible for the implementation of GOJ technical cooperation programs, organized a study team to be engaged in the Study. The JICA Study Team, in close collaboration with the DPWH Counterpart Team, commenced work in March 1992 and completed in May 1993.

OBJECTIVES OF THE STUDY

The objectives of the study are:

1) To formulate a master plan for Luzon Island Strategic Road Network Development for a period of 20 years aiming to support the regional development in the island, and

2) To exercise technology transfer to the Philippine counterpart engineers in the course of the Study.

SCOPE OF THE STUDY

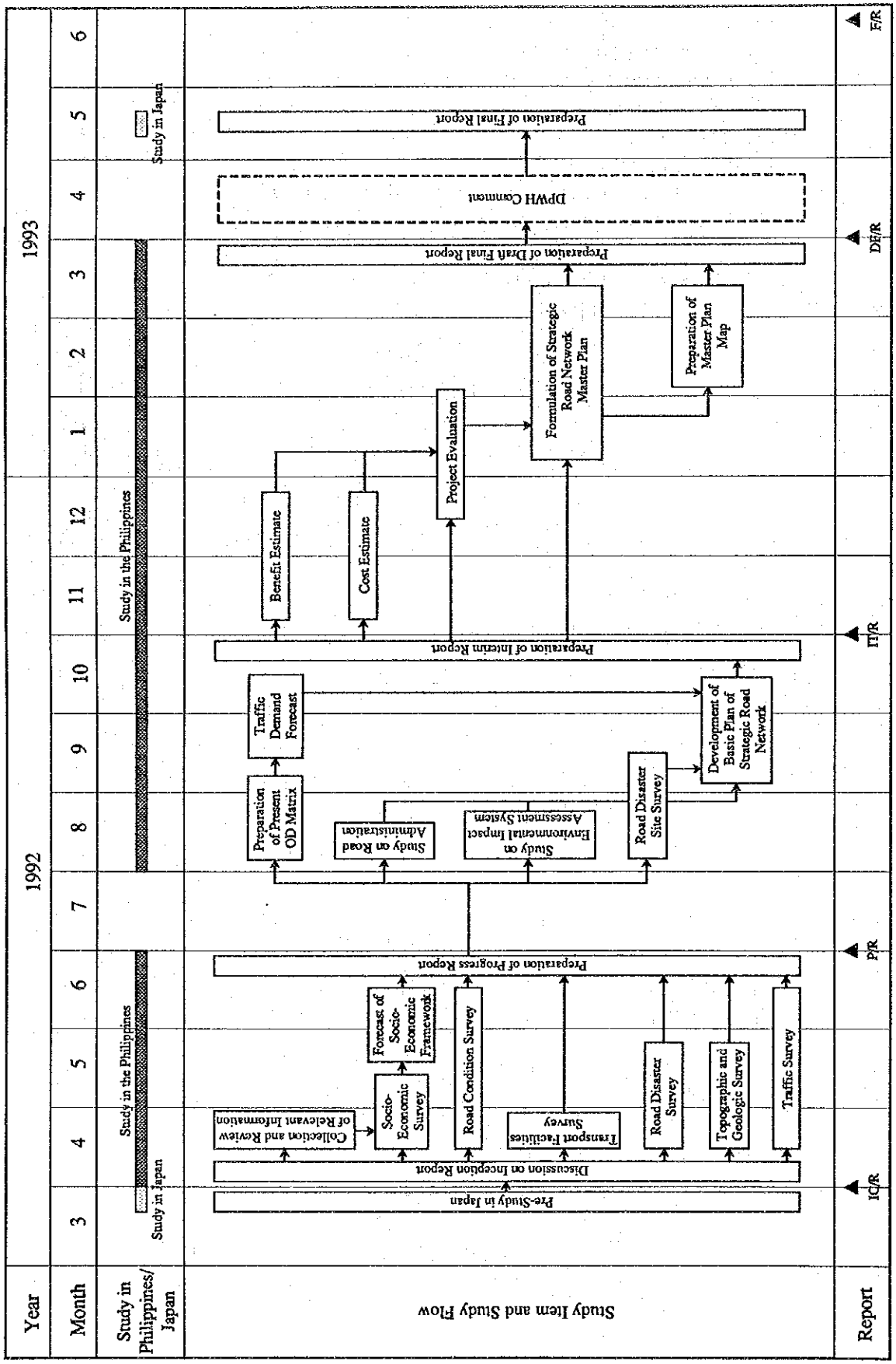
The scope of the Study are as follows:

1) Collection and review of relevant information
2) Socio-economic survey
3) Road condition survey
4) Transport facilities survey
5) Road disaster survey
6) Topographic and geologic survey
7) Traffic survey
8) Forecast of socio-economic framework
9) Preparation of present OD matrix
10) Traffic demand forecast
11) Study on road administration

12) Study on environmental impact assessment system
13) Road disaster site survey
14) Development of basic plan of strategic road network
15) Benefit estimate
16) Cost estimate
17) Project evaluation
18) Formulation of strategic road network master plan
19) Preparation of master plan map

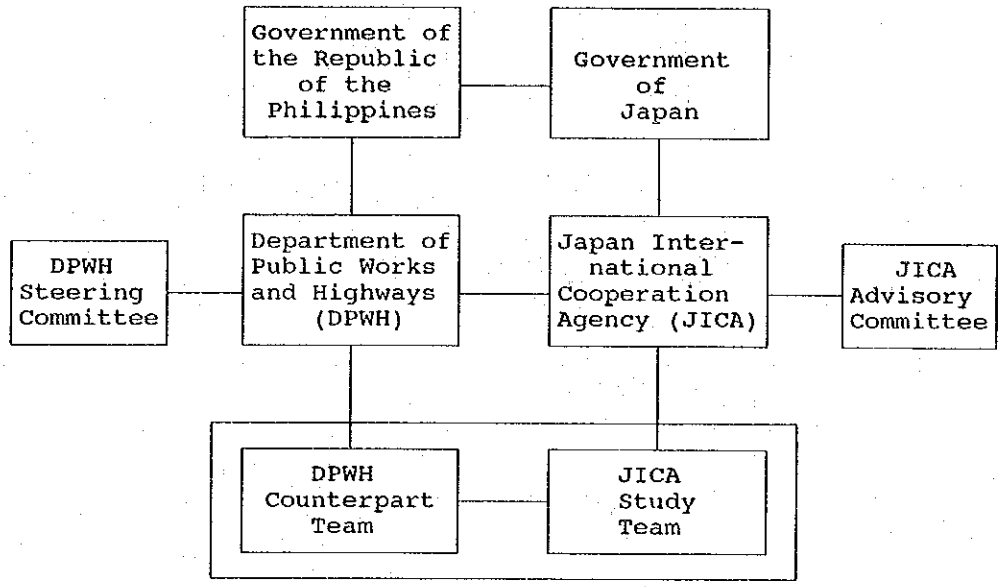
The study flow diagram is presented on the next page.

STUDY FLOW DIAGRAM



STUDY ORGANIZATION

The study was undertaken jointly by the JICA Study Team and the DPWH Counterpart Team under the guidance of the DPWH Steering Committee and the JICA Advisory Committee. The organization chart is shown below.



ORGANIZATION CHART

The members participating in the Study are listed below:

DPWH Steering Committee

Chairman	: Teodoro T. Encarnacion
Member	: Manuel M. Bonoan
Member	: Trino-Trinidad G. Meris
Member	: Ryoji Hagiwara (March 1992-June 1992)
	Yukihiro Tsukada (July 1992-May 1993)
Member	: Jose P. Gloria
Member	: Linda M. Templo

DPWH Counterpart Team

Team Leader	: Geronimo S. Alonzo
Project Coordinator	: Juanito R. Alamar
Highway Engineers	: Marieta Velasco
	: Generoso Alconis
	: Edmundo Mangaoil
	: Corazon Arceta
	: Arturo Flores
	: Filomena Vales

	: Antonio Yaptangco
	: Remigio Caleze
Traffic Engineers	: Faustino Sta. Maria, Jr.
	: Ildie Silva
	: Cesario Vicente
Economists	: Victoria Corpuz
	: Edgar Fabregas
	: Ella Dioneda
Eco. Researchers	: Rosemarie del Rosario
	: Erwin Almonte
	: Josephine Gumboc
	: Josefina Rafol
	: Encarnita Cubelo
	: Lilia Naungayan
Draftsmen	: Romeo Naungayan
	: Alex Cubelo
	: Reynaldo Camata
	: Antonio Valenzuela
	: Ronald Marcelino
Computer Programmer	: Rodelito Bagnas
	: Jasmin Figueras
Secretary/ Bookkeeper	: Ma. Lourdes Santos
Typist/Word Processor	: Esperanza Agustin

JICA Advisory Committee

Chairman	: Tamio Shimogami
Member	: Tsuyoshi Miyamoto
Member	: Keiichiro Muramatsu

JICA Study Team

Team Leader/ Highway Planner	: Kunihiko Sawano
Regional Planner	: Yuichi Fukasaka
Highway Engineer	: Takao Mitsuishi
Highway Engineer	: Mineo Endo
Disaster Prevention Expert	: Yoshio Nagami
Transport Planner	: Hani Abdel-Halim
Traffic Engineer	: Suguru Fujii
Transport Economist	: Tetsuo Wakui

REPORTS

The following reports were prepared during the Study:

· Inception Report	(April 1992)
· Progress Report	(June 1992)
· Interim Report	(October 1992)
· Draft Final Report	(March 1993)

The final report is organized with the following:

· EXECUTIVE SUMMARY
· MAIN TEXT
· APPENDIX
· ROAD INVENTORY
· PROJECT PROFILE
· MAPS

PART I

PRESENT CONDITION OF THE STUDY AREA

CHAPTER 1

PHYSICAL PROFILE OF LUZON ISLAND

1.1 TOPOGRAPHY

The Philippines is an archipelago of 7,100 islands with a total land area of 300,000 square kilometers. It lies 966 kilometers off the southern coast of Asia, between latitude 4°23'N to 21°25'N and between longitude 116°E to 127°E.

The archipelago is divided into three (3) major island groups: Luzon, with an area of 141,395 square kilometers; Visayas, with an area of 56,606 square kilometers and Mindanao, with an area of 101,999 square kilometers.

Luzon Island, the largest among the groups, has a varied topography, with lofty highlands and numerous valleys. Its two(2) major lowland plains are the Central Plain of Luzon and Cagayan Valley. These lowland plains contrast sharply with the adjacent high mountain areas on Central and East Cordillera and Zambales Mountains. Mountain ranges which lie almost parallel to each other are the Sierra Madre and Cordillera. Sierra Madre extends from Cape Engano northeast of Cagayan to a point east of Laguna de Bay while the Cordillera lies parallel to the west coast of Ilocos Region. Linking these two mountain ranges is the Caraballo Mountains, running northwest-southeast across the northern part of Central Luzon. The highest peak is Mt. Pulog in Central Cordillera with an elevation of 2,927 meters above sea level.

In the Tagalog Region, the mountains include Mt. Makiling, Tagaytay Ridge and the Banahaw. Stretching towards the south in a northwest-southeast direction for about 130 kilometers are the Tayabas Isthmus and the Bondoc Peninsula characterized by ridges and valleys of gentle slopes.

In the Bicol Region, the principal physiographic features are the Eastern Bicol Cordillera in the northeast, Ragay Hills in the southwest and the Bicol Plain in the central portion. Mt. Mayon one of the most active volcano in the country and the highest peak in the region with an elevation of 2,462 meters above sea level is a part of the Eastern Cordillera Range.

Moreover, there are seven (7) major river basins in Luzon: Cagayan and Abulug River in Cagayan Valley; Pampanga and Agno River in Central Luzon; Abra river in Ilocos Region; Pasig-Laguna Bay in southern Luzon and Bicol River in Bicol Region.

The Philippine map showing the lowland, upland, plateus and mountain areas is presented in Figure 1.1-1 while the provincial land area and regional slope classification within the study area are presented in Tables 1.1-1 and 1.1-2 respectively.

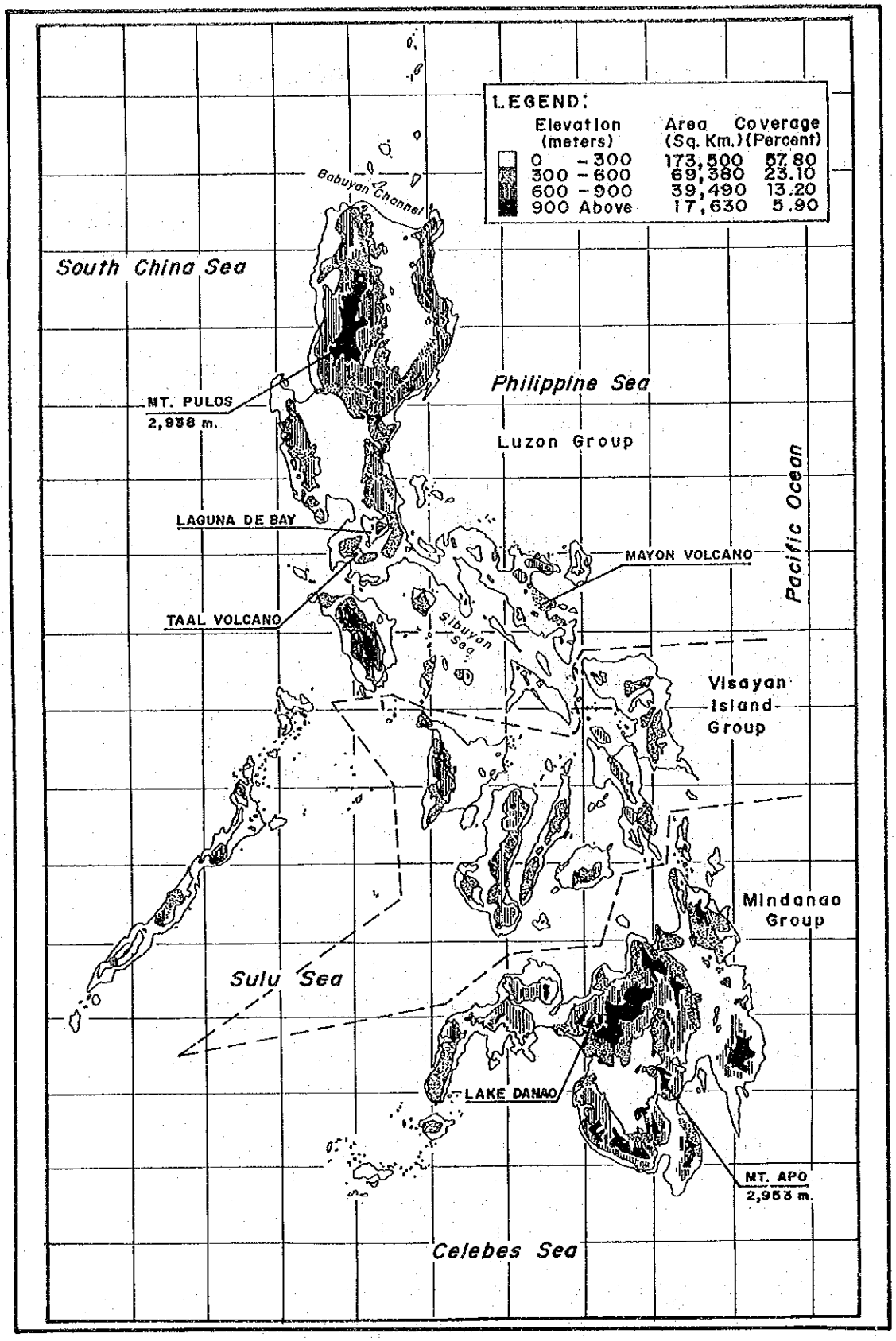


FIGURE 1.1-1 GEOGRAPHICAL AND TOPOGRAPHICAL MAP OF THE PHILIPPINES

TABLE 1.1-1 NAME OF PROVINCES AND ITS LAND AREA

Region	Name of Province	Land Area (km^2)
CAR	Abra	3,975.7
	Benguet	2,655.4
	Mt. Province	2,097.3
	Ifugao	2,517.8
	Kalinga-Apayao	7,047.6
		18,293.8
REGION I	Ilocos Norte	3,399.3
	Ilocos Sur	2,579.6
	La Union	1,493.1
	Pangasinan	5,368.2
		12,840.2
REGION II	Cagayan	9,002.5
	Isabela	10,664.6
	Nueva Vizcaya	3,903.9
	Quirino	3,057.2
		26,628.2
REGION III	Bataan	1,373.0
	Bulacan	2,625.0
	Nueva Ecija	5,284.3
	Pampanga	2,180.2
	Tarlac	3,053.5
	Zambales	3,714.4
		18,230.4
REGION IV	Aurora	3,239.8
	Batangas	3,165.8
	Cavite	1,287.6
	Laguna	1,759.7
	Quezon	8,706.7
	Rizal	1,308.8
		19,468.4
REGION V	Albay	2,552.6
	Camarines Norte	2,112.1
	Camarines Sur	5,266.8
	Sorsogon	2,141.4
		12,072.9
	Study Area	107,533.9

