REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study of the Road Improvement Project on the Pan-Philippine Highway (Philippines-Japan Friendship Highway)

FINAL REPORT

MAIN TEXT

(VOLUME II)

SEPTEMBER, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

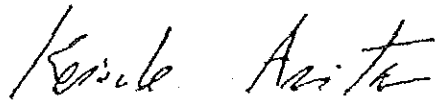
In response to the request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct a feasibility study on the Road Improvement Project of the Pan-Philippine Highway (Philippines-Japan Friendship Highway) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Tsuneo Bekki, and organized by Nippon Engineering Consultant Co., Ltd. and Katahira & Engineers Inc., from June 2, 1986 to June 23, 1987. The Team had discussions with the officials concerned of the Government of the Philippines and conducted a field survey in the project area. After the Team returned to Japan, further studies were made and the present report has been prepared.

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

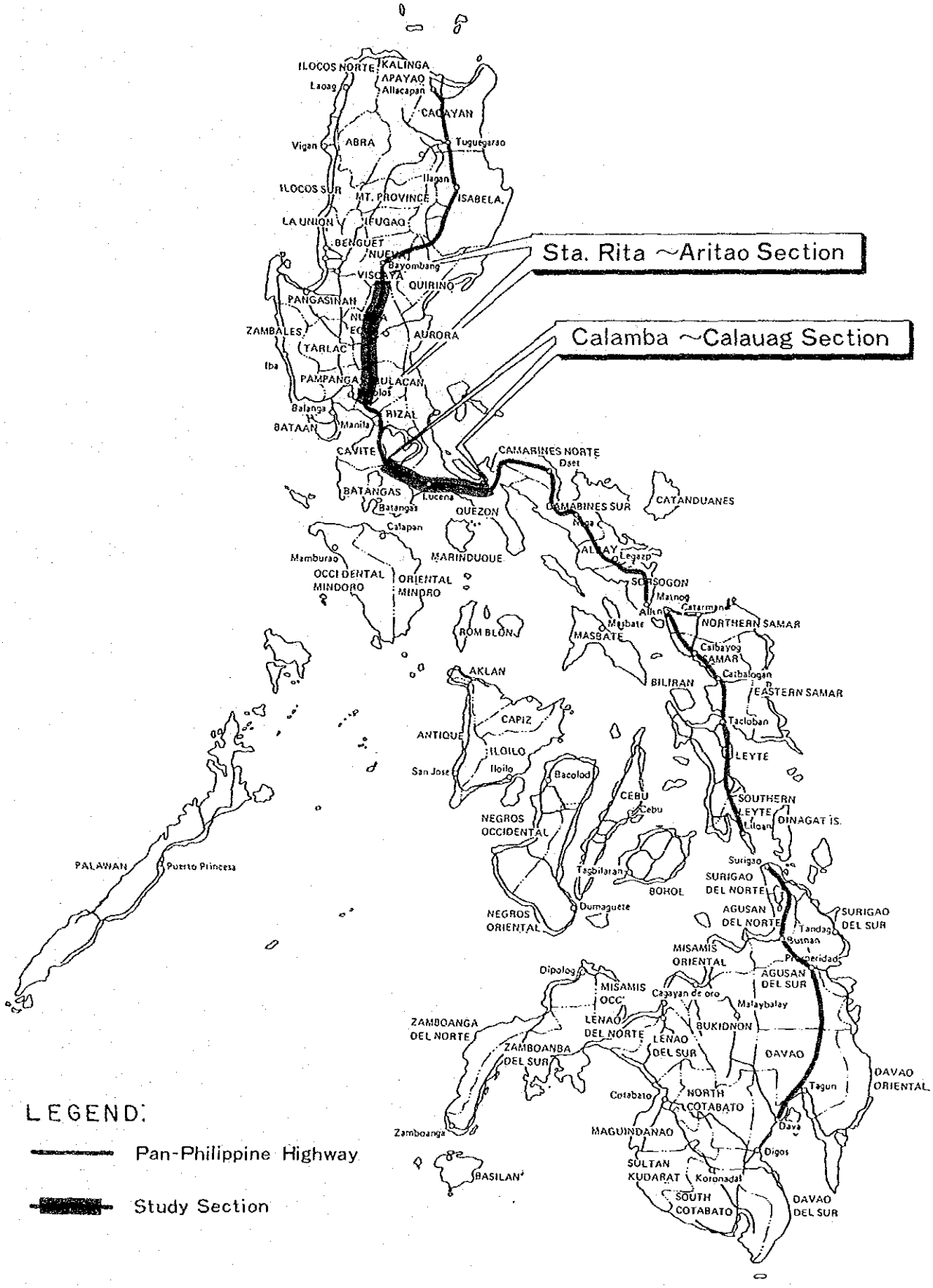
I wish to express my deep appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

September, 1987

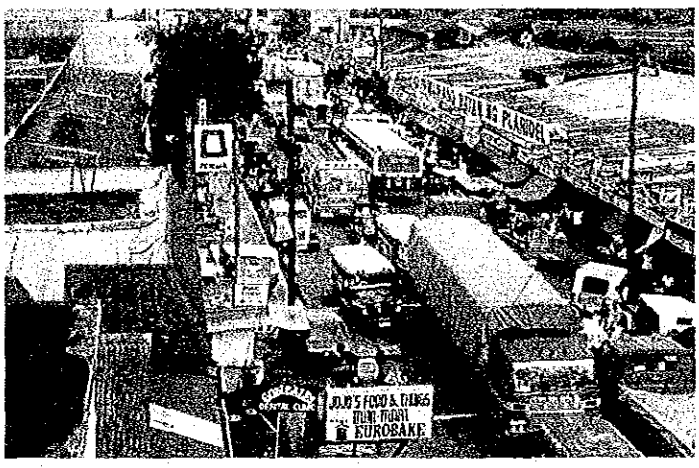


Keisuke Arita
President
Japan International Cooperation Agency

LOCATION MAP



TYPICAL RURAL SECTION
(Plaridel-San Ildefonso Section)

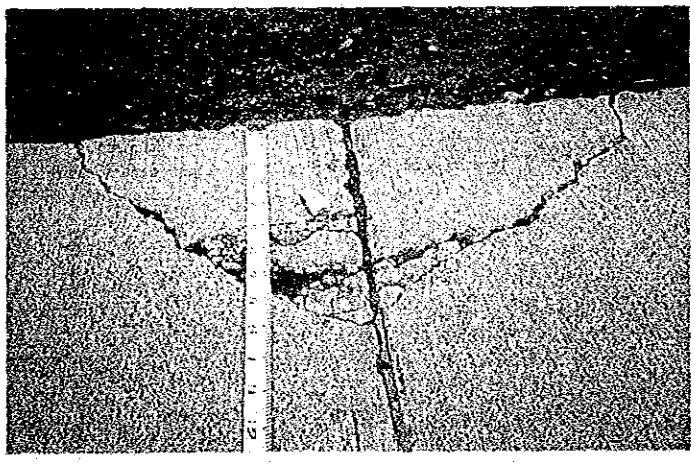


MOST CONGESTED
URBAN SECTION
(Plaridel Urban Section)

UNCONTROLLED INTERSECTION
(Plaridel Intersection)

TRANSVERSE CRACK

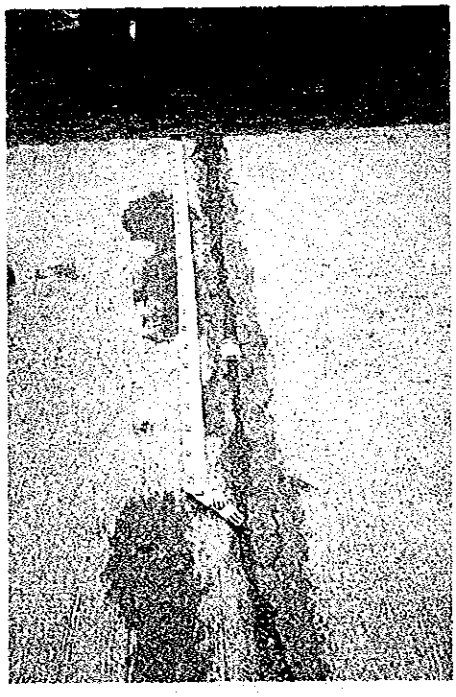
LONGITUDINAL CRACK



CORNER CRACK

BLOCK CRACKING
(Separation of Slab)

SPALLING



JOINT SEAL DAMAGE OF
TRANSVERSE JOINT

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FINDINGS AND RECOMMENDATION

FINDINGS AND RECOMMENDATIONS

1. BASIC INFORMATION

LENGTH OF STUDY SECTION

North Study Section	200 Kms	(Sta. Rita – Aritao, Km 39 – Km 239)
South Study Section	181 Kms	(Calamba – Calauag, Km 52 – Km 233)

TYPES AND NUMBER OF ROAD FUNCTION IMPROVEMENT WORKS
(SHORT TERM)

Unit: Number

Improvement Type	North Study Section	South Study Section	Total
Signalization	6	-	6
Improvement of Geometrics	1	2	3
Paving of Shoulders/Sidewalks	6	7	13
Widening to a 4-lane	-	1	1
R.O.W. Acquisition	3	-	3
TOTAL	16	10	26

TYPES AND NUMBER OF PAVEMENT REHABILITATION WORKS
(SHORT TERM)

Unit: Lane-Km

Rehabilitation Type	North Study Section	South Study Section	Total
2-lane PCC Reconstruction	91.92	110.68	202.60
1-lane PCC Reconstruction	113.96	21.12	135.08
2-lane AC Overlay	69.00	5.00	74.00
TOTAL	274.88	136.80	411.68
Treatment of Weak Subgrade	2.00	–	2.00
Side Ditch	109.73	74.52	184.25
Subsurface Drainage	3.25	11.25	14.50
TOTAL	114.98	85.77	200.75