TABLE 1.1-2 SLOPE CLASSIFICATION BY REGION

Region	Slope Class				Total	
	0-18%		0-18% Over			
	Km^2	%	Km^2	%	Km^2	%
I	7,930	61.8	4,910	38.2	12,840	100.0
II*	11,960	44.9	14,668	55.1	26,628	100.0
III	11,190	61.4	7,040	38.6	18,230	100.0
IV*	10,719	55.1	8,749	44.9	19,468	100.0
V*	6,944	57.5	5,129	42.5	12,073	100.0
CAR	3,314	18.1	14,980	81.9	18,294	100.0
TOTAL	52,057	48.4	55,476	51.6	107,533	100.0
Philippines Total	141,235	47.1	158,765	52.9	300,000	100.0

Note: *; I (Excluding Batanes), IV (Excluding Marinduque, Oriental Mindoro and Palawan), and V (Excluding Catanduanes and Masbate)
Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

1.2 GEOLOGY

The Philippine Archipelago lies in the West Pacific Ocean, just north of the junction of three great tectonic plates of the lithosphere, the Eurasian Plate, Pacific Plate and Indo-Australian Plate. It forms a roughly triangular area bounded by the Bashi Channel on the north, the North Luzon-Manila-Palawan Trench and ridge system on the west, the Sulu-Sabah Ridge Complex and Cotabato Trench on the south and the Philippine-East Luzon Trench on the east.

Morphologically, the Philippines may be described as a composite of linear, subparallel ridges alternating with basins and troughs following the trend of bordering trenches. The ridges are upthrusted and/or uplifted belts of ophiolite and volcano-plutonic complexes. The intervening lows are sedimentary basins and troughs exposed partly on land areas following uplift or folding. The archipelago is defined by a main arc of islands facing the Pacific and two narrower arcs projecting from its southwest flank linking it to Borneo. The main arc may be viewed as made up of convex arcs, the northern arc convex westward and the southern arc, convex eastward.

Considering both inland and submarine morphology, the Archipelago is divided into four (4) physiographic provinces, namely: 1) Eastern Physiographic Province; 2) Central Physiographic Province; 3) Western Physiographic Province and 4) Palawan Physiographic Province.

Luzon, which constitutes the Eastern, Central and Western Physiographic Provinces is bounded on both sides by deep trenches and are composed of a series of ridges and troughs generally parallel to the trenches. The summary of physiographical condition for each province is presented in Table 1.2-1 while the geologic time is shown in Table 1.2-2.

TABLE 1.2-1 SUMMARY OF PHYSIOGRAPHIC CONDITION FOR EACH PROVINCE

Physiographical Province	Physiographical Subprovince	Geological Characteristics
Western	Ilocos	Under: Crystalline Schists and quartzites Upper: Sedimentary rocks (locally Eocene and Miocene)
	Zambales Range	Under: Ultramatics (Peridotite, dunite and gabbro) Upper: Pelargic sediment (Eocene to Oligocene) Quartz diorites and granodiorites (east to northwestpart) Miocene clastics (Eastern Part)
Central	Luzon Central Cordillera	Under: Metavolcanics and Metasediment (Cretaceous to Tertiary) Upper: Limestone and Clastics (Miocene)
	Cagayan Basin	Marine Clastic and Carbonate rock (Oligocene to Pleistocene)
	Central Luzon	Sediments (Miocene and Pliocene)
	South of Manila Bay	Quarternary Volcanos and Pyroclastic Deposit
Central	Southern Batangas	Clastic sediment and limestone (Oligocene)
	Bondoc Peninsula	Sediment (Miocene & Pleistocene)
Eastern	Southern Sierra Madre	Lower: Rocks (Cretaceous to Tertiary) Intermediate: Younger rocks, limestone, clastics and volcanic (Oligocene to Miocene) Upper: Volcanic & Conglomerates (Miocene to Pleistocene)
	Western Bicol Range	Lower: Greenschists ultramatics volcanics, clastics and limestone (Cretaceous to Tertiary) Upper: Sedimentary and volcanic rocks (Oligocene to Miocene)
	Bicol Basin	Sediments (Miocene to Pleocene)

Source: Bureau of Mines and Geo-Science, Geology and Mineral Resources of the Philippines

TABLE 1.2-2 GEOLOGIC TIME

Million Year	Era	Period
.01 to 1.8	Cenozoic	Quaternary
1.8 to 65.0	Cenozoic	Tertiary
65 to 141	Mesozoic	Cretaceous
141 to 195	Mesozoic	Jurassic
195 to 250	Mesozoic	Triassic
250 to 280	Paleozoic	Permian
280 to 300	Paleozoic	Carboniferous

Source: Bureau of Mines and Geo-Science, Geology and Mineral Resources of the Philippines

1.2.1 The Philippine Fault Zone

The Philippine Fault Zone (PFZ) is 1,300 kilometers long, fairly continuous fault structure transecting the entire Philippine Archipelago. It is divided into three (3) major segments: the Northern Segment, which comprises traces of the PFZ as if transects the northern portion of Luzon; the Central Segment, as defined by the trace of the PFZ following a northwesterly trend cutting across the islands of Leyte, Masbate, Burias and Alabat and between the Bicol and Bondoc Peninsula and the Southern Segment, as characterized by the trace of the PFZ passing through the Agusan-Davao Basin and exits in Davao Gulf in eastern Mindanao. However, the PFZ splits into several fault zones in the northern terminus namely: Digdig, Lupao and San Manuel Faults. Figure 1.2-1 shows the tectonic features of the Philippines.

1.3 METEOROLOGY

1.3.1 Climate

The climatic classifications in the Philippines was based on the Modified Corona's Classification (1920) using the modal of the yearly type of rainfall distribution. That is, the rainfall distribution type for each year was determined and the type with the most number of occurrences during the 30-year period (1961-1990) was considered as the final climatic type. The four types of climates are described below:

Type 1 - Two pronounced seasons; dry from November to April, wet during the rest of the year. Maximum rain period is from June to September during the prevalence of the southwest moonsoon. This type of climate is found in the Ilocos Region, the western part of Mountain Province, west of Nueva Ecija, the whole of Central Luzon, Metro Manila, Cavite, Laguna and Batangas.

Type 2 - No dry season with a very pronounced maximum rainfall from November to January. There is no single dry month in the regions of this type. The regions having this type of climate are the

northern part of Kalinga-Apayao, the northwestern part of Cagayan, the western part of Quezon province and the Bicol Region.

Type 3 - Seasons not very pronounced; relatively dry from November to April and wet during the rest of the year. This type is intermediate between the preceeding two, although it resembles the first type more closely since it has a short dry season. Places belonging to this type of climate include the northeastern part of Ilocos Norte, Kalinga-Apayao, Cagayan, the Mountain Province, the western part of Isabela, the eastern part of Nueva Vizcaya, Bulacan, the eastern parts of Laguna and Batangas.

Type 4 - Rainfall is more or less evenly distributed throughout the year. This type is an intermediate between the first and second types, but it resembles the second more closely since it has a dry season. Regions with this type of climate are northern Kalinga-Apayao, eastern Cagayan, Isabela, Quezon province and the western part of the Bicol Region.

In general, the climate of Luzon is controlled by two (2) types of air stream, namely: southwest monsoon and northeast monsoon. The southwest monsoon falls to Luzon from May to October and bring heavy rainfall in August to September in western Luzon. The northeast monsoon falls from November to February, giving heavy rainfall to the east coast and along the Sierra Madre Mountains but weather condition are different in each provinces due to variation in topographic and geological conditions.

The geographical distribution of the climatic types in Luzon is shown in Figure 1.3-1. Likewise, the recorded normal monthly and annual rainfall is tabulated in Table 1.3-1 while the mean monthly and annual temperature is presented in Table 1.3-2.

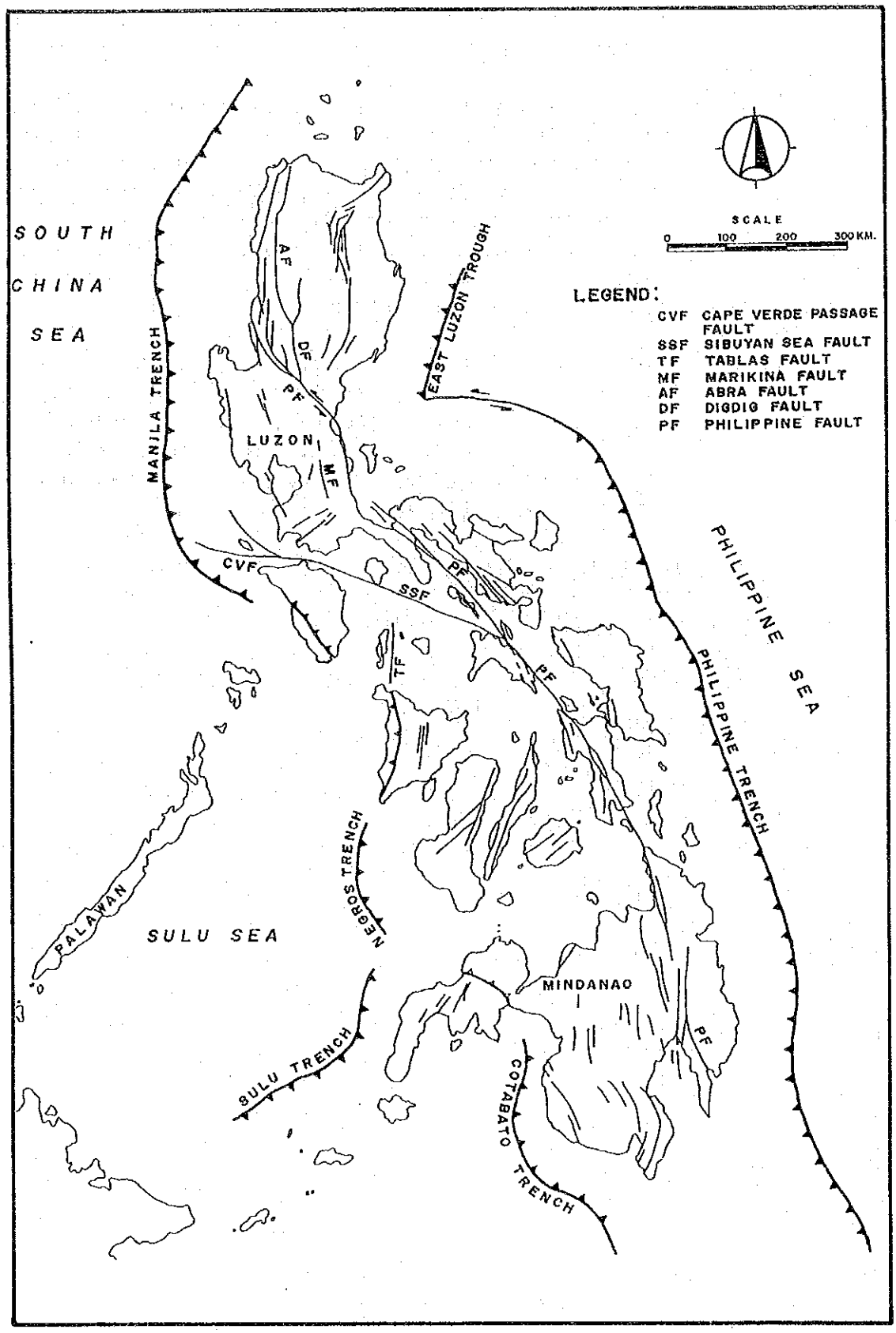
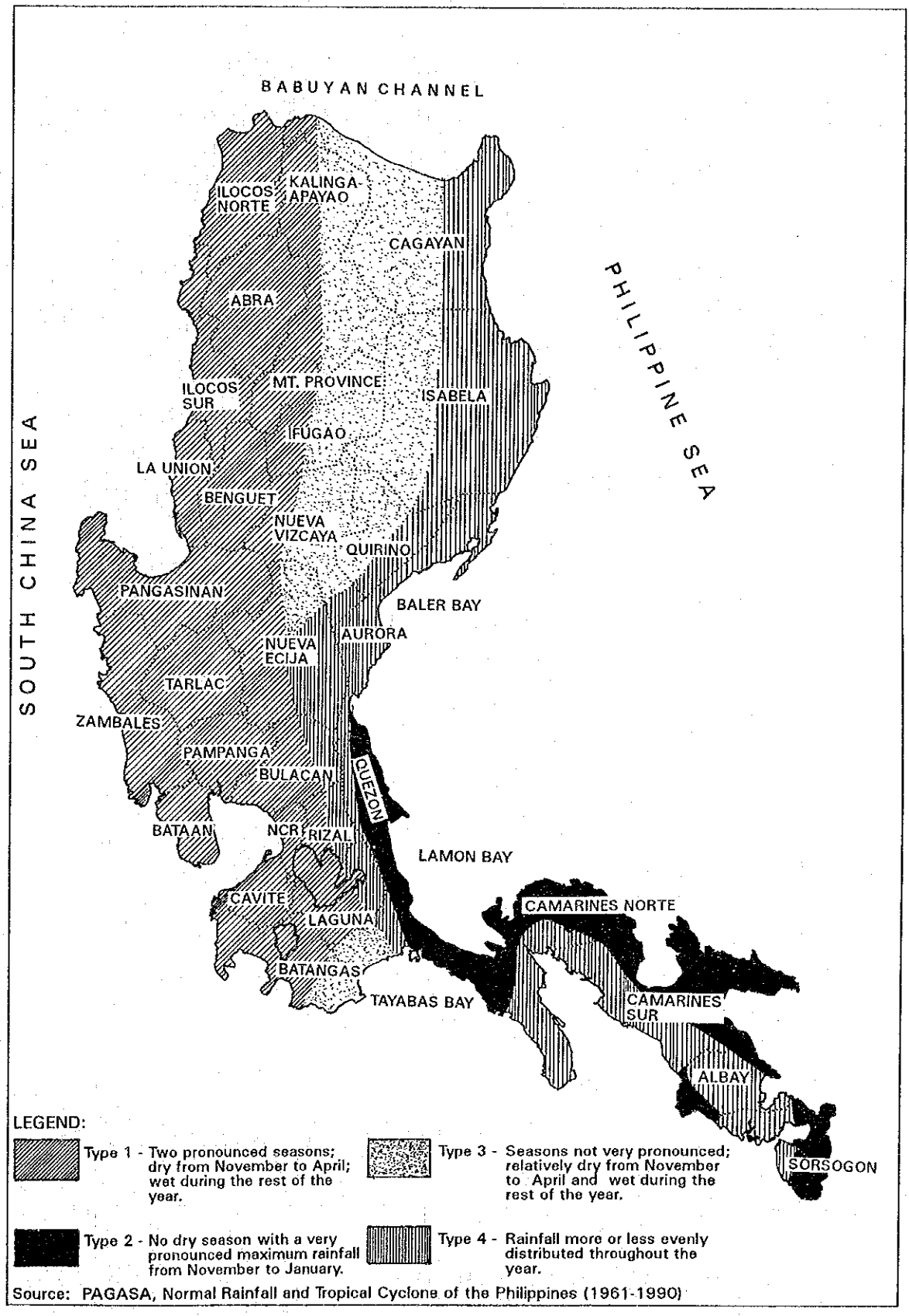


FIGURE 1.2-1 TECTONIC FEATURES OF THE PHILIPPINES



Source: PAGASA, Normal Rainfall and Tropical Cyclone of the Philippines (1961-1990)

FIGURE 1.3-1 GEOGRAPHICAL DISTRIBUTION OF CLIMATE IN LUZON

TABLE 1.3-1 NORMAL MONTHLY AND ANNUAL RAINFALL (mm)

Weather Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Rainfall	Monthly Highest
Region: CAR														
1.Baguio	12.1	35.8	55.9	102.9	331.1	480.6	670.8	847.9	582.3	262.4	152.3	28.8	3562.9	847.9
Region I														
2.Dagupan	6.2	6.2	17.6	73.2	216.1	346.6	462.1	608.4	324.8	158.5	63.1	13.8	2296.6	608.4
3.Laoag	11.8	1.1	2.5	19.8	125.1	376.8	386.4	547.3	324.1	86.1	45.1	10.2	1936.3	547.3
4.Vigan	2.3	3.3	5.0	17.4	145.9	404.3	483.3	738.9	355.7	112.5	35.1	9.1	2312.8	738.9
Region II														
5.Aparri	141.1	76.0	45.6	35.4	100.6	184.1	183.2	225.5	274.7	343.0	396.0	208.7	2213.9	396.0
6.Tuguegarao	21.4	16.5	57.2	73.6	172.1	161.6	192.8	246.5	209.1	252.9	274.2	93.9	1771.8	246.5
Region III														
7.Cabanatuan	7.5	4.9	16.4	19.7	150.1	267.6	340.8	395.8	305.2	190.8	134.8	39.9	1873.5	395.8
8.Iba,Zambales	3.0	2.7	12.1	28.8	280.7	579.0	763.1	1105.9	615.8	203.9	80.9	25.6	3701.5	1105.9
9.Munoz	9.4	1.7	8.5	55.4	88.9	385.3	299.6	466.2	258.7	169.7	90.6	15.6	1849.6	466.2
Region IV														
10.Ambulong	22.1	9.9	16.3	37.4	105.3	237.5	289.9	323.7	259.7	234.1	156.6	97.6	1790.1	323.7
11.Baler	193.1	150.8	213.1	232.4	301.4	272.3	240.5	218.6	300.6	416.0	444.4	427.9	3311.1	444.4
12.Casiguran	217.2	157.5	192.8	138.9	235.6	237.9	261.2	238.2	296.9	412.3	601.7	437.2	3427.4	601.7
13.Infanta	353.8	220.1	187.3	179.7	225.2	249.4	258.7	196.4	325.2	607.8	597.4	597.2	3998.2	607.8
14.Lucena City	89.3	60.3	42.5	54.6	90.0	160.3	184.6	198.9	225.5	336.2	305.3	235.2	1982.7	336.2
15.Sn.Francisco	49.3	17.9	27.1	25.1	88.9	162.7	222.2	187.5	179.9	220.2	173.9	126.4	1480.4	222.2
16.Sangley Pt.	25.3	2.1	7.4	13.6	102.2	259.3	259.5	460.5	243.8	185.6	91.7	32.8	1683.8	259.5
17.Tayabas	155.1	72.3	72.3	103.2	227.5	257.9	260.6	172.6	316.1	512.7	519.9	413.7	3083.9	519.9
Region V														
18.Daet	312.0	175.0	153.9	126.1	139.1	173.9	235.7	222.3	267.6	518.6	590.2	591.9	3506.3	591.9
19.Legaspi	296.9	195.6	192.6	152.1	181.3	240.9	251.3	264.2	259.9	325.5	483.7	456.0	3300.0	483.7

SOURCE: PAGASA, (1951-1985)

TABLE 1.3-2 MEAN MONTHLY AND ANNUAL TEMPERATURE (°C)

Weather Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual	Monthly Highest
Region: CAR														
1.Baguio	17.8	18.4	19.6	20.4	20.5	20.0	19.6	18.9	19.3	19.5	19.0	18.4	19.3	20.5
Region I														
2.Dagupan	25.9	26.6	28.1	29.5	29.4	28.6	28.1	27.5	27.9	28.0	27.2	26.4	27.8	29.5
3.Laoag	24.4	25.0	26.5	28.2	29.1	28.4	27.8	27.4	27.5	27.4	26.5	25.4	27.0	28.2
4.Vigan	25.3	25.8	27.1	28.4	28.8	27.7	27.2	26.7	26.9	27.2	26.9	26.2	27.0	28.8
Region II														
5.Aparri	23.4	24.1	25.7	27.6	29.0	29.2	28.9	28.5	27.9	26.9	25.5	24.1	26.7	29.2
6.Tuguegarao	24.3	25.4	27.3	29.3	30.3	29.7	29.2	28.9	28.5	27.4	25.9	24.5	27.6	30.3
Region III														
7.Cabanatuan	25.8	26.4	27.6	29.2	29.5	28.5	27.9	27.5	27.6	27.7	26.9	26.2	27.6	29.5
8.Iba, Zambales	25.6	25.8	27.0	28.3	28.3	27.5	27.0	26.5	26.9	27.3	27.1	26.3	27.0	28.3
9.Munoz	25.8	26.1	26.9	28.3	29.4	28.1	27.6	26.9	27.4	27.0	26.7	26.0	27.2	29.4
Region IV														
10.Ambulong	26.0	26.6	27.9	29.2	29.2	27.9	27.5	27.3	27.3	27.3	27.0	26.2	27.5	29.2
11.Baler	24.4	24.8	25.7	27.0	28.0	28.3	28.2	28.1	27.8	27.0	26.0	25.1	26.7	28.3
12.Casiguran	23.7	24.0	24.9	26.5	27.6	28.1	27.8	27.7	27.4	26.5	25.5	24.5	26.2	28.1
13.Infanta	24.5	24.9	25.9	27.2	28.2	28.5	28.2	28.2	27.7	26.9	26.3	25.2	26.8	28.5
14.Lucena City	25.4	25.8	26.8	28.1	29.9	29.4	27.9	27.8	27.6	27.2	26.7	25.9	27.4	29.9
15.San Francisco	25.4	25.7	26.6	27.4	28.1	27.9	27.5	27.5	27.3	27.0	26.7	25.9	26.9	27.9
16.Sangley Point	25.7	26.4	27.9	29.5	29.9	28.6	28.0	27.5	27.9	27.7	27.2	26.4	27.7	29.9
17.Tayabas	24.3	24.6	25.7	27.1	27.7	27.4	26.9	26.9	26.6	26.3	25.7	24.8	26.2	27.7
Region V														
18.Daet	25.5	25.6	26.3	27.4	28.4	28.4	28.0	28.0	27.7	27.2	26.7	25.9	27.1	28.4
19.Legaspi	25.3	25.6	26.3	27.3	28.1	28.1	27.7	27.6	27.5	27.2	26.6	25.9	26.9	28.1

SOURCE: PAGASA, (1951-1985)

1.4 NATURAL CALAMITIES

The Philippines has four (4) major natural calamities in the form of volcanic eruption, earthquake, tsunami and tropical cyclone. Based on records, volcanic eruptions, earthquakes and tsunami occured several times throughout the country particularly in Luzon Island while tropical cyclone is a normal yearly visitor especially during rainy season.

- Volcanoes

  The Philippines had a vigorous history of volcanic activity and related phenomena through recorded time as indicated in the geological record. The country has 220 Quarternary volcanoes of which 21 are classified as active as presented in Table 1.4-1. Likewise, Figure 1.4-1 shows the distribution of the country's active and inactive volcanoes.

- Earthquake

  The Philippines experienced numerous of destructive earthquakes in the past, the latest of which is the July 16, 1990, Luzon Earthquake, that inflicts extensive damage to lives and properties. The destructive effects of earthquakes are due mainly to the intense ground shaking or vibration.

  There are eight major and several minor earthquake generators in the Philippines as shown in Figure 1.4-2. These are zones or belts where differentials movements of solid materials are likely to occur and consequently trigger the generation of earthquakes.

  In the past, the Philippines had been hit by major earthquake with a magnitude of intensity 6 in the Richter Scale or greater. The location of the epicenter of these major earthquakes are shown in Figure 1.4-3.

- Tsunami

  According to PHIVOLCS, coastal areas of Luzon facing the Philippine sea are prone to tsunami because tsunamigenic earthquakes oftenly originates from the bottom of Philippine sea.

  Tsunamis are high-energy sea waves generated by earthquakes. Depending on the earthquake intensity they may reach as high as 10m. travelling approximately 700 to 800 kilometers per hour (kph) with a time interval of 20 to 30 minutes between successive waves. Figure 1.4-4 shows the areas with recorded tsunami hits.

Tropical Cyclones

The occurrence of tropical cyclones in the Philippines is a natural phenomena especially on the extreme part of northern Luzon.

Table 1.4-2 shows the occurrence of tropical cyclones of all intensities over the Philippine Area of Responsibility (PAR) during the 44-year period. During the period, a total of 869 tropical cyclones crossed the PAR or an average of 19.7 cyclones per year. The tropical cyclone season in the Philippines is from June to December, with an average monthly frequency of more than one tropical cyclone. The months of July, August and September are the most frequent tropical cyclone occurrence with an average of more than three cyclone each month. Likewise, the period from January to May, however, is not entirely free from tropical cyclones.

The frequency of tropical cyclone passage over each geographical zones in the Philippines in the past 44 years (1948-1991) is shown in Figure 1.4-5.

TABLE 1.4-1 LIST OF ACTIVE VOLCANOES

NAME	NO. OF ERUPTIONS	DATE OF LAST ERUPTION	LOCATION
1. MAYON	45	1993	Legaspi City, Albay
2. TAAL	33	1977	Talisay, Batangas
3. CANLAON	24	1988	Negros Oriental
4. BULUSAN	12	1988	Sorsogon
5. RAGANG	9	1915	Cotabato
6. SMITH	8	1924	Babuyan Island
7. HIBOK-HIBOK	6	1953	Mambajao, Camiguin Is.
8. DIDICAS	5	1978	Babuyan Island Group
9. BABUYAN CLARO	1	1913	Babuyan Island
10. CAMIGUIN DE BABUYANES	1	1957	Babuyan Island Group
11. CAGUA	1	1860	Cagayan
12. BANAHAW	1	1780	Lucena City
13. CALAYO	1	1886	Valencia, Bukidnon
14. IRAYA	?	1464	Batanes
15. PINATUBO	1	1991	Zambales
16. IRIGA	?	1641	Iriga, Camarines Sur
17. BILIRAN	?	1939	Biliran
18. BUD DAJO	?	1897	Jolo Island
19. MATUTUM	?	1911	Cotabato
20. KALATUNGAN	?	-	Bukidnon
21. MAKATURING	?	-	Lanao, Mindanao