PROPOSED ROAD FUNCTION IMPROVEMENT WORKS

	Segment	Segment Length (Km)	Short Term (1987–1992)				Medium Term (1993–1998)		Long Term (1999–2010)
			Improvement of Intersection	Paving of Shoulder and Sidewalks Within ROW	ROW Acquisition for Widening/Bypass	Widening to 4-Lane Road	Construction of Bypass/ Alternative Route	Widening to 4-Lane Road	
North Study Section	N-1 (Sta. Rita-Gapan)	46	•Plaridel •Baliuag Bypass *	•San Ildefonso (1.0 km)	•Sta Rita-Plaridel (1.5 km) •Plaridel Bypass (4.6km)	—	•Plaridel Bypass (4.6 km)	Sta. Rita Plaridel (1.5 km)	For majority of rural sections; either/combination of •Bypass plus widening of existing road •Bypass plus constructiuon of roads to link bypass •Construction of alternative route
	N-2 (Gapan-Cabanatuan)	35	•Gapan •Sta. Rosa •Cabanatuan II •Cabanatuan IV	•Gapan (1.2 km) •Sta Rosa (1.1 km) •Cabanatuan (4.5 km)	•Cabanatuan Bypass (7.1 km)	—	•Cabanatuan Urban Section (7.1 km) (Alternative) Route)		
	N-3 (Cabanatuan -San Jose)	42	•San Jose	•Talavera (1.0 km) •San Jose (3.5 km)	—	—			
	N-4 (San Jose-Dalton)	38	—	—	—	—			
	N-5 (Dalton-Aritao)	39	—	—	—	—			
South Study Section	S-1 (Calamba-Tiaong)	42	Sto. Tomas I & II (Geometric Improvement)	•Alaminos (1.2 km)	—	•Calamba-Sto. Tomas (10.0 km)	—	—	Same as North Study Section
	S-2 (Tiaong Pagbilao)	42	—	•Tiaong (1.2 km) •Candelaria (1.0 km) •Sariaya (1.0 km) •Pagbilao (1.3 km)	—	—	•Tiaong (3.0 km) •Candelaria (4.0 km) •Sariaya (4.0 km)	—	
	S-3 (Pagbilao-Plaridel)	46	—	—	—	—	—	—	
	S-4 (Plaridel-Callauag)	39	—	•Gumaca (1.5 km) •Lopez (1.0 km)	—	—	—	—	

* Geometric Improvement

SUMMARY OF LENGTH FOR PAVEMENT REHABILITATION/DRAINAGE IMPROVEMENT BY TYPE OF WORKS

Unit: Lane-Km

Segment		Segment Length (km)	Short-Term									Medium Term		Total	
			Pavement Rehabilitation (Lane-km)					Drainage improvement (km)							
			2-Lane PCC Recon-struction	1-Lane PCC Recon-struction (Manila Bound)	1-Lane PCC Recon-struction (Opposite Lane)	2-Lane AC Overlay	Sub-Total	Treatment of Weak Subgrade	Side Ditch	Sub-Surface Drainage	Sub-Total	Pavement Rehabili-tation (Lane-Km)	Drainage Improve-ment (Km)	Pavement Rehabili-tation (Lane-Km)	Drainage Improve-ment (Km)
North Study Section	N-1 (Sta. Rita-Gapan)	46	21.60	25.00	15.20	7.00	68.70	2.0	19.30	--	21.30	23.30	26.70	92.00	48.00
	N-2 (Gapan-Cabanatuan)	35	27.90	2.85	2.75	13.00	46.50	--	8.60	--	8.60	23.50	26.40	70.00	35.00
	N-3 (Cabanatuan-San Jose)	42	5.10	15.02	1.95	--	22.07	--	9.75	--	9.75	61.93	32.25	84.00	42.00
	N-4 (San Jose-Dalton)	38	10.90	17.18	14.53	25.00	67.61	--	35.08	--	35.08	8.39	2.92	76.00	38.00
	N-5 (Dalton-Aritao)	39	26.52	11.74	7.74	24.00	70.00	--	37.00	3.25	40.25	8.00	2.00	78.00	42.25
	Sub-Total	200	91.92	71.79	42.17	69.00	274.88	2.0	109.73	3.25	114.98	125.12	90.27	400.00	205.25
South Study Section	S-1 (Calamba-Tiaong)	42	10.22	7.03	1.65	--	18.90	--	12.95	--	12.95	65.10	29.05	84.00	42.00
	S-2 (Tiaong-Pagbilao)	54	12.76	2.13	0.85	3.00	18.74	--	10.85	--	10.85	89.26	43.15	108.00	54.00
	S-3 (Pagbilao-Plaridel)	46	44.10	3.40	1.10	--	48.60	--	25.45	11.25	36.70	43.40	20.55	92.00	57.25
	S-4 (Plaridel-Calauag)	39	43.60	2.48	2.48	2.00	50.56	--	25.27	--	25.27	27.44	13.73	78.00	39.00
	Sub-Total	181	110.68	15.04	6.08	5.00	136.80	--	74.52	11.25	85.77	225.20	106.48	362.00	192.25
TOTAL		381	202.60	86.83	48.25	74.00	411.68	2.0	184.25	14.50	200.75	350.32	196.75	762.00	397.50

PROJECT COST
(SHORT TERM)

Unit: Million Peso

		November 1986 Price			Escalated Cost		
		Road Function	Pavement Improvement	Total	Road Function	Pavement Improvement	Total
Detailed Engineering	Foreign	7.97	22.90	30.87	7.97	22.90	30.87
	Local/Tax	5.34	9.81	15.15	6.71	11.56	18.27
	Total	13.31	32.71	46.02	14.68	34.46	49.14
Right-of-way Acquisition	Foreign	–	–	–	–	–	–
	Local/Tax	25.06	–	25.06	31.46	–	31.46
	Total	25.06	–	25.06	31.46	–	31.46
Construction	Foreign	86.49	490.75	577.24	86.49	490.75	577.24
	Local/Tax	66.86	326.93	393.79	85.45	422.00	507.45
	Total	153.35	817.68	971.03	171.94	912.75	1,084.69
Construction Supervision	Foreign	4.69	34.35	39.04	4.69	34.35	39.04
	Local/Tax	3.14	14.71	17.85	3.94	19.27	23.21
	Total	7.83	49.06	56.89	8.63	53.62	62.25
TOTAL	Foreign	99.15	548.00	647.15	99.15	548.00	647.15
	Local/Tax	100.40	351.45	451.85	127.56	452.83	580.39
	Total	199.55	899.45	1,099.00	226.71	1,000.83	1,227.54

SUMMARY OF PROJECT COST
– ROAD FUNCTION IMPROVEMENT AND PAVEMENT REHABILITATION –
(SHORT TERM AND MEDIUM TERM)

North Study Section

Unit: Million Pesos Nov. 1986 Prices

Segment	Short Term (1987-1992)			Medium Term (1993-1998)			
	Road Function	Pavement	Sub-Total	Road Function	Pavement	Sub-total	Total
N – 1	17.42	153.22	170.64	90.63	68.57	159.20	329.84
N – 2	64.22	95.27	159.49	63.00	71.32	134.32	293.81
N – 3	28.57	51.33	79.90	–	148.90	148.90	228.80
N – 4	–	142.48	142.48	–	32.13	32.13	174.61
N – 5	–	153.56	153.56	–	29.28	29.28	182.84
Sub-Total	110.21	595.86	706.07	153.63	350.20	503.83	1,209.90
South Study Section							
S – 1	72.67	46.44	119.11	–	152.23	152.23	271.34
S – 2	9.94	39.14	49.08	82.50	185.53	268.03	317.11
S – 3	–	111.68	111.68	–	93.59	93.59	205.27
S – 4	6.73	106.33	113.06	–	59.73	59.73	172.79
Sub-Total	89.34	303.59	392.93	82.50	491.08	573.58	966.51
TOTAL	199.55	899.45	1,099.00	236.13	841.28	1,077.41	2,176.41

NOTE: Project cost included construction, right-of-way acquisition and consultancy costs.

ECONOMIC INDICATORS
– ROAD FUNCTION AND PAVEMENT REHABILITATION –
(SHORT TERM)

Segments	Length (Km)	IRR(%)	B/C	NPV (M₱)	Implementation Priority
N – 1 (Sta. Rita – Gapan)	46	105.6	4.39	645.5	1
N – 2 (Gapan – Cabanatuan)	35	76.1	4.78	631.7	1
N – 3 (Cabanatuan – San Jose)	42	41.3	2.77	118.9	3
N – 4 (San Jose – Dalton)	38	39.3	2.38	163.4	3
N – 5 (Dalton – Aritao)	39	38.1	2.31	163.5	2
North Study Section	200	61.7	3.58	1,722.9	
S – 1 (Calamba – Tiaong)	42	56.8	6.17	461.9	2
S – 2 (Tiaong – Pagbilao)	54	78.4	4.09	95.4	3
S – 3 (Pagbilao – Plaridel)	46	41.3	2.44	127.1	1
S – 4 (Plaridel – Calauag)	39	34.9	2.08	86.3	3
South Study Section	181	49.9	3.67	770.7	
Whole Study Section	381	57.2	3.61	2,493.5	

CONSTRUCTION COST PER UNIT
(SHORT TERM)

November 1987 Price

	North Study Section	South Study Section
Road Function Improvement	6.0 M₱/number	8.2 M₱/number
Pavement Rehabilitation	1.8 M₱/lane-km (2.4 M₱/km)	1.7 M₱/lane-km (1.3 M₱/km)
Drainage Improvement	0.5 M₱/lane-km (0.29 M₱/km)	0.5 M₱/lane-km (0.24 M₱/km)

( ) per study section length

IMPLEMENTATION SCHEDULE (SHORT TERM 1987-1992)

			1986	1987	1988	1989	1990	1991	1992	Total
Feasibility Study (This Study)										
Financial Arrangement for Implementation										
Detailed Engineering										
Prequalification/Tender										
Construction	High Priority Segments (N-1, N-2, S-3)									
	Second Priority Segments (N-5, S-1)									
	Third Priority Segments (N-3, N-4, S-2, S-4)									
Construction Supervision										
Project Cost	Road Function	Foreign Component			1.98 (1.98)	28.80(28.80)	31.40(31.40)	36.97(36.97)	—	99.15 (99.15)
		Local Component			6.65 (7.47)	21.83(26.00)	28.49(35.97)	43.43(58.12)	—	100.40 (127.56)
		Total			8.63 (9.45)	50.63(54.80)	57.89(67.37)	80.40(95.09)	—	199.55 (226.71)
Nov. 1986 Price (Escalated Cost)	Pavement Rehabilitation	Foreign Component			10.70 (10.70)	77.50(77.50)	216.45(216.45)	141.10(141.10)	102.25(102.25)	548.00 (548.00)
		Local Component			4.58 (5.15)	48.05(53.34)	142.17(179.49)	91.61(122.59)	65.04(92.26)	351.45 (452.83)
		Total			15.28 (15.85)	125.55(130.84)	358.62(395.94)	232.71(263.69)	167.29(194.51)	899.45 (1,000.83)
Unit: Million P	TOTAL	Foreign Component			12.68 (12.68)	106.30(106.30)	247.85(247.85)	178.07(178.07)	102.25(102.25)	647.15 (647.15)
		Local Component			11.23(12.62)	69.88(79.34)	170.66(215.46)	135.04(180.71)	65.04(92.26)	451.85 (580.39)
		Total			23.91 (25.30)	176.18(185.64)	418.51(463.31)	313.11(358.78)	167.29(194.51)	1,099.00 (1,227.54)

Figures in parenthesis show the escalated fund requirement.
Annual escalation rate: Foreign Currency: 0%
Local Currency : 6%

3. FINDINGS AND RECOMMENDATIONS

3.1 Road Function Improvement

Short Term Improvement Measures (1987-1992)

In general, the "rural" sections of the Study Section are still providing relatively good quality of service, except the two sections nearest to Metro Manila, i.e. the Sta. Rita-Plaridel section and the Calamba-Sto. Tomas section. The latter is recommended to be widened to a 4-lane road in the Short-term period, while the former is recommended to be partly widened to a 4-lane road with the construction of a new route to bypass the central business district of Plaridel in the medium term period.

On the other hand, traffic related problems were observed mainly in the urban sections, due mainly to the presence of large volume of tricycles whose operation is not only slow but most of all chaotic and disorderly; uncontrolled loading and unloading of commodities as well as passengers of public utility vehicles, "on-street" parking, heavy roadside friction at the public markets and other business areas, uncontrolled intersections; etc. The situation is aggravated by the fact that most of the urban sections are still of the "rural" type cross section, i.e. gravel shoulders with no sidewalks. In the short term period, improvement measures for urban sections are recommended from the viewpoints of maximum utilization of the existing road right-of-way as follows:

- Paving of shoulders that will be used mainly as tricycle lanes and for loading/unloading zones for public utility vehicles (13 urban sections)
- Construction of sidewalks which will secure pedestrians' safety and minimize friction between pedestrians and vehicular traffic (13 urban sections)
- Signalization of intersection to improve functional efficiency of the urban section as a whole and to attain orderly traffic flow (6 intersections);
- Improvement of intersection geometrics to secure traffic safety and to assign right-of-way to traffic on the Pan-Philippine Highway (3 intersections);
- Strict enforcement of traffic rules and regulations;
- Road right-of-way acquisition for projects to be undertaken in the medium term (3 projects).

Medium Term Improvement Measures (1993-1998)

The "rural" road sections as described in the short term period are expected to provide still an acceptable level of service within the medium term period and therefore no significant improvement measures are recommended.

Some of the major urban sections are expected within the medium-term period to have serious traffic problems in view of two incompatible functions of mobility and access i.e. mobility would be required by long-distance or thru traffic while access would be demanded

by local traffic. In this case, it is recommended, among the options considered, to construct a bypass or an alternative route along the following urban sections in the medium term period:

North Study Section (at the early stage of this period);

- Plaridel Urban Section
- Cabanatuan Urban Section

South Study Section (at the latter stage of this period);

- Tiaong Urban Section
- Candelaria Urban Section
- Sariaya Urban Section

Long Term Improvement Measures (1999-2010)

In the early stage of this period the "rural" section will begin to suffer capacity problems. By the end of the period, about 50 percent of the "rural" section along the North Study Section and 25 percent along the South Study Section would by then be congested and therefore need improvements. The following three schemes and/or combination of these schemes should be studied to find out the optimum solution at the early stage of this period:

- Bypass + widening of existing rural sections
- Bypass + construction of roads to link bypasses
- Construction of an alternative route

3.2 Pavement Rehabilitation

The road pavements along the Study Section are in a state of progressive deterioration which require immediate rehabilitation before these are completely lost.

It appears that premature deterioration is caused mainly of the following factors: i) over-loaded vehicles; ii) inadequate pavement structural capacities; iii) inferior material qualities, and iv) poor/non-drainage systems.

Realizing the fact that pavement deteriorations are progressive and likely to be more and more severe in a fast pace if no immediate intervention is undertaken, the following basic technical propositions are recommended to be adopted and practiced when any road improvement/rehabilitation work is planned to be undertaken.

Design

- Pavement structures should be designed to withstand projected number of traffic loading applications.

- The desired level of reliability (combined standard error of traffic prediction and performance prediction) should be established for each road class in the country.

- The selection of pavement types should be made on initial investment cost required and total discounted cost based on life-cycle cost analyses as well as non-monetary considerations. The relative importance of each factor should be assigned by the project characteristics.

Traffic

- Traffic loading data is a key factor in pavement design. Traffic damaging factors should be well established to unify the reliability of pavement performance in the country.

- The strict implementation of traffic regulations is highly recommended, otherwise, the huge investments are inevitable.

Material Quality

- Properties of material available locally should be examined thoroughly to establish the standard values for pavement design requirements.

- Bearing capacity of roadbed soils (subgrade) should be investigated accurately and extensively.

Drainage

- Pavement life is dependent upon the drainage conditions, and, therefore, must be adequately provided and maintained at all times.

PART I GENERAL

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

The Pan-Philippine Highway (Philippines-Japan Friendship Highway) is undoubtedly the most important trunkline in the country's highway network linking the four major islands of Luzon, Samar, Leyte and Mindanao. This artery extends to a length of 2100 km starting from the province of Cagayan in the northeastern most part of Luzon and ends in the City of Davao in the island of Mindanao. Initial upgrading of existing sections were started in 1969 with financial assistance from Japan and the entire length of the highway was completed in 1979. The Highway is by standards a two-lane road with 6.7 meters pavement width, 95 percent of which is paved with portland cement concrete and the rest with asphalt concrete.

From the time the initial improvement were undertaken up to the present (1987), the highway has increasingly played a very vital role in the economic development of the regions directly traversed and of the country as a whole. Socio-economic development activities along the entire span of the highway have continuously increased at a pace even faster than what was initially envisioned. Consequently, vehicular traffic increased in folds and to such an extent that problems related to transport efficiency in the utilization of the facility has likewise increasingly developed thru the years. Capacity problems in some sections are starting to be felt so much so that traffic congestion has become critical in the urban areas traversed. Pavements in many sections have deteriorated resulting in high cost of transportation and maintenance. These, plus other problems, have started to affect the overall efficiency of the network, which if not corrected, will impede the momentum of the socio-economic development currently being pursued for the country.

Cognizant of the related problems and in view of the importance of the Pan-Philippine Highway in the overall network of the country, the Government of the Philippines (hereinafter referred to as "GOP") thru the Department of Public Works and Highways (DPWH) has decided to pursue THE FEASIBILITY STUDY OF THE ROAD IMPROVEMENT PROJECT ON THE PAN-PHILIPPINE HIGHWAY (PHILIPPINES-JAPAN FRIENDSHIP HIGHWAY) (hereinafter referred to as "the Study") thru a technical assistance from the Government of Japan (hereinafter referred to as "GOJ") so that measures could be identified and subsequetly undertaken before these problems get worse.

In response to the request of GOP, GOJ has decided to conduct the Study. The Japan International Cooperation Agency (hereinafter referred to as "JICA"), which is the official agency responsible for the implementation of GOJ technical cooperation programs, dispatched a team of seven experts to be engaged in the Study. A Study Team composed of members of the JICA consultant team and the Philippine counterpart team commenced the work in June 1986 and completed in September, 1987.

1.2 OBJECTIVES OF THE STUDY

The objectives of this Study are:

1) To identify and establish the needed improvement works to upgrade the functional efficiency of the Study section.

2) To prioritize the road segments for which improvement works are required.

3) To conduct feasibility study of typical improvement works proposed within the prioritized segments.

1.3 SCOPE OF THE STUDY

1) Study Section (See Figure 1.3-1)

Sta. Rita-Aritao Section (approximately 200 kilometers) and Calamba-Calauag Section (approximately 180 kilometers)

2) Improvement Works:

The Study section shall be assessed to identify improvement works as mentioned below.

a. Establishment of new by-passes
b. Widening of narrow roads
c. Intersection improvement and/or installation of traffic signals
d. Geometric realignments
e. Road structures and sections on weak foundations

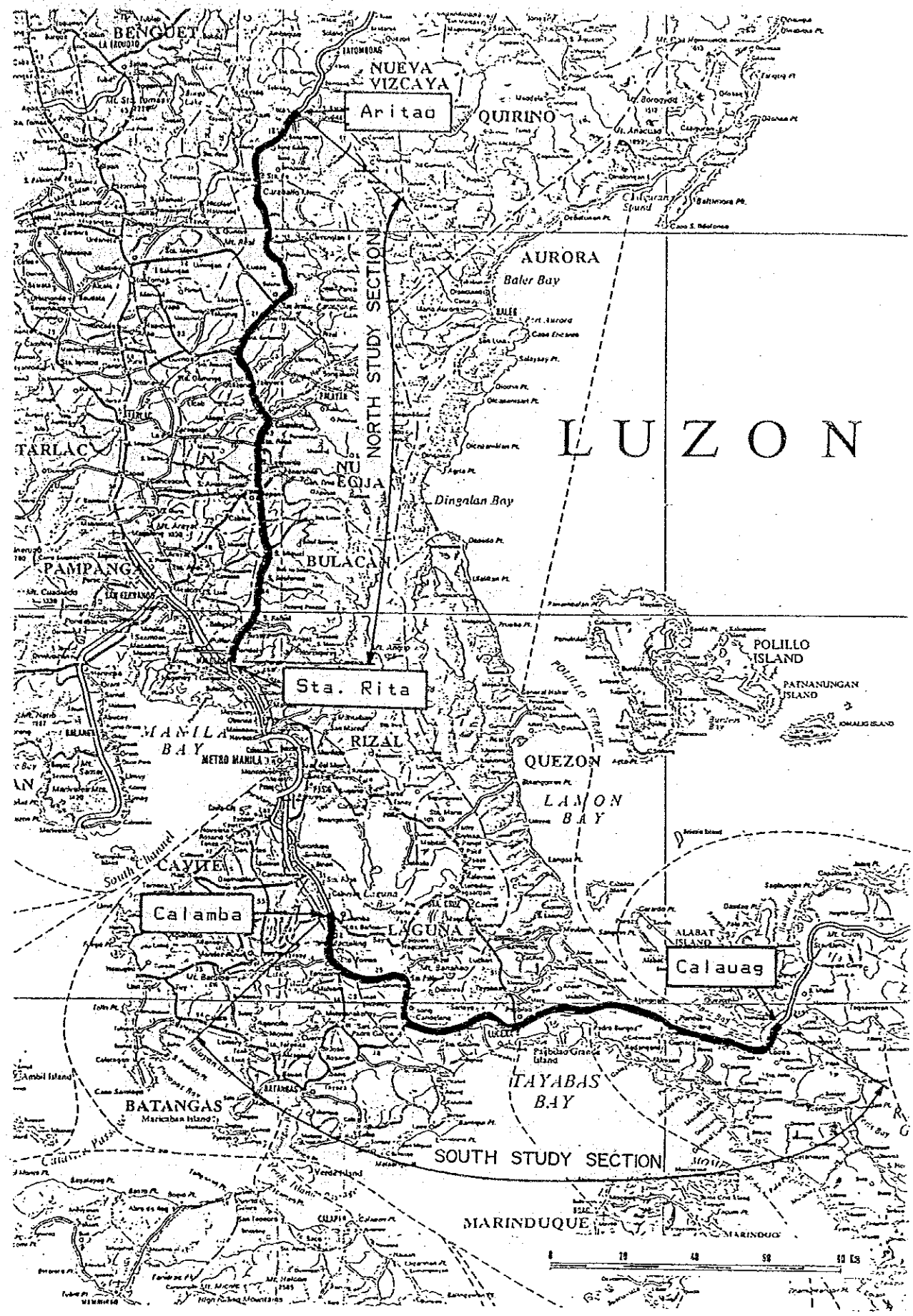


FIGURE 1.3-1 STUDY SECTION

1.4 EXECUTION OF THE STUDY

1.4.1 Organization of the Study

The Study was undertaken by a Study Team composed of the JICA Consultants and counterpart members from the Project Management Office-Feasibility Studies of the Department of Public Works and Highways (DPWH).