Source: PHIVOLCS, Volcanoes of the Philippines

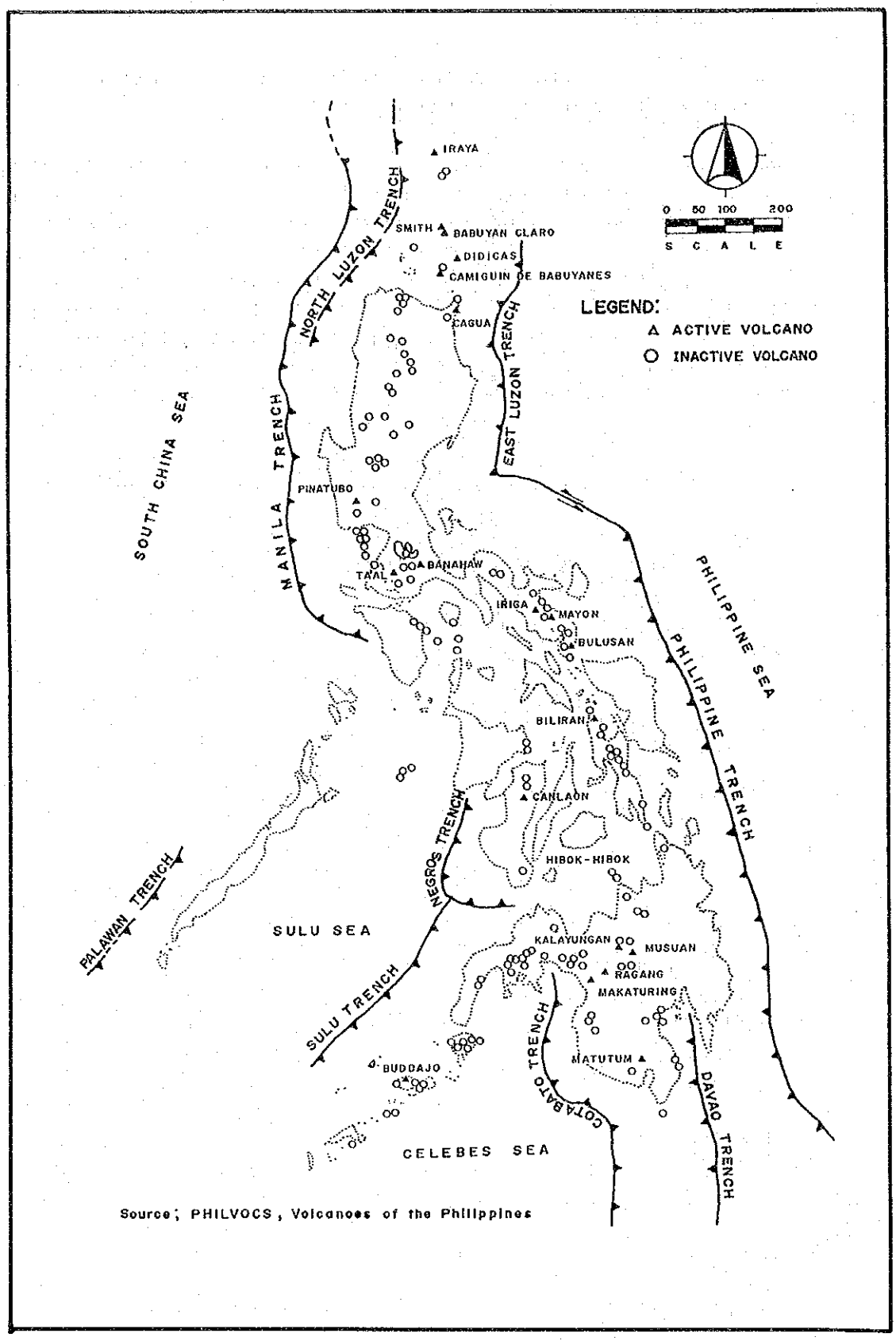


FIGURE 1.4-1 ACTIVE AND INACTIVE VOLCANOES IN THE PHILIPPINES

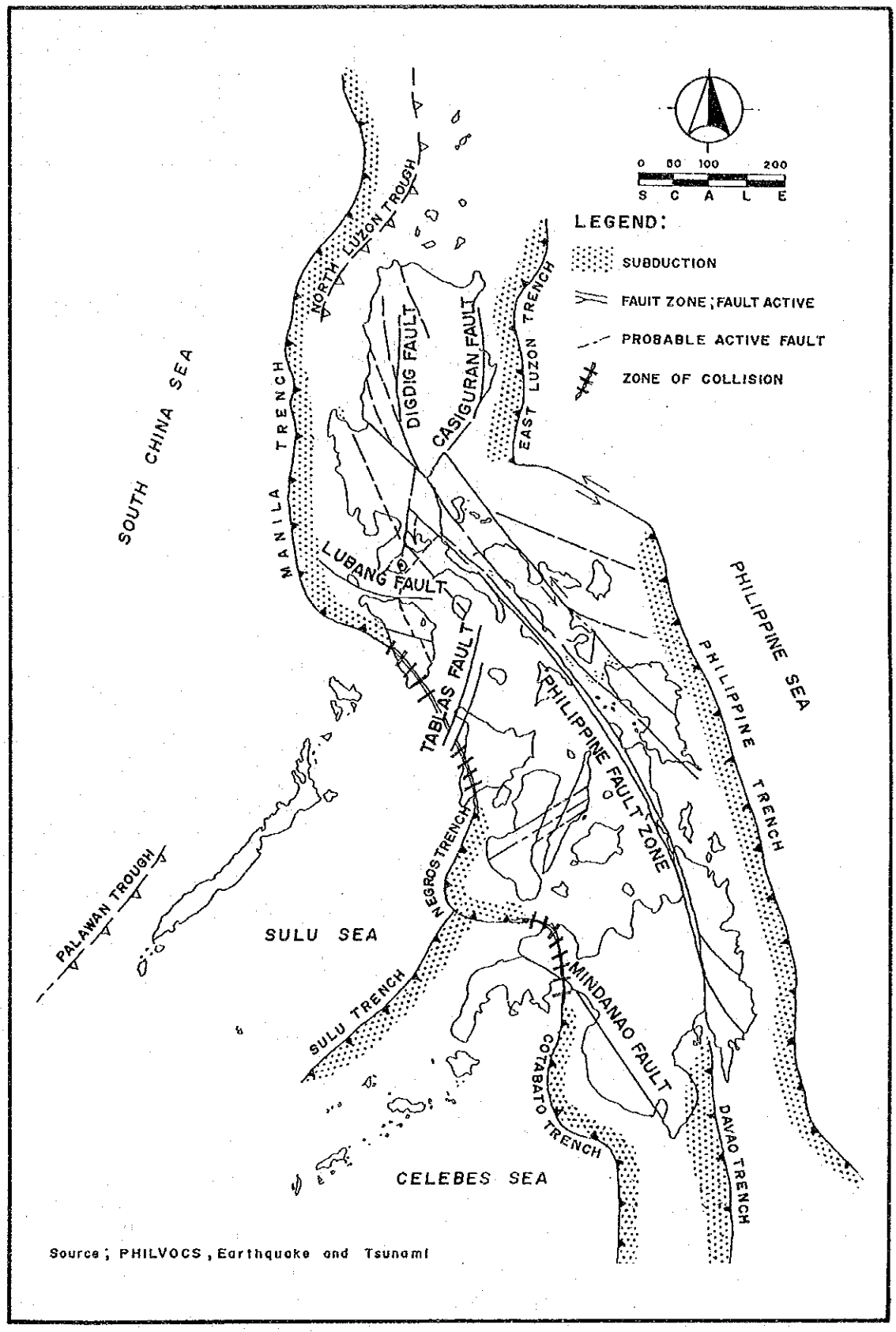
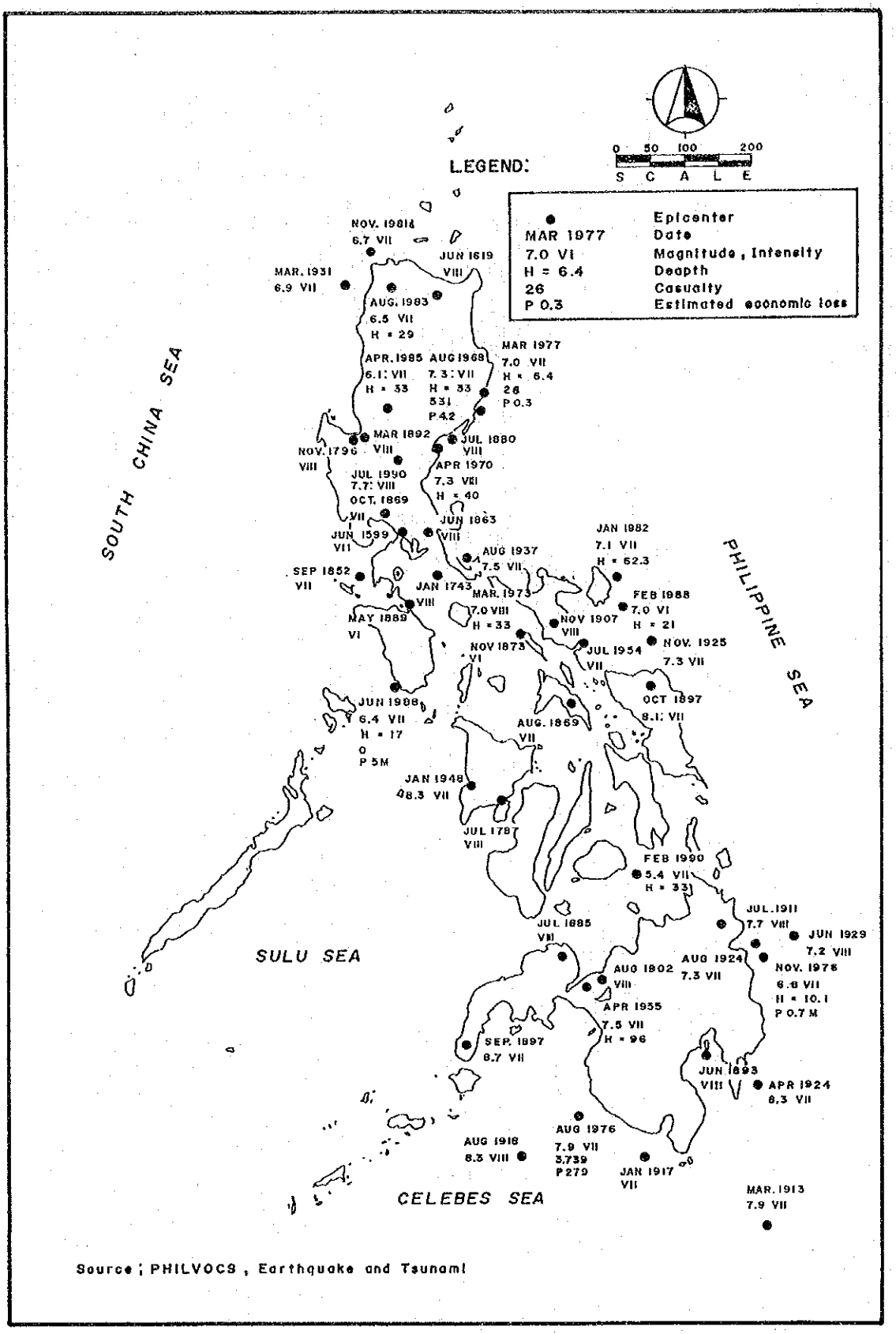


FIGURE 1.4-2 EARTHQUAKE GENERATORS IN THE PHILIPPINES



Source ; PHILVOCS , Earthquake and Tsunami

FIGURE 1.4-3 EPICENTER OF MAJOR AND STRONG EARTHQUAKE (M>6.0 AND/OR INTENSITY > VI) (1599-1990)

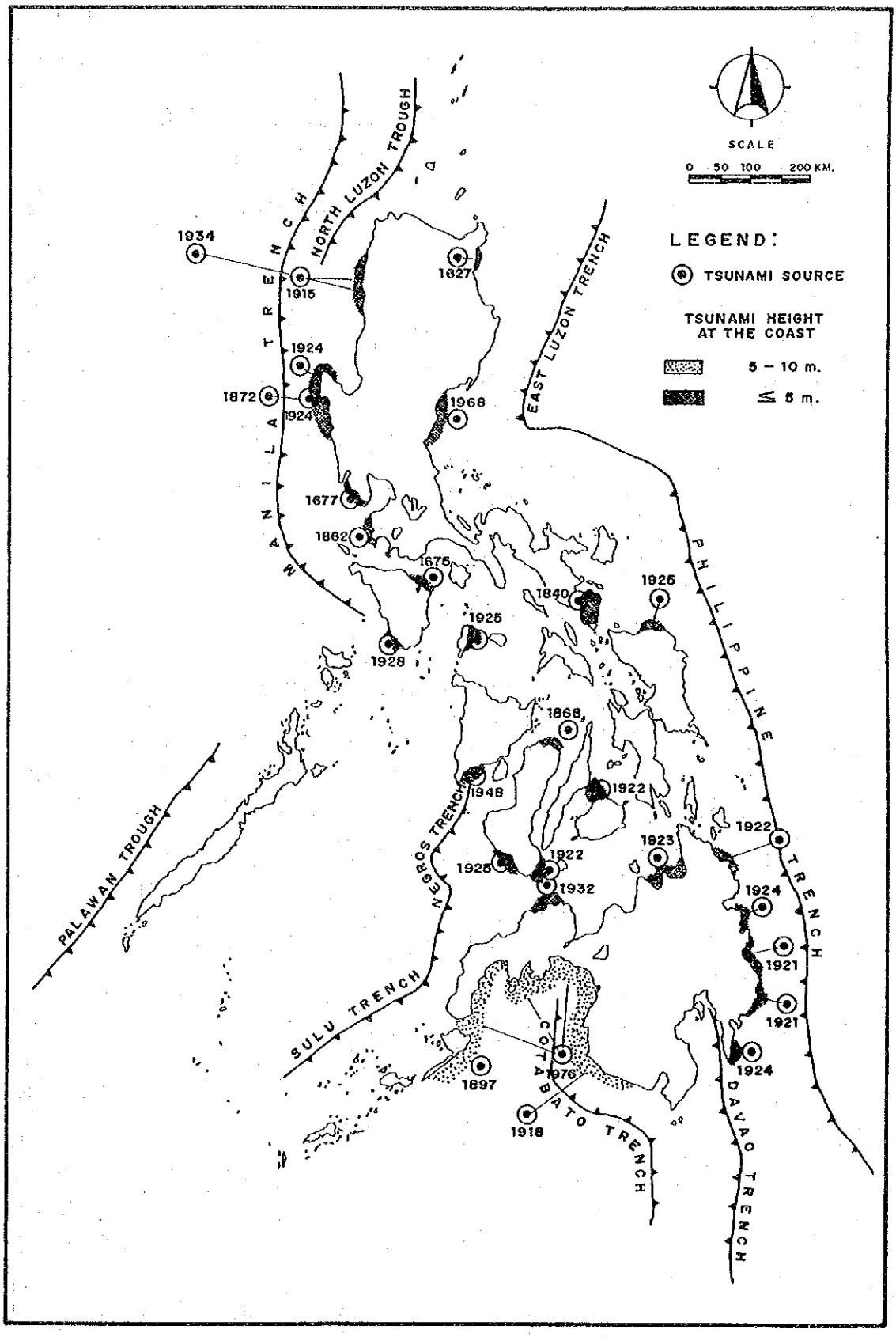


FIGURE 1.4-4 TSUNAMI PRONE AREAS

TABLE 1.4-2 FREQUENCY OF TROPICAL CYCLONE IN THE P.A.R. (1948 TO 1991)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1948	1	0	0	0	1	0	3	1	3	2	6	3	20
1949	1	0	0	0	0	2	5	2	4	3	3	2	22
1950	0	0	0	0	1	2	3	1	3	2	2	1	15
1951	0	0	0	0	1	1	1	4	2	2	1	2	13
1952	0	0	0	0	0	5	2	3	4	4	4	4	26
1953	1	1	0	0	1	2	0	5	2	2	3	2	19
1954	0	0	1	0	1	0	1	6	2	2	3	1	18
1955	1	1	0	1	0	0	2	3	1	4	1	1	15
1956	0	0	1	2	0	0	4	4	5	1	5	3	25
1957	2	0	0	1	0	2	1	2	3	3	1	0	15
1958	1	0	0	0	0	1	4	3	3	2	3	0	17
1959	0	1	1	0	0	0	1	4	2	4	3	2	18
1960	1	0	0	1	1	2	2	6	1	3	0	2	19
1961	1	1	1	0	1	3	4	4	4	1	1	2	23
1962	0	1	0	0	2	0	4	6	4	1	3	0	21
1963	0	0	0	0	1	3	4	2	3	1	0	2	16
1964	0	0	0	0	2	1	9	5	5	3	4	1	30
1965	2	1	1	0	2	2	6	2	3	1	1	0	21
1966	0	0	0	1	3	1	7	1	3	2	2	2	22
1967	0	1	1	1	1	2	4	5	0	2	3	1	21
1968	0	1	0	0	0	2	2	3	3	1	3	0	15
1969	0	0	0	1	1	0	4	2	4	1	2	0	15
1970	0	1	0	0	0	3	2	4	4	4	2	1	21
1971	1	0	1	3	3	2	5	2	3	5	2	0	27
1972	2	0	0	0	0	2	4	2	4	1	1	1	17
1973	0	0	0	0	0	1	2	4	1	3	1	0	12
1974	1	0	0	0	0	3	4	4	2	5	2	2	23
1975	1	0	0	0	0	0	1	2	4	3	2	1	14
1976	1	1	0	1	1	3	3	3	4	0	2	3	22
1977	1	0	0	0	1	1	4	2	4	2	2	2	19
1978	0	0	0	1	0	3	1	7	6	4	2	1	25
1979	0	0	1	1	2	1	3	3	3	4	2	2	22
1980	0	1	1	1	3	2	4	3	2	2	3	1	23
1981	0	1	0	0	0	3	5	4	3	2	3	2	23
1982	0	0	2	0	1	0	5	4	4	2	0	2	20
1983	0	0	0	0	0	0	3	3	4	6	4	3	23
1984	0	0	0	0	0	1	2	8	1	4	3	1	20
1985	1	0	0	0	1	2	2	3	4	3	0	1	17
1986	0	1	0	1	1	2	3	2	1	4	3	3	21
1987	1	0	0	0	0	1	4	3	2	2	2	1	16
1988	1	0	0	0	1	3	3	0	3	6	2	1	20
1989	1	0	0	0	1	2	6	1	2	3	2	1	19
1990	0	0	0	0	3	3	2	3	4	1	3	1	20
1991	0	0	1	1	1	1	4	2	4	2	3	0	19
TOTAL	22	13	12	17	38	70	145	143	133	115	100	61	869
% OF TOTAL	2.5	1.5	1.4	1.9	4.4	8.1	16.7	16.5	15.3	13.2	11.5	7.0	100
MEAN	0.5	0.3	0.3	0.4	0.8	1.5	3.2	3.4	3	2.6	2.3	1.4	19.7
RANK	9	11	12	10	8	6	1	2	3	4	5	7	