The Study Team was guided by the Steering Committee of the Government of the Republic of the Philippines and the Advisory Committee of the Government of Japan.

Most of the work for the Study was done in the Philippines up to the completion of the Draft Final Report to enable the effective transfer of technology from the JICA Consultants to the local counterpart members.

The organization diagram with names of members of the Steering Committee, the Advisory Committee, the Study Team is shown in Figure 1.4.-1.

1.4.2 Study Approach

The Study was divided into three (3) phases. Phase I of the Study involved project assessment and included the following activities:

- Collection of necessary data
- Conduct of traffic survey
- Conduct of a road function survey
- Conduct of a pavement serviceability survey
- Conduct of a pavement distress survey
- Conduct of an engineering survey
- Evaluation of the level of service
- Evaluation of pavement serviceability
- Analysis of the causes of pavement distress

Phase 2 of the Study involved the determination of the relative priority of segments, and the selection of segments for the feasibility study. The following activities were included in this Phase:

- Forecast of future traffic demand
- Establishment of road function improvement level
- Study of road function improvement measures
- Establishment of pavement improvement level
- Study of pavement improvement measures
- Determination of the relative priority of segments
- Selection of segments for the feasibility study

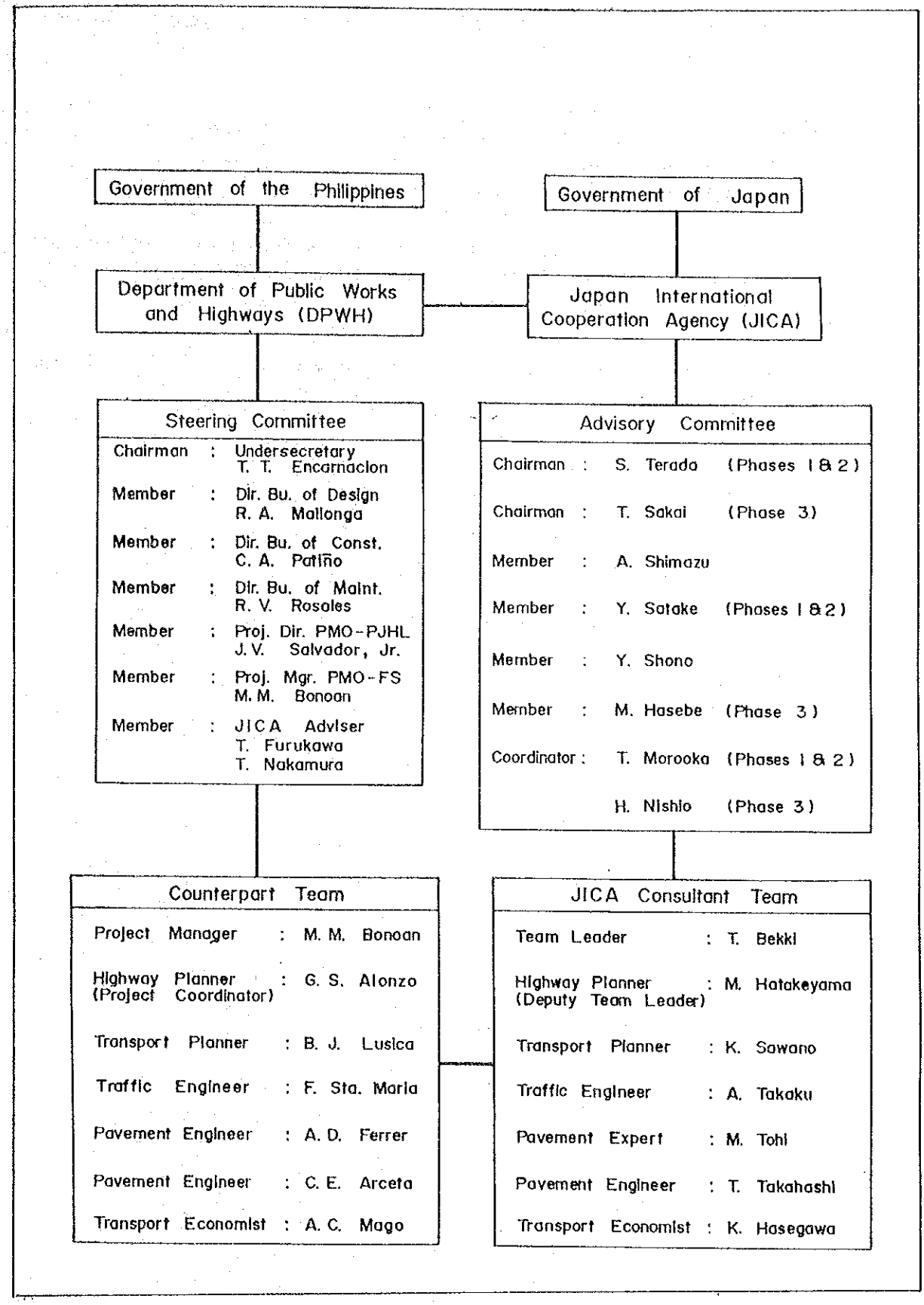


FIGURE 1.4-1 ORGANIZATION DIAGRAM

Phase 3 of the Study involved the feasibility study of selected segments, of which major activities were as follows:

- Conduct of the topographic survey
- Undertaking of preliminary designs of improvement measures
- Project evaluation
- Preparation of project implementation program

In addition to these studies, two reports, namely "Guide for Road Function Improvement Planning" and "Guide for Pavement Rehabilitation Design", were prepared based on the findings of the Study.

The procedure followed to achieve the objectives of the Study is illustrated in Figure 1.4-2.

1.5 REPORTS

The final report is organized with the following:

Volume I: Executive Summary
Volume II: Main Text
Volume III: Appendix
Volume IV: Drawings
Volume V: Guide for Road Function Improvement Planning
Volume VI: Guide for Pavement Rehabilitation Design

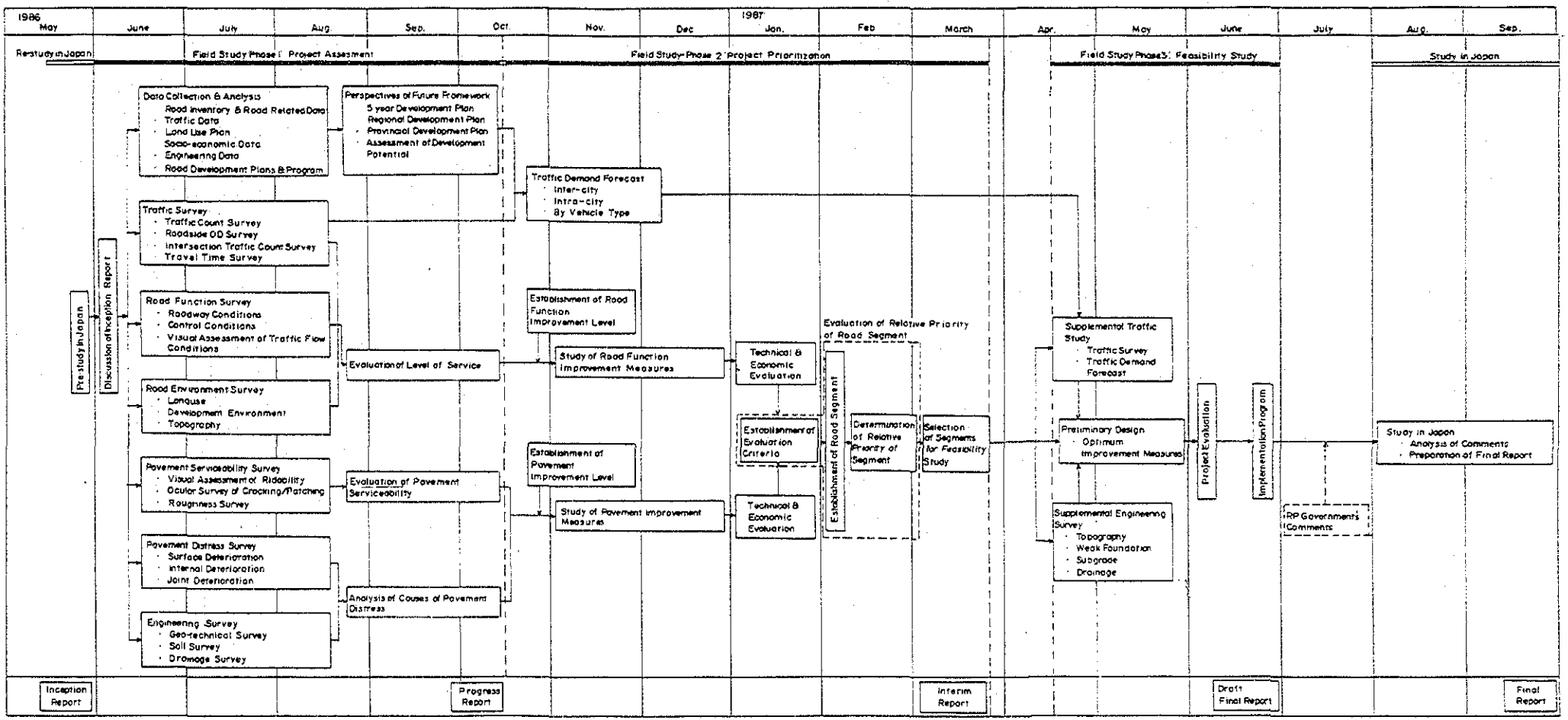


FIGURE 1.4-2 STUDY FLOW DIAGRAM

CHAPTER 2
THE PAN-PHILIPPINE HIGHWAY

2.1 HISTORY

For a country like the Philippines which consists of about 7,100 islands and composed of more than 50 diverse clans, each one speaking its own dialect and having its distinct cultural trait, a major road network that will traverse the entire archipelago, connect major islands and link 54 million Filipinos, is the single most important factor necessary to achieve the country's unification and integration of all economic and developmental activities.

In 1966, the plan to construct the Pan-Philippine Highway was formulated, which focused on establishment of efficient linkages between Metro Manila and potential but depressed regions of Cagayan, Bicol, Eastern Visayas and Mindanao. The total length of the Highway under the original plan was about 3,480 kms from Laoag in the northern tip of Luzon to Zamboanga in the southern tip of Mindanao. Considering the magnitude of the Project, stage construction strategy was adopted. The section from Allacapan to Davao City which extends to about 2,100 kms. was selected for Phase 1 construction. Construction works consisted of 1,389 kms. of concrete pavement, 92 kms of asphalt pavement, construction of 234 bridges and facilities for 2 ferry routes.