SOURCE: PAGASA

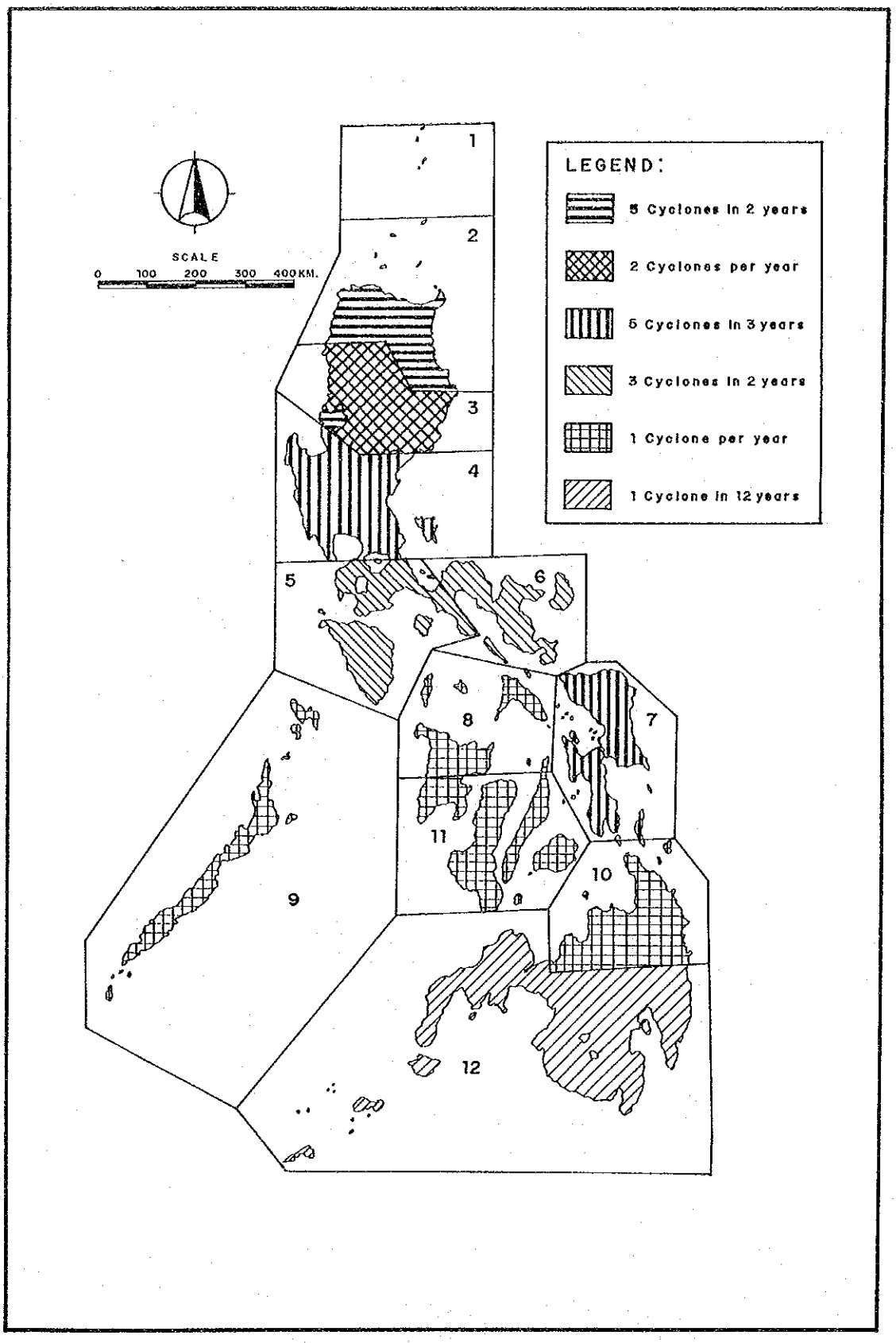


FIGURE 1.4-5 FREQUENCY OF TROPICAL CYCLONES OVER EACH GEOGRAPHICAL ZONES IN THE PHILIPPINES FOR THE PAST 44 YEARS (1948-1991)

CHAPTER 2

SOCIO-ECONOMIC PROFILE OF THE STUDY AREA

2.1 GENERAL OUTLOOK

2.1.1 Administrative Division

The national land of the Philippines is politically divided into local administrative units according to the hierarchy of Region - Province - City/Municipality - Barangay. The Study Area (the Luzon Island excluding NCR) is composed of five regions or 29 provinces, which are further subdivided to 19 cities and 634 municipalities. Within these cities and municipalities, there are 16,228 barangays as of the year of 1991 (Table 2.1-1).

TABLE 2.1-1 NUMBER OF LOCAL ADMINISTRATIVE UNIT IN THE STUDY AREA

Regions	Province	City	Municipality	Barangay
I Ilocos	4	3	122	3,245
II Cagayan Valley	4	-	87	2,259
III Central Luzon	6	5	116	2,850
IV Southern Luzon	6	7	143	3,829
V Bicol	4	3	91	2,909
CAR	5	1	75	1,136
Total	29	19	634	16,228
Philippines	65	60	1,532	40,904

Note: The figures do not include the following seven provinces outside the Luzon island; Batanes in Cagayan Valley, Marinduque, Occidental Mindoro, Oriental Mindoro, Palawan and Romblon in Southern Tagalog and Masbate and Catanduanes in Bicol Region.

The Barangay is the basic unit of the Philippine political system. It consists of a part of a city or a municipality with not less than 1,000 inhabitants. It is administrated by a set of elective officials headed by a Barangay Chairman. Although the Barangay has autonomous power of itself, it functions mainly as an administrative arms delivering goods and services from the upper-ranked local government to local community.

A municipality is a subsidiary of the province and it consists of 20 - 30 barangays within its territorial boundaries, one of which is the seat of government found at the town proper (Poblacion).

Cities in the Philippines are of two classes: one is a group of the "highly urbanized cities" with more than 150,000 population and an average annual income of 30 million pesos and the other is a group of the "component cities" with a

population of over 100,000 and income of 10 million pesos. While the former cities are administratively independent of the province, the letters are part of the provinces where they are located and subject to their administrative supervision.

Currently in the Philippines, there are 11 cities designated as highly urbanized cities, out of which three cities are located in the Luzon Island; Metro Manila Area, Baguio City and Olongapo City.

The province is the largest unit of the political structure of the Philippines. Its functions and duties in relation to its component cities and municipalities are generally coordinative and supervisory. Provinces have their territory of at least 3,500 square kilometers with a population of at least 500,000 persons and an average annual income exceeding 10 million pesos.

The regions are not political units with any local government bodies but are defined mainly for statistical and planning purposes. Some organizations of the central Government have their local offices in each regional center such as the regional offices of DPWH.

Cordillera Autonomous Region which is established in 1988, however, is an exceptional region, as well as the Region IX and XII. It is given broad autonomous powers to administer the affairs of the government in the unit of the region, in order to accelerate the economic and social growth. (Its lawmaking body is called Sangguniang Pampook, whose members are elected by the people in the region. Their duties include the maintenance of school, legislation and implementation of development plans except for national defense, security, banking, trade and foreign affairs).

The map in Figure 2.1-1 shows the boundaries of the regions and provinces of the Study Area. Some island provinces of Region II, IV and V are not illustrated because they are out of the scope of the Study.

2.1.2 Population and Economy

The Study Area, the whole Luzon Island excluding NCR covers 107,534 square kilometer which stands for 36% of the national land. In 1990, this area was inhabited by 22.8 million of population, 38% of the total population which means population density of the Study Area was almost same as the national average (Table 2.1-2).

On the other hand, the Study Area produced 341.9 billion pesos of Gross Regional Production (GRDP) in the year of 1990 at current price, which was only 32% of the Gross Domestic Production. Consequently, GRDP per capita in the Study Area was 13,455 pesos (US$538), at the level of 77% of the national average (US$702).

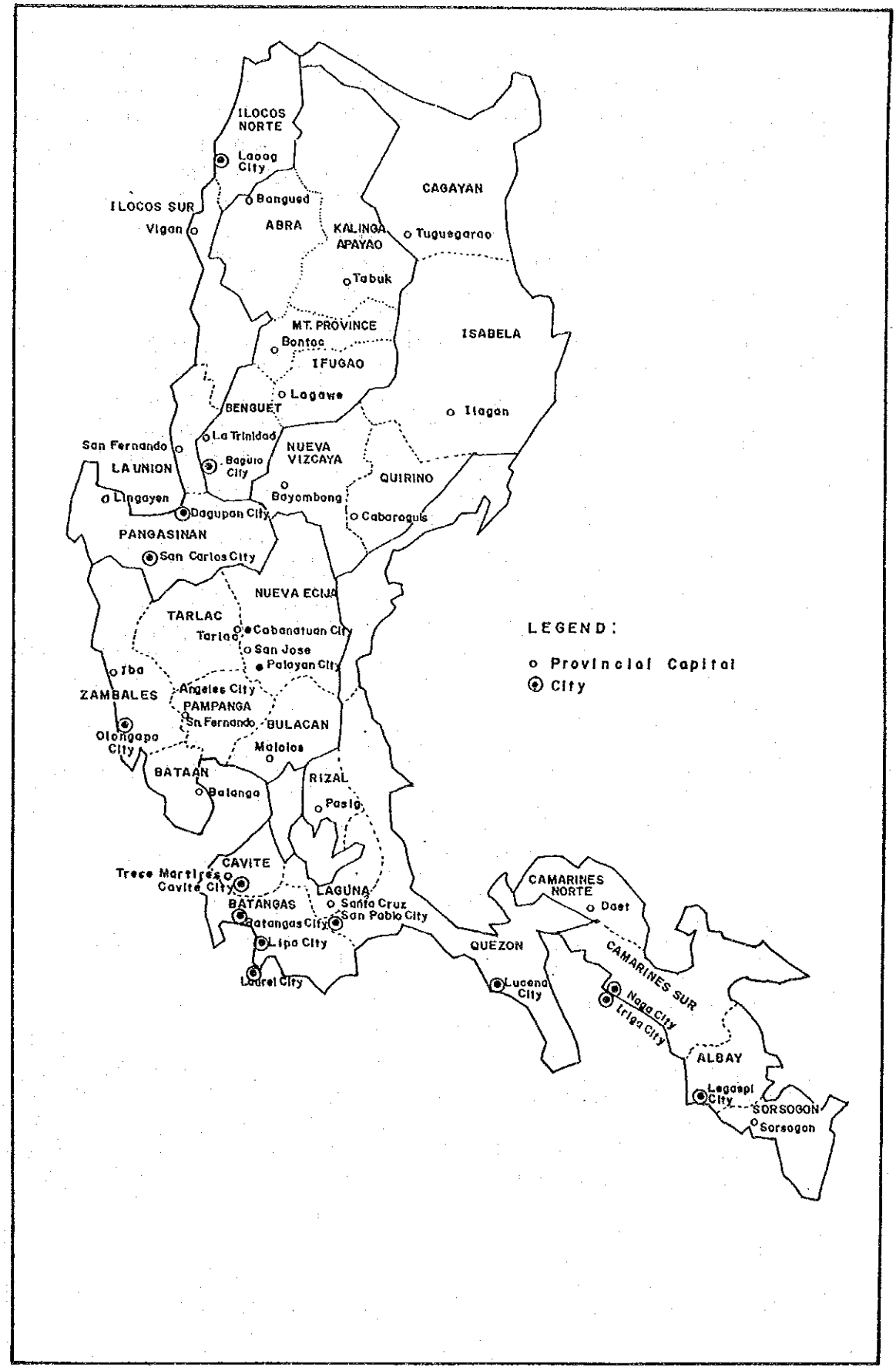


FIGURE 2.1-1 ADMINISTRATION MAP IN THE STUDY AREA

In the Philippines, economic activities are extremely concentrated to NCR, that is, the GRDP of NCR was 345.9 billion pesos, 32% of GDP, while NCR was populated by 7.9 million inhabitants, only 13% of the total. As the results, the GRDP per capita in NCR is as 2.5 times high as that of the other regions. Therefore, it is concluded that the per capita productivity of the Study Area is not so low comparing to the average of the other regions than NCR.

According to the household income survey in 1988, the average household income of the Study Area was 45,912 pesos, not so low as the national average of 50,510 pesos at 1990 current price.

The infrastructure program of DPWH allots the amount of 14,870 million pesos to the road sector for the year of 1993, of which 1,519 million pesos are to nationwide projects and 13,351 million pesos are distributed to each region. The Study Area was allocated 5,822 million pesos, 43.6% of the total.

TABLE 2.1-2 SOCIO-ECONOMIC INDICATORS OF THE STUDY AREA

Item	Unit	Year	(1) Study Area	(2) Philip-pines	(1)/(2)
1 Area	Sq.Km.		107,534	300,000	0.358
2 Population	1000	1980	18,045	48,098	0.375
	1000	1990	22,836	60,685	0.376
3 GDP (at current price)	Mill.₱	1990	341,892	1,066,224	0.321
4 Per capita GDP	₱/Capita	1990	13,455	17,570	0.766
5 Ave. Family Income	₱/Year	1988	45,912	50,510	0.909
6 Road Investment	Mill. ₱	1993	5,823	13,352	0.436

Source: NEDA, DPWH and NSO

2.2 PRESENT LAND USE

2.2.1 Regional Characteristics

Of the study area of 107,534 km^2, 52,057 km^2 or 48% are less than 18% of slope degrees, which are classified as an arable land suitable for agricultural production activities in general. The arable land in Region I to V is ranging 55% to 62% to the respective land area, while the CAR is limited to 18% due to mountainous land extend. Slope classification in the study area is shown in Table 2.2-1.

TABLE 2.2-1 LAND AREA CLASSIFICATION BY SLOPE DEGREE IN THE STUDY AREA

Regions	Distribution by Slope		Total Area	
	0 - 18%	18% Over	%	Km^2
CAR	18	82	100	18,294
I	62	38	100	12,840
II *	45	55	100	26,628
III	61	39	100	18,231
IV *	55	45	100	19,468
V *	58	43	100	12,073
Study Area	48 (52,057 Km^2)	52 (55,476 Km^2)	100	107,534
Philippines Total	47 (141,235 Km^2)	53 (158,765 Km^2)	100	300,000

Note : *; I (Excluding Batanes), IV (Excluding Marinduque, Occidental Mindoro, Oriental Mindoro and Palawan), and V (Excluding Catanduanes and Masbate)
Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

The regional land use distribution by major land item is shown in Table 2.2-2. The agricultural land including pasture and idle grassland in the study area occupies 58,070 km^2 or 54% to the total area, of which proportion is larger than the country average of 41%. On the other hand, forestry in the study area covers 35% of the land which is smaller than the national average of 52%. Agricultural land development in the study area is advanced than the national general progress. Agricultural land in Region I occupies extremely high share of 80% and the lowest of 32% in Region II. The regional land use distribution is shown in Figure 2.2-1.

TABLE 2.2-2 PRESENT LAND USE IN THE STUDY AREA

Regions	Distribution (%)			Total Area	
	Agricultural Land *	Forestry	Built-up & Others	%	Km^2
CAR	59	38	3	100	18,294
I	80	14	6	100	12,840
II	32	53	15	100	26,628
III	55	36	9	100	18,231
IV	61	34	5	100	19,468
V	54	15	31	100	12,073
Study Area	54 (58,070 Km^2)	35 (37,956 Km^2)	11 (11,508 Km^2)	100	107,534
Philippines	41 (123,000 Km^2)	52 (154,644 Km^2)	7 (22,356 Km^2)	100	300,000

Note : * Including pasture and grassland
Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

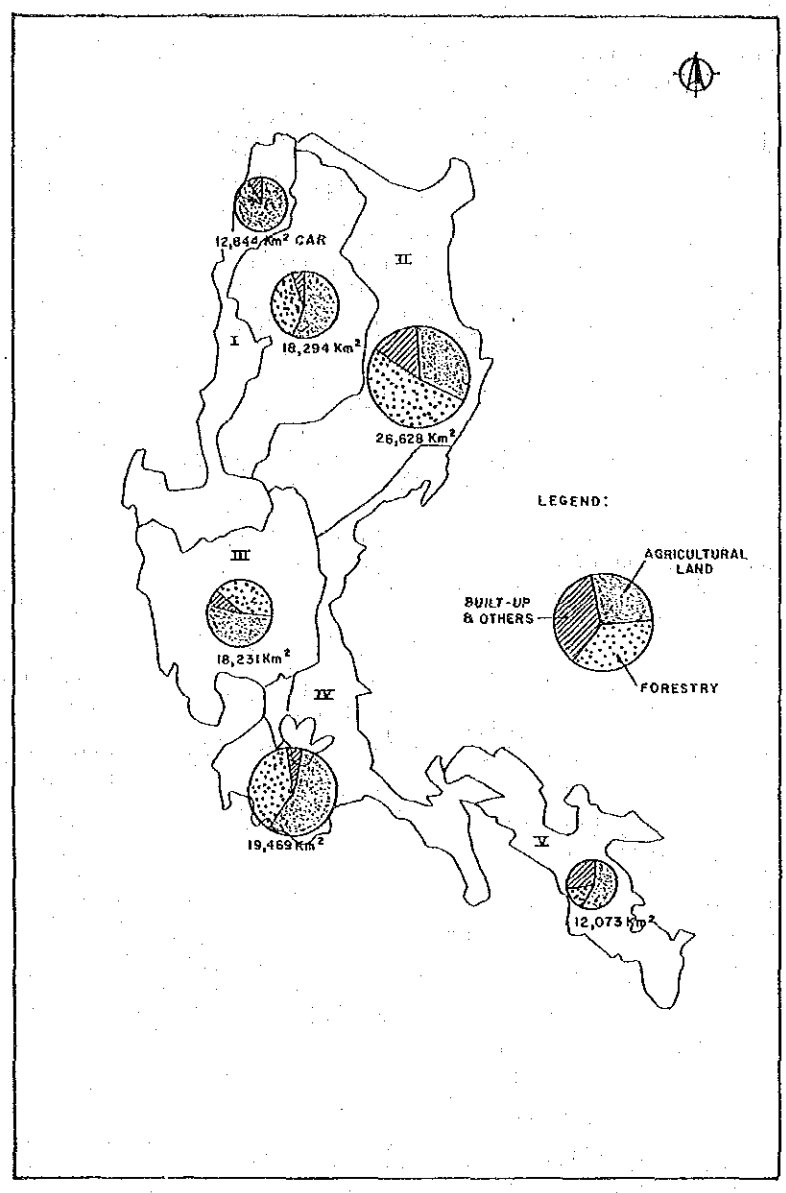


FIGURE 2.2-1 PRESENT LAND USE IN THE STUDY AREA

The arable land usually located at the area with less than 18% of slope degrees and is divided into lowland with less than 8% of slope degrees and upland above 8%. While the land area such as agricultural crop land, pasture, idle grass land, and built-up in the study area is estimated at 69,581 km^2 and larger than the area less than 18% of slope degrees with 52,057 km^2 as shown in Table 2.2-3. Especially in CAR, total developed land of 11,351 km^2 accounts for around 3.4 times of the area less than 18% of slope degrees with 3,314 km^2. The reforestation, agro-forestry development or land and soil conservation works should be promoted especially at upland or more steep area utilized for crop production, pasture or idle grassland.

TABLE 2.2-3 PRESENT LOWLAND AND UPLAND USE IN THE STUDY AREA

Regions	Distribution (%)				Total Area	
	Crop Land	Pasture	Grassland (Idle)	Built-up & Other	%	Km^2
CAR	32	47	16	4	100	11,351
I	35	52	7	7	100	11,063
II	51	10	8	32	100	12,445
III	58	3	25	13	100	11,612
IV	71	5	16	8	100	12,872
V	61	1	2	36	100	10,238
Study Area	52 (36,001 km^2)	19 (13,344 km^2)	13 (8,727 km^2)	17 (11,509 km^2)	100	69,581

Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

2.2.2 Agricultural Land Use

The agricultural land use map of the study area as shown in Fig. 2.2-2 was prepared based on the existing land use maps collected from the Bureau of Soils and Water Management and the regional offices of NEDA. The agricultural land use in lowland and upland is summarized in Table 2.2-4 and 2.2-5 respectively.

TABLE 2.2-4 PRESENT AGRICULTURAL LAND USE IN LOWLAND

Regions	Distribution (%)				Total Area	
	Paddy Field		Diversified Crop Land	Grassland (Idle)		
	Irrigated	Rainfed			%	Km^2
CAR	25	11	57	6	100	1,222
I	30	49	19	2	100	3,679
II	33	13	49	5	100	3,998
III	36	32	13	19	100	8,091
IV	18	29	27	26	100	3,209
V	37	24	34	5	100	2,256
Study Area	31 (7,071 km^2)	29 (6,506 km^2)	27 (6,046 km^2)	13 (2,832 km^2)	100	22,455

Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

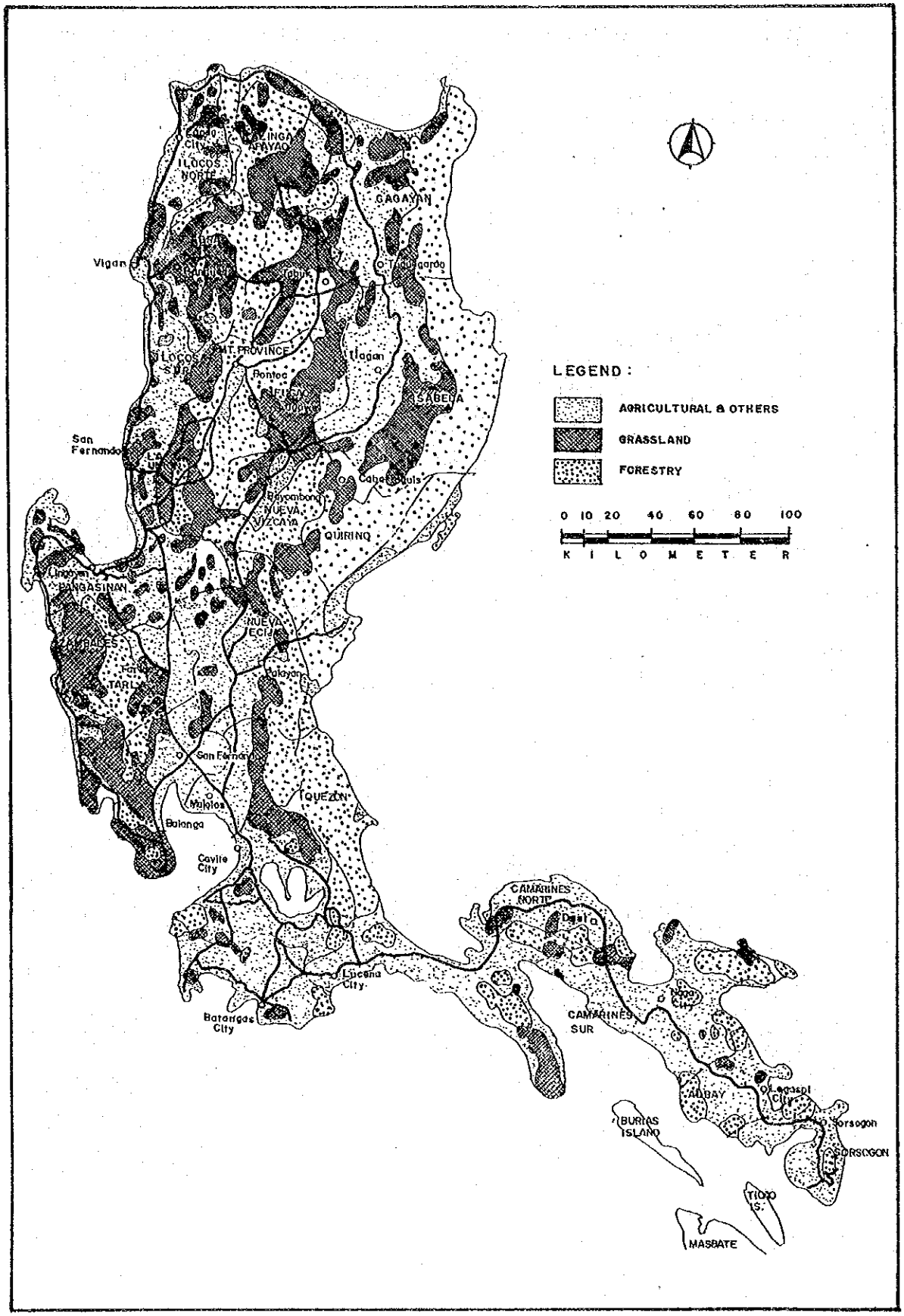


FIGURE 2.2-2 PRESENT LAND USE MAP

TABLE 2.2-5 PRESENT AGRICULTURAL LAND USE IN UPLAND

Regions	Distribution (%)			Total Area	
	Permanent Crop Land	Pasture	Grassland (Idle)	%	Km^2
CAR	26	56	18	100	9,648
I	4	86	10	100	6,639
II	56	27	17	100	4,438
III	11	18	70	100	1,969
IV	78	7	15	100	8,634
V	96	2	2	100	4,287
Study Area	46 (6,376 km^2)	37 (13,344 km^2)	17 (5,895 km^2)	100	35,615

Source: Regional Physical Framework Plan, Data from Bureau of Soil, NIA and DENR.

Of the lowland agricultural area of 22,455 km^2 in the study area, 13,577 km^2 or 60% is paddy field. The irrigated paddy land is estimated at 7,071 km^2 or around 52% of the total paddy land. The rest of the agricultural land is diversified crop land (27%) cultivating corn, vegetables, beans, root crops, sugarcane, tobacco, etc., and idle grassland (13%). Agricultural land in upland is developed as permanent crop land planting coconuts and other fruit trees, pasture and idle grassland. The permanent crop land occupies 16,376 km^2 or 46% of the total upland area, followed by pasture (37%) and grassland (17%).

Progress of agricultural land development will be expressed by the proportion of agricultural crop land and pasture to the total agricultural land including idle grassland. The provincial agricultural land development status is shown in Figure 2.2-3. As shown in Table 2.2-6, the lowland development in the study area is progressed more than 87% on average ranging 74% in Region IV to 98% in Region I. The upland development progress is 83% on the average and slightly less developed than the lowland. The future agricultural land development is needed to focus on the improvement of existing agricultural land through irrigation development, soil improvement, land consolidation, and conversion of pasture or idle grassland to more productive production land such as diversified crop land, permanent crop land, agro-forestry, etc.

TABLE 2.2-6 AGRICULTURAL LAND DEVELOPMENT STATUS (%)

Regions	Lowland	Upland	Total
CAR	93.7	82.0	83.3
I	97.9	90.1	92.9
II	95.2	82.9	88.7
III	80.9	29.9	70.9
IV	74.1	85.2	82.2
V	95.0	98.0	96.9
Study Area	87.4	83.4	85.0

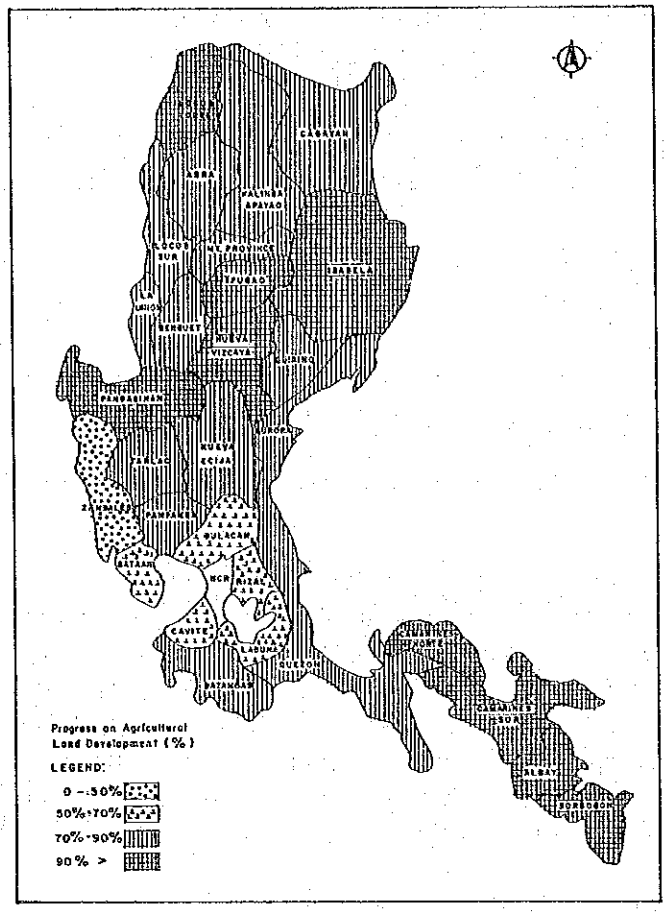


FIGURE 2.2-3 AGRICULTURAL LAND DEVELOPMENT STATUS BY STUDY PROVINCE

2.2.3 Other Land Use

To maintain environment conditions as well as to conserve land and soil in the area or the lower reaches of streams, reforestation is urgently needed. The DENR is an official executing agency to promote reforestation programs in the country. The reforestation and forest conservation area in the study area covers 16,395 km^2 or 43% of the present forestry area with 37,956 km^2 as shown in Table 2.2-7. The programmed area in the CAR, Region I and V covers 74% to 77% of the present forestry area, while the area in Region II is limited to 14%.