In 1969, construction of the Phase 1 Section started with financial assistance from Japan, thus the highway is also called as the Philippine-Japan Friendship Highway. The work was divided into various small contracts with some involving only 2 kms in length and a few involving more than 10 kms. Local contractors were employed and construction was finally completed in 1979. The Highway has been in service for 8 to 17 years.

2.2 INITIAL OBJECTIVES

The objectives initially envisioned in the implementation of the Highway were to establish the backbone trunk road penetrating through the archipelago of the country and to provide a fast, reliable, safe and comfortable means of transportation as well as to contribute to the following:

- Development of regional industries to create more employment
- Stimulation of socio-economic activities in rural areas
- Promotion of construction, transport and tourism industries
- Reduction of regional growth disparities
- Discouragement of regionalism and promotion of alliance between regions
- Stimulation of population movement to reduce over concentration of population in specific urban areas
- Land expansion for commercial and industrial use
- Maintenance of public peace and order

2.3 CONTRIBUTIONS ACHIEVED BY THE PAN-PHILIPPINE HIGHWAY

The Pan-Philippine Highway has contributed and will continuously contribute to various fields of socio-economic activities of the country. Major contributions achieved by the Highway are discussed hereunder.

1) Highway Development

The Pan-Philippine Highway greatly contributed to the nation's highway development. Paved length of the national roads increased from 7,393 kms in 1970 to 10,116 kms in 1980, an increase of 2,723 kms of which 1,481 kms or 54% were contributed by the Pan-Philippine Highway.

Just after completion of the Pan-Philippine Highway in 1980, the Highway alone accounted for 9% of the total length of the national roads, therefore, improvement of the highway raised overall condition of the national roads. Efficiency of national road network system highly depends on the Highway.

2) Traffic Growth

Traffic volume, in general, increased in proportion to the magnitude of socio-economic activities. Table 2.3-2 shows traffic volume in 1968 (before the project), in 1980 (soon after the project) and in 1986 (current). Traffic volume of all sections grew drastically during the period from 1968 to 1980 with an annual average traffic growth rate of 5 to 13 percent. Traffic volumes before and after the Project on the San Jose-Aritao Section which is the gateway to the Cagayan Valley Region showed drastic increase by about 2.70 times. Improvement of this section made possible easier access to the Cagayan Valley Region, which in turn accelerated development of the Region. Likewise, improvement of the Gumaca-Calauag Section stimulated socio-economic activities in Bicol Region, resulting in an increase of traffic volume of more than 4 times in the period from 1968 to 1980.

Traffic growth on the Pan-Philippine Highway clearly shows that the Highway contributed to the development of Regions as well as the country's economic growth.

3) Vital Support to Various Development Projects

Various development projects such as the Cagayan Valley Integrated Development Project, and the Samar Integrated Area Development Project, were implemented or are being implemented. For execution of these projects, the Pan-Philippine Highway contributed or is contributing as an essential tool for the success of these projects.

4) Promotion of Construction and Transport Industries

During the construction of the Highway, a lot of contractors were employed and some of them grew to an internationally competitive status through their experience in the Project, thus the construction industry was greatly benefited. The transport industry was also promoted as proved by an increase of traffic volume.

5) Unity of the Country

Society of the Philippines is composed of more than 50 communities in which cultural and linguistic basis is different. The Highway created a sense of unity among the people by linking such different communities.

6) National Securities

Mobility provided by the Highway greatly contributed to maintain and improve peace and order situation in the country.

TABLE 2.3-1 NATIONAL ROAD DEVELOPMENT

	1970		1980		
	Length (Km)	% of National Road	Length (Km)	% of National Road	Increase (Km)
National					
Paved	7,393 (38.5%)	–	10,116 (42.8%)	–	2,723
Unpaved	11,805 (61.5%)	–	13,525 (57.2%)	–	1,720
Total	19,198 (100%)	–	23,641 (100%)	–	4,443
Pan-Philippine Highway					
Paved	639 (30.1%)	8.6	2,120 (100%)	21.0	1,481 (54% of total increase)
Unpaved	1,481 (69.9%)	12.5	–	–	–
Total	2,120 (100%)	11.0	2,120 (100%)	9.0	–

SOURCE: Planning Service, DPWH

TABLE 2.3-2 INCREASE OF TRAFFIC

	Traffic Volume (Veh/day)			Ratio		Average Growth Rate (%)	
	1968[1/]	1980[2/]	1986[3/]	1980/1968	1986/1980	1968/1980	1980/1986
North Study Section							
Sta. Rita-Gapan	2,630	5,650	6,780	2.15	1.20	6.6	3.1
Gapan-Cabanatuan	2,390	5,250	6,230	2.20	1.19	6.8	2.9
Cabanatuan-San Jose	1,010	3,300	4,160	3.27	1.26	10.4	3.9
San Jose-Aritao	610	1,650	2,370	2.70	1.44	8.6	6.2
South Study Section							
Calamba-Sto. Tomas	2,820	8,190	11,600	2.90	1.42	9.3	6.0
Sto. Tomas – Tiaong	1,600	4,390	5,860	2.74	1.33	8.8	4.9
Taong-Lucena	2,290	4,170	5,010	1.82	1.20	5.1	3.1
Lucena-Gumaca	620	1,990	2,160	3.21	1.09	10.2	1.4
Gumaca-Calauag	410	1,810	2,070	4.41	1.14	13.2	2.3

SOURCE: 1/ Philippine Transport Study, 1970
2/ NTPP, 1982
3/ This Study

2.4 DESIGN STANDARDS

The Pan-Philippine Highway is by standards a 2-lane road with 6.7 meters pavement width, 95 percent of which was paved with portland cement concrete and the rest with asphalt concrete. Design standards adopted are summarized in Table 2.4-1 and the typical cross section is shown in Figure 2.4-1.

TABLE 2.4-1 DESIGN STANDARDS ADOPTED FOR THE PAN-PHILIPPINE HIGHWAY

	Terrain		
	Flat	Rolling	Mountainous
Design Speed (km/h)	80-100	60-80	40-60
No. of Lane	2	2	2
Pavement Width (m)	6.7	6.7	6.7
Shoulder Width (m)	2.5	2.5	1.0
Minimum Horizontal Radius (m)	220-350	120-220	50-120
Maximum Grade (%)	4-3	5-4	7-6
Bridge Design Loading	AASHO H–20		

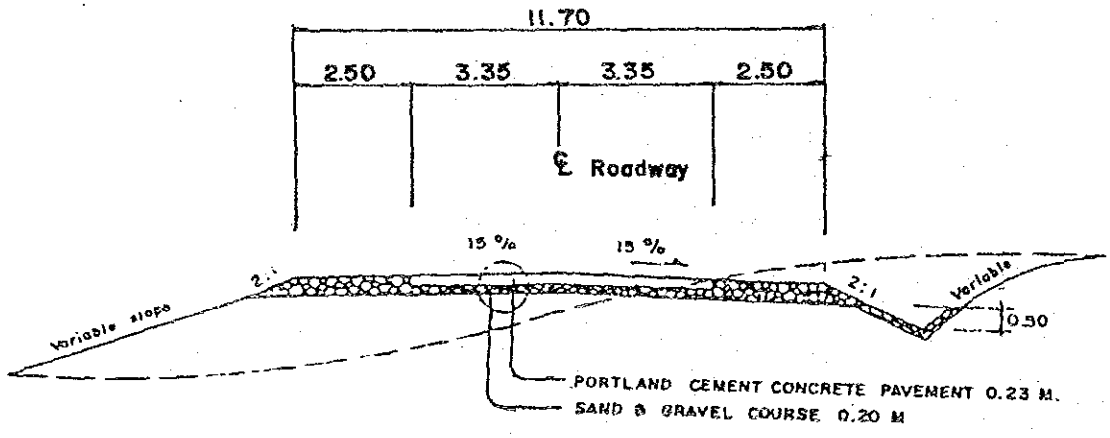


FIGURE 2.4-1 TYPICAL CROSS SECTION OF PAN-PHILIPPINE HIGHWAY

CHAPTER 3
PROFILE OF STUDY AREA

3.1 NATURE

3.1.1 Topography and Geology

The Philippines, made up of 7,100 islands, were formed by repeated orogenic movements and volcanic activities. The Northern Sierra Madre and Cordillera Central Mountain ranges located in North Luzon were formed by upheavals of the land, and the Cagayan Valley, which is surrounded by the two ranges, was formed by a submergence of the land. The Caraballo Mountain is located at the southern tip of the two ranges. The vast Luzon Central Plain is surrounded by the Caraballo Mountain in the north, the Southern Sierra Madre Range in the east and the Zambales Range in the west. The Luzon Upland is located south of Metro Manila. (See Figure 3.1-1).

The skeletal structure of the Philippine islands was formed at a relatively late geological period (late Cretaceous and Paleocene periods). Therefore, it is mainly composed of relatively soft, unconsolidated sedimentary rock such as sandstone, tuff, mudstone and conglomerates. There are also a considerable quantity of igneous rock such as diorite, andesite and basalt formed by repeated volcanic activities. The borders where igneous and sedimentary rocks meet usually show strong alternation.

The Philippine Fault runs north and south through the Philippine islands, and secondary faults and holds resulting from the major fault can be seen in all regions.

The North Study section of the Pan-Philippine Highway runs through the Luzon Central Plain from Sta. Rita (km. 39) to San Jose (km. 161), climbs up and down the Dalton Pass of the Caraballo Mountain Range between San Jose and Sta. Fe (km. 216), then traverses the Cagayan Valley from Sta. Fe to Aritao (km. 239). Faults and developed fracture zones are found in the Dalton Pass Section.

The South Section runs through the Luzon Upland from Calamba (km. 52) to Lucena (km. 130), crosses the southern tip of the Southern Sierra Madre between Lucena and Atimonan (km. 177) where faults and developed fractures are found, then runs along the coastal area from Atimonan to Calauag (km. 227).

3.1.2 Climate

i) Air Streams

The climate of the Philippines is controlled to a great extent by air streams and tropical cyclones as well as geography and topography.