TABLE 2.2-7 REFORESTATION AND FOREST CONSERVATION AREA IN THE STUDY AREA (Unit: Km^2)

Regions	Present Forestry	Reforestation and Forest Conservation Area	
		Area	Share to Present Forestry (%)
CAR	6,943	5,157	74
I	1,778	1,352	76
II	14,183	2,037	14
III	6,620	2,667	40
IV	6,597	3,766	57
V	1,835	1,416	77
Study Area	37,956	16,395	43

Source: DENR

National parks located at the area of 839 km^2 and the watershed reservation covers 5,459 km^2 in the study area as shown in Table 2.2-8. Development activities on agriculture, industry and mining, and other related infrastructure should pay attention to those location and environmental influence. The reforestation area and location of protection area is shown in Figure 2.2-4.

TABLE 2.2-8 OTHER PROTECTION AREA IN THE STUDY AREA (Unit: Km^2)

Regions	National Parks	Watershed Reservation	Others	Total
CAR	157	1,613	1,029	2,799
I	23	48	170	241
II	82	1,013	412	1,507
III	329	2,116	184	2,629
IV	0	377	33	410
V	248	292	335	875
Study Area	839	5,459	2,163	8,461

Source: DENR

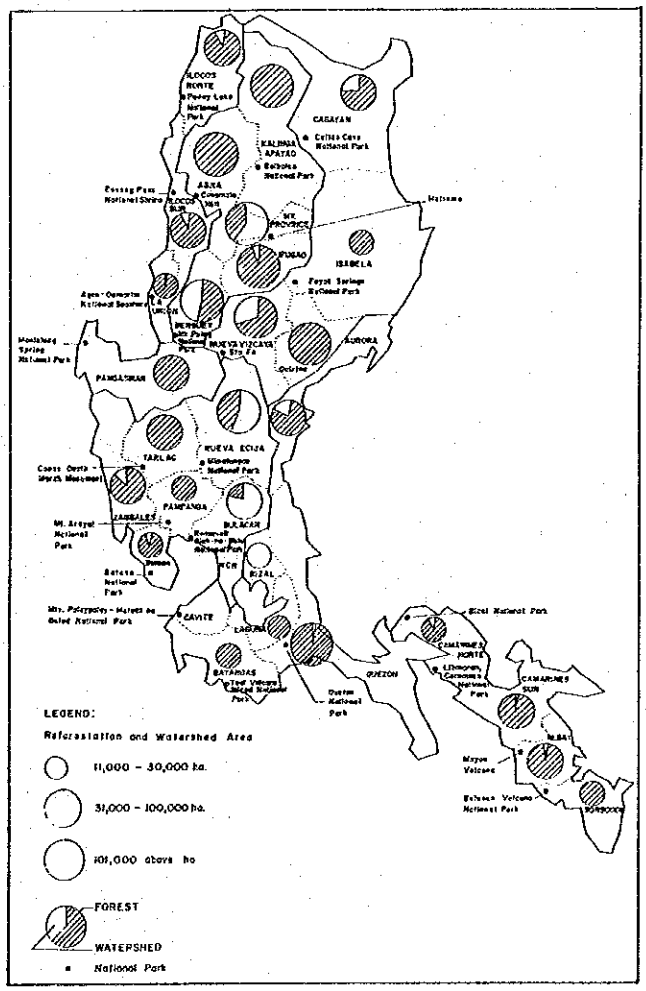


FIGURE 2.2-4 PROTECTION AREA IN THE STUDY

2.3 POPULATION

2.3.1 Historical Trend

The 1990 censue population of the Study Area was 22.8 million, 38% of the national population. Adding 7.9 million of NCR population to this, the population of Luzon Island was more than half of the total.

According to the censuses in the past (Table 2.3-1 and Figure 2.3-1), population of the Study Area has been increasing by four to five million inhabitants in each decade. In the latest decade of 1980 to 1990, the annual increase rate was 2.4% in the Study Area which was sligthly higher than that of the nation of 2.3%.

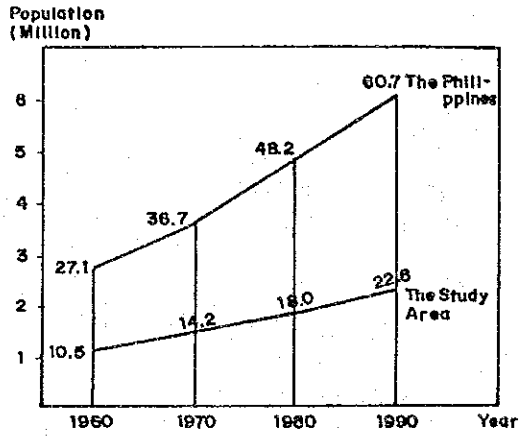


FIGURE 2.3-1 PAST POPULATION TREND IN THE STUDY AREA

TABLE 2.3-1 POPULATION TREND OF THE STUDY AREA, 1960-1990

Regions	1960	1970	1980	1990
I Ilocos	2,042,865	2,488,391	2,922,892	3,550,606
II Cagayan Valley*	1,025,441	1,451,325	1,907,000	2,325,626
III Central Luzon	2,525,379	3,615,496	4,802,793	6,198,957
IV Southern Tagalog*	2,359,000	3,436,786	4,710,580	6,491,710
V Bicol*	2,026,736	2,473,973	2,892,462	3,122,884
CAR	551,032	730,906	914,432	1,145,880
STUDY AREA (LUZON IS.)	10,530,453	14,196,877	18,150,159	22,835,663
METRO MANILA (NCR)	2,462,488	3,966,695	5,925,884	7,934,079
OTHER REGIONS	14,094,744	18,520,914	24,346,058	29,915,145
THE PHILIPPINES	27,087,685	36,684,486	48,098,460	60,684,887

Note : * See Table 2.2-1

2.3.2 Age and Sex Structure

Figure 2.3-2 illustrates the age and sex structure of the 1990 population in the Study Area. Taking male population as 100 female population is 98.4. The male is more than the female in the age groups younger than 25 years and the adverse is true in the other age groups with only one exception of 40 to 44 years.

The age composition shows so-called pyramid type, the younger, the more, which is typical in society with high birth rate. The dependent population to productive age (15-64) population is 74.0 which is still in high level although it is historically declining. This high dependent population rate is one of the disadvantageous conditions for the economic growth. The rate of the whole nation is 73.0.

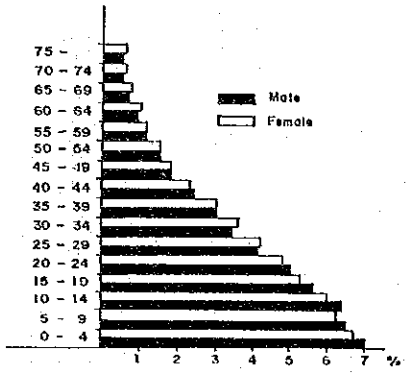


FIGURE 2.3-2 POPULATION DISTRIBUTION BY AGE AND SEX IN THE STUDY AREA (1990)

2.3.3 Geographical Distribution

The province-wise population in the Study Area are shown in Table 2.3-2 and the population change during 1980-1990 in Figure 2.3-3, 12.6 million inhabitants, 55% of the Study Area population are in Region III and Region IV which located inside about 100 Km. sphere from the Capital.

47% of the Study Area population inhabitat in the urban area, while there was no remarkable change in the remote provinces. Population of Region IV increased at 3.2% per annum and Region III at 2.5% per annum, while the growth rates of other Regions were lower than the Study Area average. Rizal provinces located to the east of the Capital showed the highest rate of 5.6% per annum.

Figure 2.3-4 shows population distribution in terms of density. The average of the Study Area is 212 persons/km^2. The most densely inhabited province is Cavite (890 persons) followed by Laguna (779 persons), Rizal (749 persons) and Pampanga (703 persons), all of which are located near the Capital. On the contrary, lowest provinces are remote and mountainous area in CAR and Region II. Municipal population distribution of the Study Area in 1990 is shown in Figure 2.3-5.

TABLE 2.3-2 POPULATION DISTRIBUTION BY PROVINCE IN 1990

Region/ Province	Population in 1990			Growth Rate 1980-1990 (%Year)	Land Area (Km^2)	Density (person/ Km^2)
	Urban	Rural	Total			
CAR	357,326	788,554	1,145,880	2.24	18,293.8	63
Abra	44,020	140,723	184,743	1.44	3,975.7	46
Benguet	256,300	229,246	485,546	3.11	2,655.4	183
Mt. Province	10,506	106,029	116,535	1.23	2,097.3	56
Ifugao	15,871	131,410	147,281	2.82	2,517.8	58
K. Apayao	30,629	181,146	211,775	1.30	7,047.6	30
Region I	1,339,140	2,211,466	3,550,606	1.97	12,840.2	277
Ilocos Norte	130,586	331,075	461,661	1.72	3,399.3	136
Ilocos Sur	125,162	394,768	519,930	1.63	2,579.6	202
La Union	157,429	391,313	548,742	1.94	1,493.1	368
Pangasinan	925,953	1,094,310	2,020,273	2.12	5,368.2	374
Region II	543,490	1,782,136	2,325,626	1.95	26,628.2	87
Cagayan	195,434	634,540	829,974	1.52	9,002.5	92
Isabela	247,051	833,290	1,080,341	2.11	10,664.6	101
Nueva Vizcaya	71,919	229,260	301,179	2.17	3,903.9	77
Quirino	29,086	85,046	114,132	3.11	3,057.2	37
Region III	3,712,220	2,486,737	6,198,957	2.53	18,230.4	340
Bataan	317,528	108,275	425,803	2.70	1,373.0	310
Bulacan	1,189,802	315,417	1,505,219	3.16	2,625.0	573
Nueva Ecija	511,569	801,041	1,312,610	2.03	5,284.3	248
Pampanga	1,079,806	452,876	1,532,682	2.58	2,180.2	703
Tarlac	256,594	603,057	859,651	2.22	3,053.5	237
Zambales	356,921	206,071	562,992	2.37	3,714.4	152
Region IV	3,733,028	2,758,682	6,491,710	3.21	19,468.4	333
Aurora	60,599	78,987	139,586	2.65	3,239.8	43
Batangas	398,725	1,078,058	1,476,783	2.38	3,165.8	466
Cavite	875,825	276,709	1,152,534	4.10	1,287.6	890
Laguna	1,017,908	352,324	1,370,232	3.46	1,759.7	779
Quezon	451,379	921,002	1,372,381	1.83	8,706.7	158
Rizal	928,592	51,602	980,194	5.62	1,308.8	749
Region V	1,012,626	2,110,258	3,122,884	1.37	12,072.9	259
Albay	285,835	617,188	903,023	1.06	2,552.6	354
Camarines Norte	132,549	258,433	390,982	2.37	2,112.1	185
Camarines Sur	458,332	847,587	1,305,919	1.71	5,266.8	248
Sorsogon	135,910	387,050	522,960	0.40	2,141.4	244
Study Area	10,697,830	12,137,833	22,835,663	2.38	107,533.9	212

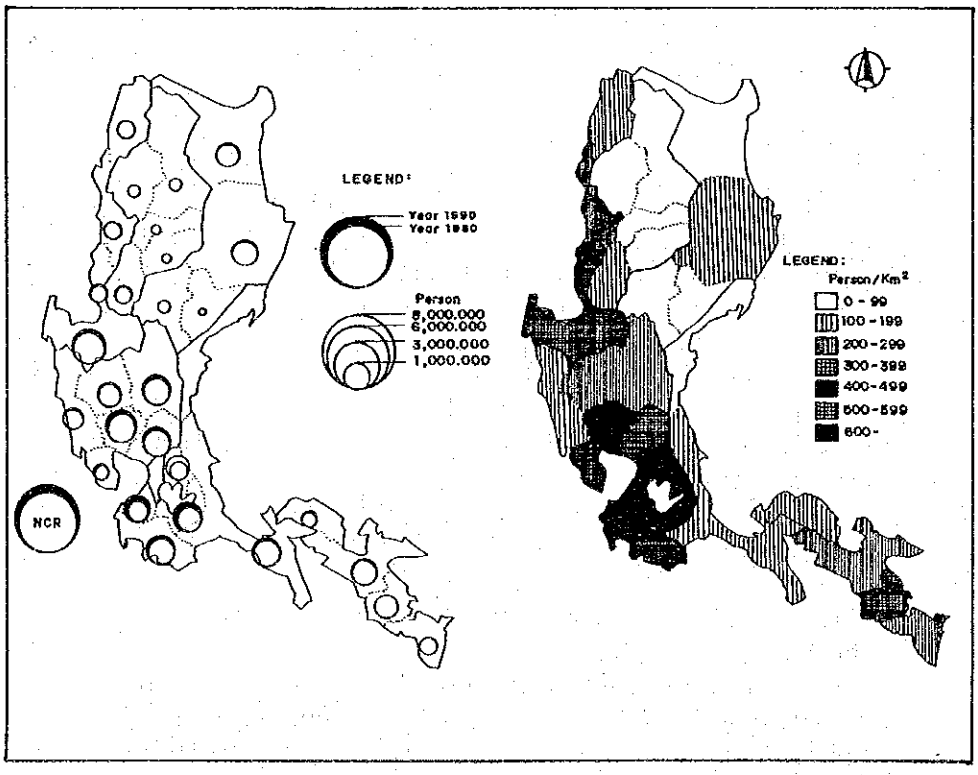


FIGURE 2.3-3 POPULATION INCREASE BY PROVINCE (1980-1990)