The principal air streams affecting the Philippines are the Northeast Monsoon, the Southwest Monsoon and the North Pacific Trades. The Northeast Monsoon first affects the Philippines in October as a weak stream, attaining maximum strength in January. It gradually weakens in March and finally disappears in April. The Southwest Monsoon first appears in early May, attains maxi-

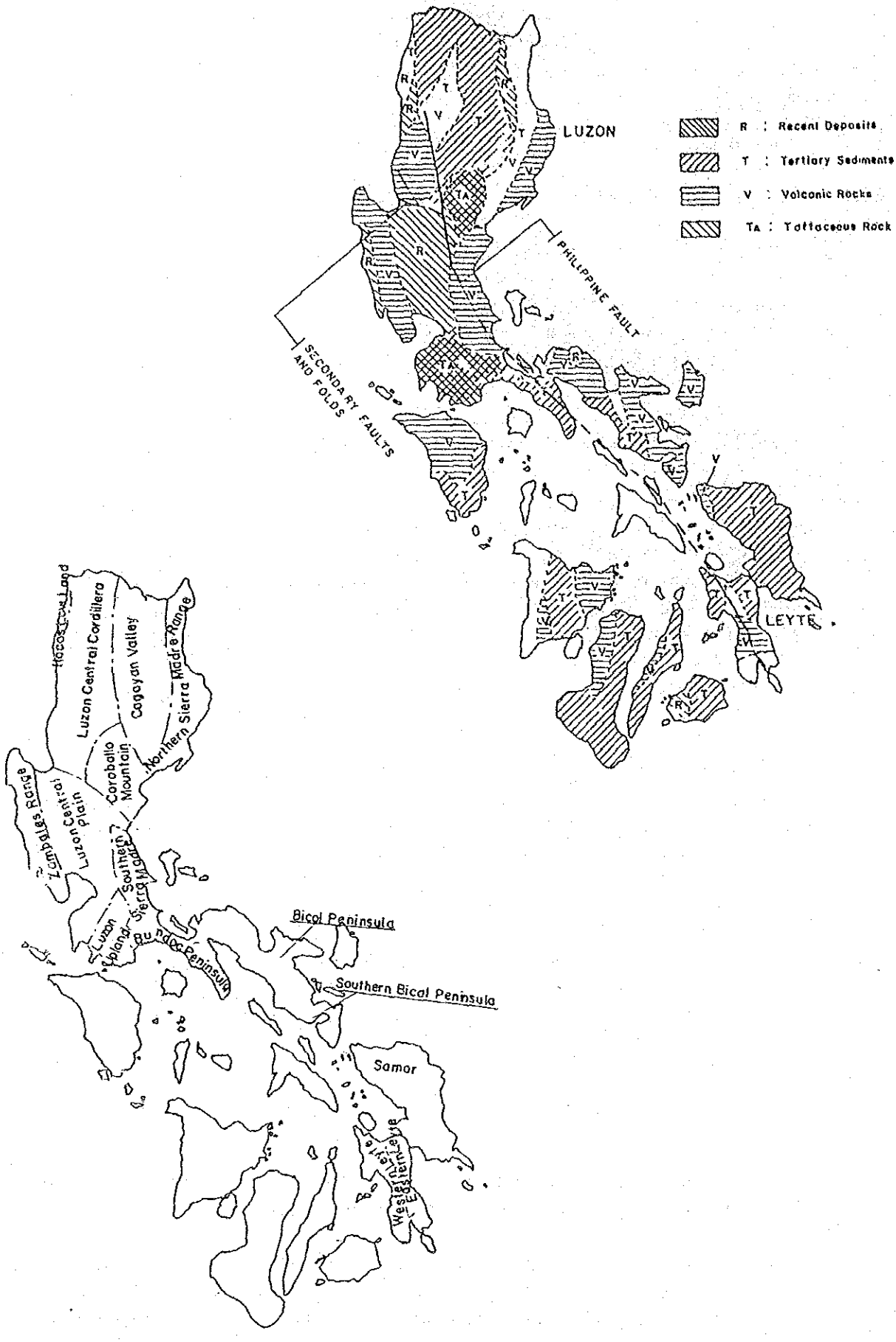


FIGURE 3.1-1 TOPOGRAPHY AND GEOLOGY

mum intensity in August and gradually disappears in October. The North Pacific Trades are generally dominant over the entire Philippines in April and early May and over the central and southern Philippines in October.

The Northeast Monsoon has a low temperature and a low humidity. Its temperature near the surface is about 25°C. The Southwest Monsoon is warm and very humid. Its temperature near the surface is generally between 25.5°C and 27.5°C. The North Pacific Trades are the warmest air streams and have a temperature of about 27°C near the earth's surface.

ii) Tropical Cyclones

The Philippines is located in a region which is recognized as having the greatest frequency of tropical cyclones in the world. Tropical cyclones are classified into the following three (3) categories: tropical depression, tropical storm, and typhoon.

Average annual frequency of tropical cyclones in 36 years (1948-1983) is 19.9, of which 4.0 are tropical depressions, 5.1 tropical storms and 10.8 typhoons.

The tropical cyclone season lasts from June to December, although the other months are not entirely free of these cyclones. The period from June to December accounts for 88% of the mean annual total number of tropical cyclones. July and August have the greatest mean frequency with 3.3 and September is second with 3.2. February and March have the smallest mean frequency with about 0.3.

Tropical cyclones follow widely variable tracks in the vicinity of the Philippines. During the months of April, May and June, the cyclones which hit the Philippines generally cross the Visayas. During the months of July, August and September, most of the cyclones cross northern Luzon or the Batanes Islands. During the period from October to March, cyclones generally cross the Visayas.

iii) Type of Climate

Recognizing the fact that temperature differences in the Philippines are very small, while rainfall variations are large, climate is classified into four (4) types based solely on rainfall characteristics.

- First Type : There are two pronounced seasons; dry from November to April and wet for the rest of the year. The section between Sta. Rita and Sta. Fe in the North Study Section and the section between Calamba and Sariaya in the South Study Section are of this type.

- Second Type : There is no dry season, and the maximum rain period is from November to January. The section from Pagbilao to Calauag in the South Study Section belongs to this type.

- Third Type : The seasons are not very pronounced; relatively dry from November to April and wet for the rest of the year. The maximum rain periods are not very pronounced, but the short dry season lasts only from one to three months. The section between Sta. Fe and Aritao in the North Study Section is of this type.

- Fourth Type : Rainfall is more or less evenly distributed throughout the year. The section between Sariaya and Pagbilao in the South Study Section is of this type.

iv) Rainfall

The average annual rainfall for the Philippines is 2,504.4 mm. Luzon has an annual average of 2,812.8 mm. Visayas 2,304.0 mm and Mindanao 2,394.0 mm.

In Luzon, October has the highest average monthly rainfall with 451.3 mm, while February has the smallest average with 74.9 mm. August and October have the most rainy days with 20 days (See Table 3.1-1).

v) Temperature

The mean annual temperature of the Philippines is 27.0°C. The average annual temperature in Luzon is 26.8°C, 27.3°C in Visayas and 26.9°C in Mindanao. For the whole country in general, the hottest months are May with 28.2°C, June with 27.9°C and April with 27.2°C. The coldest months are January with 25.6°C, February with 25.9°C and December with 25.9°C. The absolute maximum temperature recorded in the Philippines was 42.2°C at Tuguegarao on April 29, 1912. The absolute minimum of 3.9°C was recorded at Baguio City in January 1903.

TABLE 3.1-1 AVERAGE ANNUAL RAINFALL AND NO. OF RAINY DAYS: 1978-1984

Month	Philippines		Luzon	
	Normal Rainfall (mm.)	No. of Rainy Days	Normal Rainfall (mm.)	No. of Rainy Days
January	163.9	15	143.0	14
February	114.6	11	74.9	10
March	84.8	9	80.3	8
April	102.8	9	91.7	8
May	137.6	13	176.6	13
June	272.1	18	279.7	17
July	279.6	18	335.6	18
August	297.2	18	423.6	20
September	260.6	18	294.0	19
October	319.7	20	451.3	20
November	245.1	16	262.7	15
December	225.8	16	199.9	15

Source: P A G A S A

3.2 TRANSPORTATION

3.2.1 The Transport System

Of the four (4) transport modes, namely road, rail, sea and air transport, road transport is the dominant one in the Philippines. The road network has been developed rapidly in the last two (2) decades, and carries 90 percent of passenger and 65 percent of freight traffic. Almost all intra-island transport depends on road transport.

Complementing this road network system but not, in general, competing with it is a system of ports, which carries 7 percent of passenger and 35 percent of freight traffic.

Rail transport peaked out in the 1960's and is now in a state of decline. The shift from rail to road transport has been marked since trunk roads became paved.

There is a good network of air transport network serving mostly high-income passengers.

TABLE 3.2-1 APPROXIMATE NATIONAL MODAL SPLIT, 1980
(DOMESTIC TRAFFIC ONLY)

Mode	Freight		Passenger	
	Ton-kms (Billion)	Share (%)	Passenger-kms (Billion)	Share (%)
Sea	12	(35)	4	(7)
Road	22	(65)	53	(90)
Rail	0.04	(–)	0.4	(1)
Air	(Negligible)	(–)	1.2	(2)

SOURCE: NTPP

3.2.2 Transport Facilities

1) Roads

Total road length expanded by 1.55 times in 10 years from 104,430 kms in 1975 to 161,709 kms in 1985, resulting in increase of the road density from 0.35 to 0.54 per square km. Paving of a road surface also progressed significantly. About 3,694 kms of roads have been paved in 10 years.

The national roads which form the trunk road network in the country increased by 4,604 kms in length from 21,665 kms in 1975 to 26,259 kms in 1985. The national roads were the main target for improvement. Of roads paved in 10 years, 93 percent or 3,435 kms are the national roads.

TABLE 3.2-2 ROAD DEVELOPMENT (1975-1985)

	Road Length				Ratio	Road Density	
	1975 (kms)	(%)	1985 (kms)	(%)	1985/ 1975	1975	1985
National Roads							
Paved	8,413	(39)	11,848	(45)	1.41		
Unpaved	13,252	(61)	14,411	(55)	1.09		
Sub-total	21,665	(100)	26,259	(100)	1.21	0.07	0.09
Local Roads							
Paved	9,131	(11)	9,390	(7)	1.03		
Unpaved	73,634	(89)	126,060	(93)	1.71		
Sub-total	82,765	(100)	135,450	(100)	1.64	0.28	0.45
T o t a l							
Paved	17,544	(17)	21,238	(13)	1.21		
Unpaved	86,886	(83)	140,471	(87)	1.62		
Total	104,430	(100)	161,709	(100)	1.55	0.35	0.54

SOURCE: Planning Service, DPWH

Table 3.2-3 shows national road length in 1985 by Region in the Study Area. Region IV-A had the highest national road density of 0.12 km per square km, followed by Region V. National road density of Region III is the same as that of the national average. Region II has lower national road density than the national average.

Region III has the highest pavement ratio of 78 percent, followed by Region IV-A. Region II has the lowest pavement ratio of 31 percent which is lower than that of the national average.

TABLE 3.2-3 NATIONAL ROAD LENGTH BY REGION: 1985

Region	National Road			Road Density (km/sq. km)	Pavement Ratio (%)
	Paved (km)	Unpaved (km)	Total (km)		
Philippines	11,848	14,411	26,259	0.09	45
Region II	715	1,592	2,307	0.06	31
Region III	1,312	378	1,690	0.09	78
Region IV-A	1,481	871	2,352	0.12	63
Region V	1,026	1,009	2,035	0.11	50

SOURCE: Planning Service, DPWH

2) Other Transport Facilities

i) Rail

Two lines of the Philippine National Railways (PNR) operate within the Study Area.

- Main Line North (Manila-San Fernando, La Union) .... 226 kms.
- Main Line South (Manila-Camalig) ..... 460 kms.

There is also a branch line of the Main Line north between Tarlac and San Jose, however, PNR suspended its operation in mid-1986.

The Pan-Philippine Highway and the Main Line South run more or less parallel to each other and compete with each other in South Luzon. However, rail transport is gradually losing ground to road transport due to the deteriorated equipment and lower service standard.

ii) Sea

There are three (3) public ports which handle over 15,000 tons of commodities annually in North Luzon and eight (8) in South Luzon.

Sea transport is mostly inter-island services. Intra-island (coastal) transport is quite small, as indicated by the fact that only 6 percent of domestic sea freight are intra-island cargo. Among intra-island cargo, oil accounts for 98 percent of coastal transport, therefore, other intra-island cargoes are transported by land.

The National Transport Planning Project (NTPP) estimates that road transport can compete effectively with sea transport within the following distances:

- For passenger transport, up to 1,000 kilometers (corresponds to Manila-Sogod, Southern Leyte)
- For general mixed freight, up to 600 kilometers (corresponds to Manila-Sorsogon)
- Less than the above distance for large volume-bulk and semi-bulk cargoes.

If the mode of transport is selected in line with the above, all transport demands will select road transpot within the Study Area.

iii) Air

There are two (2) international airports (Manila and Laoag) and 10 secondary airports in the Study Area. Reliance on air transport for either passenger or cargo transport is still minimal.

3.2.3 Trunk Road Network

Defining roads actually functioning as trunk roads an "inter-provincial roads with pavement widths of 6.1 meters or more", existing trunk roads in the Study Area are as shown in Figure 3.2-1.

The Pan-Philippine Highway and the Manila North Road are two axes of trunk road network system in North Luzon. The Pan-Philippine Highway serves the entire Cagayan Valley, which is bordered on three sides by the Sierra Madre Range along the eastern coast, the Luzon Central Cordillera located slightly to the west of center and the Caraballo Mountains to the south. The Manila North Road runs through the narrow flat land along the western coast. The Luzon Central Cordillera range located in between the two trunk roads prevent these roads from being linked. The east-west links are not developed yet, thus trunk roads in North Luzon are not functioning as a network yet.

Trunk roads in Central Luzon are rather well developed owing to favorable topographical conditions in this region. In addition to the north-south links of the Pan-Philippine Highway and the Manila North Road, several east-west links are developed.

South Luzon, from Quezon Province southward, is a generally long and narrow land with only about 20 to 50 kms wide. The sole trunk road is the Pan-Philippine Highway.

In general, most regions are accessible only by one trunk road. Socio-economic activities of most regions are dependent upon one trunk road, therefore, to maintain trunk roads in good condition in order to make them function efficiently is quite important issue of the country.

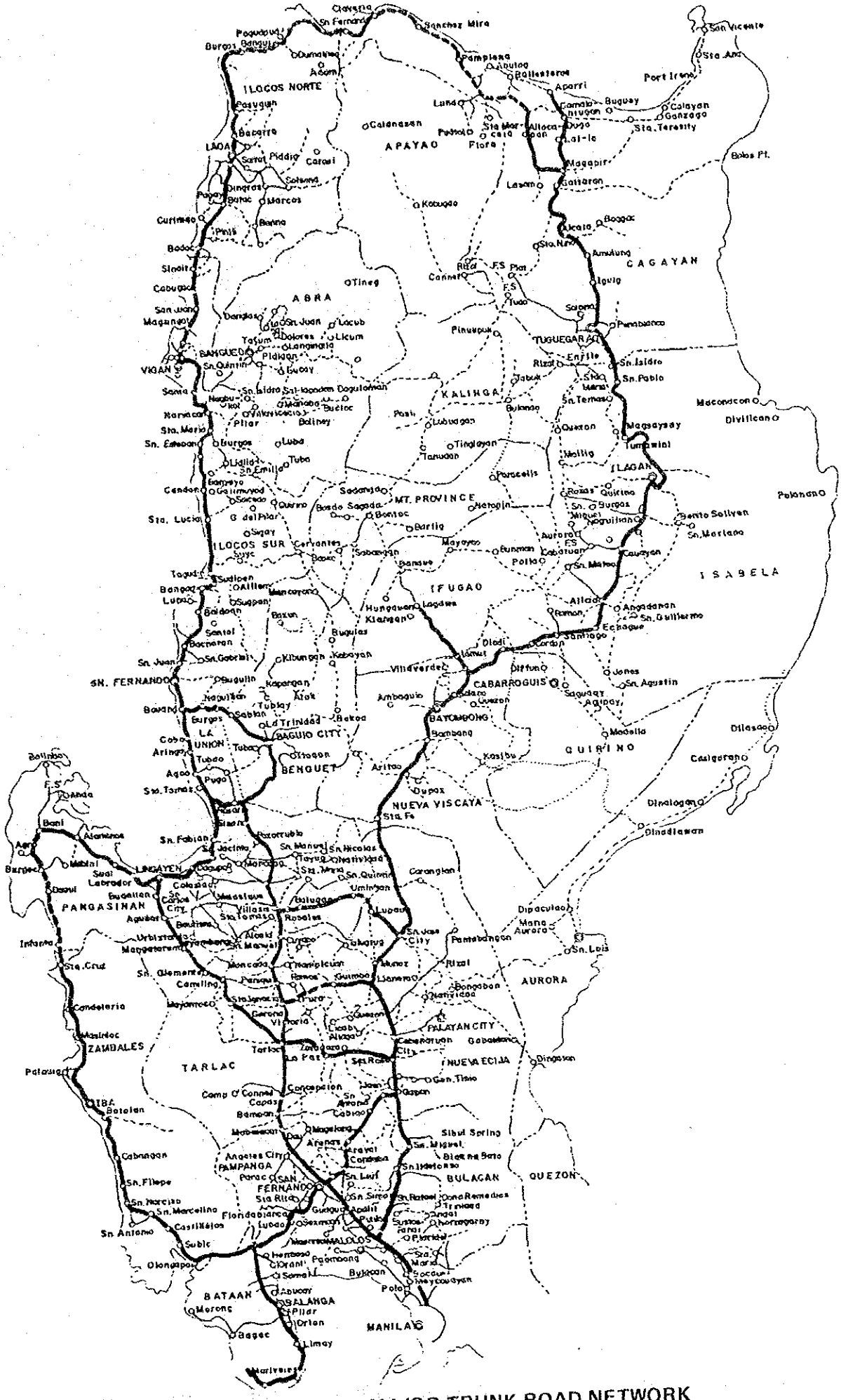


FIGURE 3.2-1 (1) MAJOR TRUNK ROAD NETWORK (CENTRAL AND NORTHERN LUZON)