FIGURE 2.3-4 POPULATION DENSITY BY THE PROVINCE

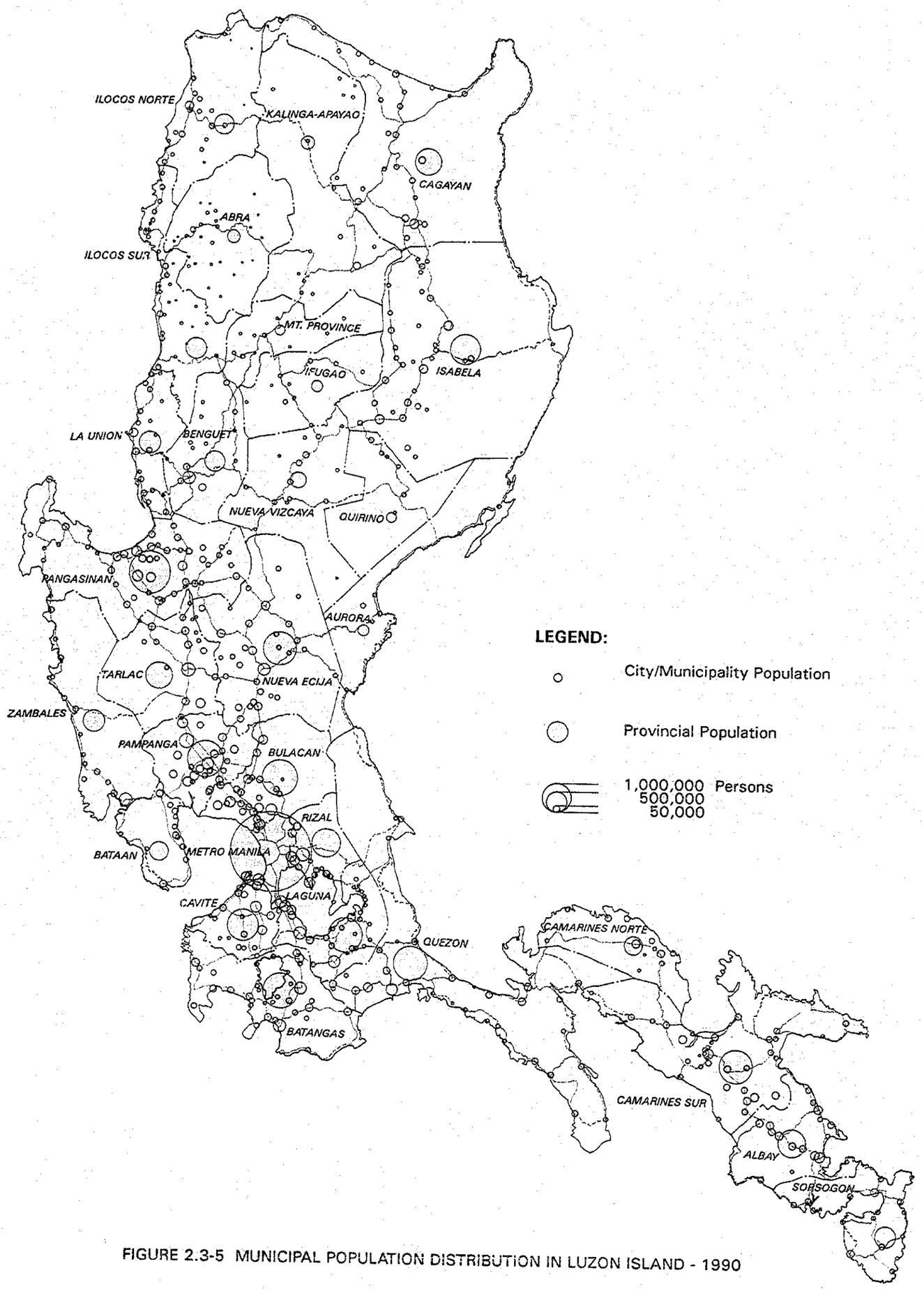


FIGURE 2.3-5 MUNICIPAL POPULATION DISTRIBUTION IN LUZON ISLAND - 1990

2.3.4 Migration

Inter-regional migration occurred in 1975-1980 as shown in Table 2.3-3. Total migrants of the Philippines during the six years were 849,000 of which 432,000 were the emigrants from the Study Area and 392,000 were immigrants to the Study Area. Thus, the Study Area had 40,000 net social decrease of population during the period.

55% of the emigrants from the Study Area moved to NCR, 13% to Region IV and 9% to Region III.

TABLE 2.3-3 INTER-REGIONAL MIGRATION DURING 1975-1980

(1,000 person)

Origin	Destination NCR	I	II	III	IV	V	Other	Total
Metro Manila (NCR)	0	12	5	42	91	16	38	204
I Ilocos	43	0	13	13	9	1	8	87
II Cagayan Valley	16	7	0	4	4	1	6	38
III Central Luzon	51	7	8	0	16	3	7	92
IV Southern Luzon	75	4	2	14	0	10	10	115
V Bicol	52	1	1	9	28	0	9	100
Other Region	142	5	4	20	36	6	0	213
Total	379	36	33	102	184	37	78	849

Source: NSO

2.4 ECONOMY

2.4.1 GRDP of the Study Area

The six (6) study regions produced 341.9 billion pesos or around 32% of the Gross Domestic Product (GDP) of 1,066.2 billion pesos in 1990. The Gross Regional Domestic Product (GRDP) in the NCR occupies 33% of the GDP and the GRDPs in the seven regions including the NCR occupies 65%. The GRDP in the 6 regions is almost same amount as the NCR's. The GRDP of Region IV occupies 43% of the GRDPs in the 6 regions which is the biggest share, followed by Region III (28%) as shown in Table 2.4-1.

TABLE 2.4-1 GRDP DISTRIBUTION BY REGION IN 1990 (Current Price)

Regions	GRDP (Million Pesos)	% to the Philippines
CAR	17,844	1.7
I	31,025	2.9
II	20,392	1.9
III	94,157	8.8
IV	147,600	13.8
V	30,874	2.9
6 Regions Total	341,892	32.1
NCR	345,942	32.4
7 Regions Total	687,834	64.5
Philippines	1,066,224	100.0

Source: NSCB

Sectoral share of Gross Value Added (GVA) in the 6 regions is 31% in agriculture and 69% in non-agriculture. The GVA of each sector in the 6 regions accounts for 45% and 29% of the respective national GVA. The NCR occupies 42% of the national GVA in non-agriculture as shown in Table 2.4-2.

TABLE 2.4-2 GRDP DISTRIBUTION BY SECTOR IN 1990

Regions	Distribution (%)	
	Agriculture	Non-Agriculture
CAR	3.9	2.4
I	12.3	3.1
II	10.1	1.7
III	20.5	12.5
IV	41.0	17.9
V	12.2	3.1
6 Regions Total	100.0	40.7
(Million Pesos)	(104,919)	(236,973)
NCR	0	59.3
7 Regions Total	100.0	100.0
(Million Pesos)	(104,919)	(582,915)
Philippines (Million Pesos)	(235,465)	(830,759)

Source: NSCB, NSO

The past GRDP growth through 1985 to 1990 is summarized in Table 2.4-3. The GDP grew at an annual average growth rate of 5.1%. The GRDP growth rates in the 6 regions range between 2.8% in Region II and 5.6% in Region III. Agricultural GVA growth rates in Region III, IV, V and CAR are lower than non-agricultural sectors, while those in Regions I and II are higher. Per capita GRDP in the 6 regions amounts to 13,455 pesos in 1990, which is around 31% of the NCR's 43,631 pesos. During 1987 to 1990 period, per capita GRDP in the 6 regions grew at an annual average growth rate of 2.4%, ranging from 0.2% in Region II to 3.5% in Region III as shown in Table 2.4-4.

TABLE 2.4-3 PAST GRDP GROWTH BY SECTOR
(1985/87 Average - 1988/90 Average, %/Year)

Regions	Agriculture	Non-Agriculture	GRDP
Philippines	3.00	5.74	5.08
NCR	-	7.08	7.08
CAR *	3.98	4.04	4.02
I	3.81	3.33	3.50
II	2.87	2.77	2.82
III	5.28	5.67	5.58
IV	3.83	6.09	5.40
V	1.11	4.69	3.10

* : Growth rate between 1989 and 1990
Source: NSCB, NSO

TABLE 2.4-4 PER CAPITA GRDP (Pesos, 1990 Constant Price)

Region	1990	Growth Rate (1987-90, %/year)
CAR	15,572	1.74
I	8,738	1.39
II	8,712	0.22
III	15,192	3.49
IV	17,857	1.82
V	7,896	3.15
6 Regions	13,455	2.43
NCR	43,631	3.42
7 Regions	20,631	3.07
Philippines	17,570	2.40

Source: NSCB, NSO

2.4.2 Provincial Account Estimate

There are no official data on Gross Provincial Domestic Product (GPDP). For the study purposes, the GPDP in the study area is estimated on the basis of the following data:

1) Agricultural GVA:

   a. agricultural production for crops, livestock, fishery and forestry,
   b. agricultural farmgate price statistics, and
   c. GVA ratio by commodities

2) Non-Agricultural GVA (Industry and Service Sectors)

   a. number of family by sector (Family Income and Expenditure Survey, 1988), and
   b. implicit price index of GRDP.

Agricultural GVA is estimated by the multiplication of production data, those prices and GVA ratios. The estimation of non-agricultural GVA has an assumption that there are no significant productivity difference among provinces under the same region. The non-agriculture GVA of region is allocated to the respective province according to the distribution of number of family by sector. The GPDP estimate in 1990 is shown in Table 2.4-5.

TABLE 2.4-5 GPDP ESTIMATE IN 1990 (Unit :₱000, 1990 Price)

Region/ Province	Agriculture, Forestry & Fishery	Industry Sector	Service Sector	Total
NCR	0	147,603,719	198,337,963	345,941,682
CAR	4,142,057	8,260,395	5,441,431	17,843,883
Abra	526,041	461,253	1,176,610	2,163,904
Benguet	1,404,157	5,851,870	2,288,366	9,544,393
Mt. Province	497,048	788,225	508,510	1,793,783
Ifugao	538,467	713,532	935,196	2,187,195
K. Apayao	1,176,344	445,515	532,749	2,154,608
Region I	12,877,279	5,908,208	12,239,820	31,025,307
Ilocos Norte	1,403,623	604,617	1,795,626	3,803,866
Ilocos Sur	1,674,046	546,440	2,077,950	4,298,436
La Union	1,648,292	1,131,059	2,347,766	5,127,117
Pangasinan	8,151,316	3,626,092	6,018,478	17,795,888
Region II	10,545,367	2,442,367	7,404,079	20,392,382
Cagayan	2,112,083	1,028,260	3,104,507	6,244,850
Isabela	7,045,637	1,116,109	3,187,399	11,349,145
N. Viscaya	799,157	188,399	850,590	1,838,146
Quirino	562,400	88,234	218,061	868,695
Others	26,659	21,365	43,522	91,546
Region III	21,479,211	36,863,833	35,813,781	94,156,825
Bataan	923,606	2,542,893	3,046,344	6,512,843
Bulacan	4,403,238	11,579,028	10,235,563	26,217,829
Nueva Ecija	6,529,680	5,526,313	5,350,682	17,406,675
Pampanga	3,758,862	9,559,947	9,331,282	22,650,091
Tarlac	3,350,757	3,392,250	3,870,848	10,613,855
Zambales	2,513,068	4,263,402	3,979,062	10,755,532
Region IV	43,054,482	55,747,901	48,797,613	147,599,996
Aurora	1,546,517	752,857	752,598	3,051,972
Batangas	6,992,048	5,207,984	4,682,022	16,882,054
Cavite	4,595,984	14,927,284	6,807,728	26,330,996
Laguna	5,742,607	14,824,355	10,433,841	31,000,803
Quezon	8,111,465	6,279,296	4,917,529	19,308,290
Rizal	4,064,343	9,071,382	13,970,449	27,106,174
Others	12,001,518	4,684,743	7,233,446	23,919,707
Region V	12,819,827	5,023,145	13,030,714	30,873,686
Albay	1,974,253	1,585,992	3,540,537	7,100,782
Cam. Norte	1,243,523	785,947	1,201,732	3,231,202
Cam. Sur	5,320,228	1,100,794	4,054,658	10,475,680
Sorsogon	1,343,518	582,118	1,922,294	3,847,930
Others	2,938,305	968,294	2,311,493	6,218,092

Note: Consultant estimate based on the data from NSCB and NSO

2.4.3 Employment Situation

Based on the NSO survey in 1988, the labor force in the 6 regions accounts for 10.7 million or 47% of the national total. Employment and unemployment ratios in the 6 regions are 94.8% and 5.2% respectively. The unemployment ratio in the 6 regions is slightly higher than the national 4%. The share of agricultural employment in the 6 regions is 46% of the total labor force and 49% of the employed population, which are higher than the national average of 44% and 46% respectively. The employment status in the study regions is summarized in Table 2.4-6.

TABLE 2.4-6 EMPLOYMENT STATUS IN 1988

Regions	Total Labor Force ('000)	Distribution (%)		
		Agri-culture	Non-Agriculture	Unem-ployed
CAR	507	53	44	3
I	1,321	54	412	5
II	977	63	34	3
III	2,270	34	58	8
IV	3,814	40	55	5
V	1,844	58	38	4
6 Regions Total	10,733	46	49	5
NCR	2,748	0	90	10
7 Regions Total	13,481	37	57	6
Philippines	22,937	44	51	4

Source: NSO

The GVAs per employed population in agriculture and non-agriculture sectors are estimated in Table 2.4-7. Per capita GVA in the 6 regions is 21,221 pesos in agriculture, 45,345 pesos in non-agriculture and 33,616 pesos in both sectors. The former is around 47% of the latter. Per capita GVA in Region V is a significantly low amount of 17,403 pesos, followed by Region II's 21,488 pesos.

TABLE 2.4-7 PER EMPLOYED POPULATION GVA BY SECTOR IN 1990

(Pesos, 1990 Price)

Regions	Agri-culture	Non-Agriculture	All Sectors
CAR	15,398	61,443	36,268
I	18,214	33,177	24,741
II	17,010	29,928	21,488
III	28,175	54,820	45,081
IV	28,513	49,713	40,852
V	11,914	25,865	17,403
6 Regions	21,221	45,345	33,616
NCR	0	140,570	140,570
7 Regions	21,221	75,831	54,453
Philippines	23,169	70,391	48,542

Source: NSCB, NSO

Average family income and expenditure per household in 1988 is coverted to the value in 1990 using the consumer price index and summarized in Table 2.4-8. Per household annual income in the 6 regions amounys to 45,912 pesos which is 46% of the NCR's 99,936 pesos and 91% of the national 50,510 pesos.

TABLE 2.4-8 AVERAGE FAMILY INCOME AND EXPENDITURE IN 1988

(Pesos/Household : 1990 Price)

Regions	Income	Expenditures	Savings
CAR	43,313	36,764	6,549
I	42,539	34,588	7,951
II	42,162	31,465	10,697
III	56,695	44,359	12,336
IV	48,232	28,369	2,826
V	31,195	28,369	2,826
6 Regions	45,912	38,063	7,849
NCR	99,936	76,047	23,889
7 Regions	59,232	47,492	11,740
Philippines	50,510	40,651	9,859

Source: NSO