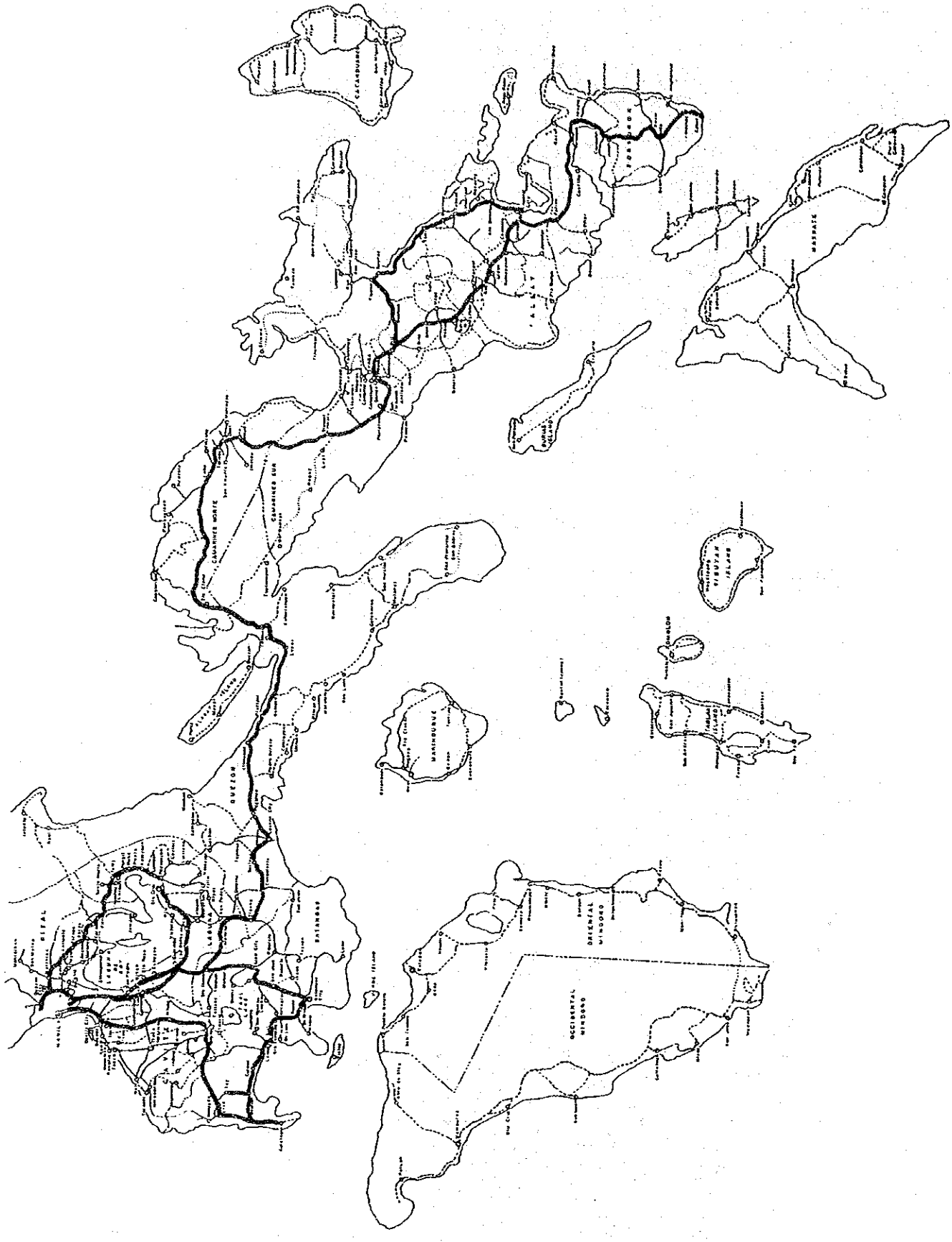
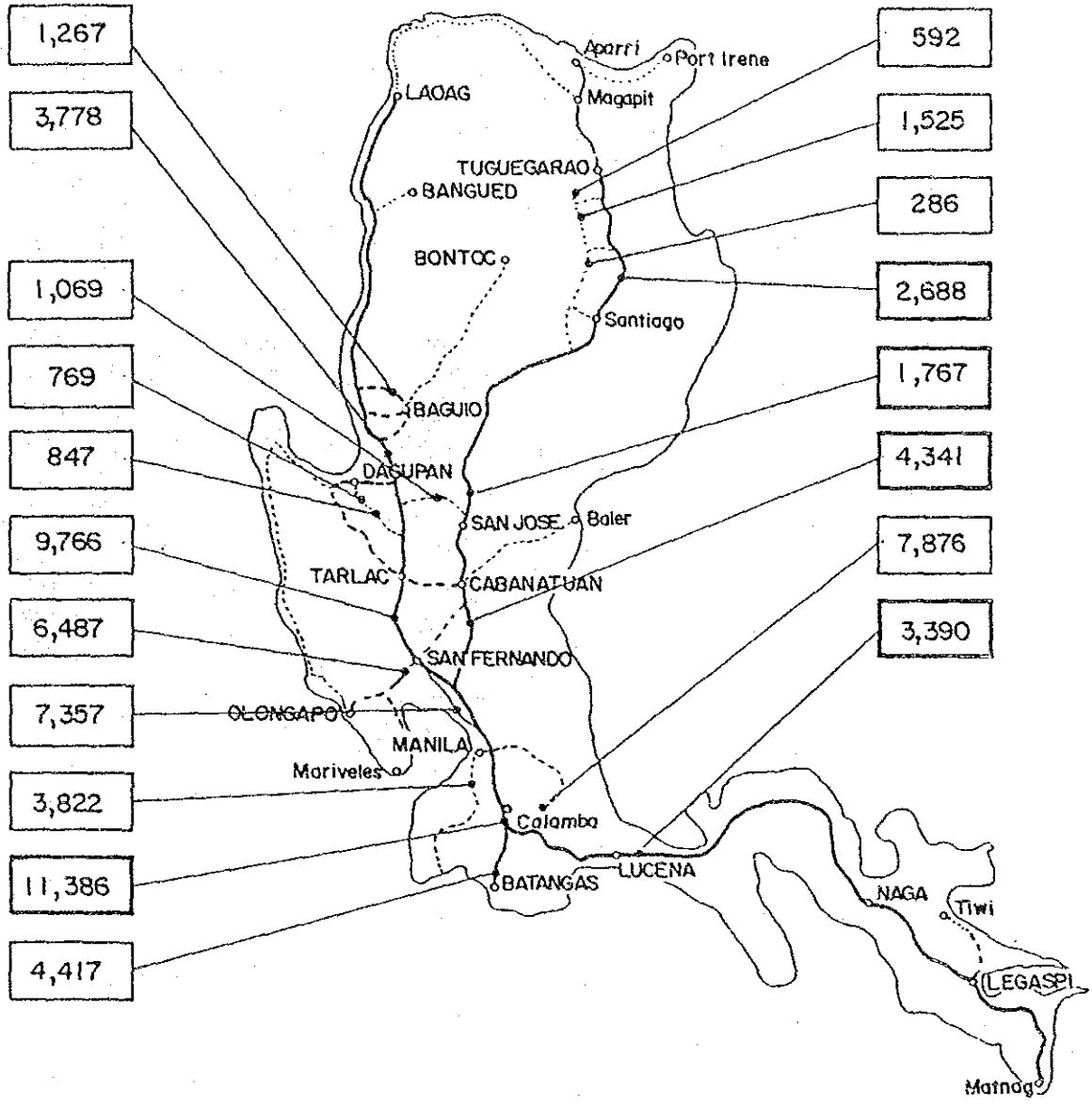


FIGURE 3.2-1 (2) MAJOR TRUNK ROAD NETWORK (SOUTHERN LUZON)

3.2.4 Traffic Volume on Trunk Roads

Figure 3.2-2 shows traffic volume in 1984 on major trunk roads in the Study Area. Traffic volumes on rural sections of the Pan-Philippine Highway ranged from 4,340 to 1,770 vehicle per day in the north of Metro Manila, and from 11,390 to 3,390 vehicle per day in the south of Metro Manila. Traffic volumes on the Manila North Road ranged from 9,770 to 3,780 vehicle per day.



SOURCE: Pavement and Axle Load Study

FIGURE 3.2-2 AVERAGE DAILY TRAFFIC (1984)

3.2.5 Number of Registered Motor Vehicles

Total number of registered motor vehicles in 1985 were 1.12 million, of which 31% were cars, 36% utility vehicles, 1% buses, 8% trucks, 22% motorcycles/tricycles and 1% trailers. Abot 41% of motor vehicles were registered in NCR. Regions II, III, IV and V shares 2%, 14%, 10% and 2%, respectively. (See table 3.2-4).

TABLE 3.2-4 MOTOR VEHICLES' REGISTRATION BY TYPE AND BY REGION (1985)

Region	Vehicle Type						Total
	Cars	Utility Vehicles	Buses	Trucks	Motorcycles/ Tricycles	Trailers	
NCR	222,105	165,693	4,543	27,544	37,631	6,297	463,813
I	11,213	23,956	1,969	4,669	22,066	792	64,665
II	2,716	9,189	388	3,492	11,452	315	27,552
III	40,194	59,930	2,800	14,379	37,440	3,628	158,371
IV	22,315	50,886	1,958	8,254	25,122	1,182	109,717
V	3,222	8,946	793	2,344	10,835	79	26,219
VI	11,381	19,892	312	9,121	14,205	550	55,461
VII	15,194	18,305	438	5,911	20,502	558	60,908
VIII	1,610	6,322	252	2,458	7,896	161	18,699
IX	2,141	6,961	229	2,082	12,802	87	24,302
X	4,661	11,554	399	4,639	15,440	236	36,929
XI	8,512	17,031	511	6,475	20,049	750	53,328
XII	2,685	7,165	144	2,570	7,550	94	20,208
TOTAL	347,949	405,830	14,736	93,938	242,990	14,729	1,120,172

SOURCE: LTC, MOTC

3.2.6 Government Policy on Road Development

Government policy on road development is clearly stated in the Medium-Term Philippine Development Plan 1987-1992 as follows:

> "Priority shall be given to the maintenance of existing and soon-to-be completed infrastructure to prolong their useful lives, reduce costs to the users, and postpone huge investments for their replacement. Management, regulatory, and operational reforms shall also be carried out to optimize the use of existing facilities.

Rehabilitation and restoration, as well as improvement and upgrading, of existing facilities shall take precedence over replacement and new construction as low-cost measures to provide acceptable levels of infrastructure services.

Rehabilitation and improvement of major roads will be selectively carried out particularly in sections that can no longer economically service the present and immediate future traffic volume and where transport costs are excessively high so as to restrain production and marketing."

3.3 POPULATION

3.3.1 National and Regional Demographic Trend

The total population of the country grew from 36.7 million in 1970 to 54.7 million in 1985, showing an increase of 49% during the 15-year span. The average annual population growth rate is gradually declining from 2.8% during the period 1970-75 to 2.6% during the period 1980-85. This trend is mainly due to a declining crude birth rate. An estimated 35.2 births per 1000 population in 1975 decreased to 33.2 births per 1000 population in 1980.

Among five (5) Regions in the Study Area, National Capital Region (NCR) has the highest population growth rate. The population growth rate of NCR for the period 1980-85 was 3.2% which was much higher than the national average. It is clear that people are migrating to NCR. Region IV also shows higher population growth rate than the national average. Region V has lower population growth rate than the national average, which probably means that there are outmigrations from the Region. Regions II and III maintains more or less the same population growth rate as the national average.

Concentration of population in NCR is obvious. About 12.7% of total population settle in the area of only 0.2% of total land area, resulting in quite high population density of 1,465 persons per square km. in 1985. Region III has also higher population density by about 1.6 times than the national average. On the other hand, Region II has quite low population density of only 69.3 persons per square km.

In general, NCR which is the huge center of all kinds of activities of the country attracts people as proved by population growth rates and high population density. Whereas, population growth rates as well as population densities decrease in proportion to distance from NCR.

3.3.2 Employment

Of the total population in 1975, 22.6 million or 53.7% were 15 years old and over. Of this group, 51.0% or 15.2 million were members of the labor force. Total gainful work force for the same year was 6.3 million or 42.0% of the total labor force.

Total labor force in 1980 was 17.3 million which comprises a total gainful work force of about 42.1% or 7.3 million. This indicates a slight increase (14.2%) over the 1975 total labor force.

About 29% of Regions's population are gainful workers except NCR where about 35% are gainful workers.

Sectoral distribution of workers shows characteristics of economic activities of each Region. In NCR, industrial and service sectors are predominant. Region II and V are predominantly agricultural. Region III has almost even distribution of sectoral workers. About one half of workers are agricultural in Region IV.

TABLE 3.3-1 NATIONAL AND REGIONAL DEMOGRAPHIC TREND

	Land Area (Sq. Km.)	Population (In Thousand)				Population Density (Person/Sq. Km.)				Population Growth Rate (%)		
		1970	1975	1980	1985	1970	1975	1980	1985	1970-75	1975-80	1980-85
Philippines	300,000	36,681	42,070	48,097	54,667	122.3	140.2	160.3	182.2	2.8	2.6	2.6
	(100)	(100)	(100)	(100)	(100)							
N C R	636	3,967	4,970	5,926	6,942	6,237.9	7,814.5	9,317.4	1,465.0	4.6	3.6	3.2
	(0.2)	(10.8)	(11.8)	(12.3)	(12.7)							
Region II	36,403	1,691	1,933	2,215	2,521	46.5	53.1	60.9	69.3	2.7	2.8	2.6
	(12.1)	(4.6)	(4.6)	(4.6)	(4.6)							
Region III	18,231	3,615	4,210	4,802	5,456	198.3	230.9	263.4	299.3	3.1	2.7	2.6
	(6.1)	(9.9)	(10.0)	(10.0)	(10.0)							
Region IV	46,924	4,456	5,214	6,119	7,089	95.0	111.1	130.4	151.1	3.2	3.3	3.0
	(15.6)	(12.1)	(12.4)	(12.7)	(13.0)							
Region V	17,633	2,966	3,194	3,477	3,921	168.3	181.1	197.2	222.4	1.5	1.7	2.4
	(5.9)	(8.1)	(7.6)	(7.2)	(7.2)							

SOURCE: Philippine Statistical Yearbook, 1986

NOTE: 1) *Population in 1985 is projected population by NCSO.*
2) Figure in ( ) shows % share to national total.

TABLE 3.3-2 GAINFUL WORKERS BY REGION IN 1980

S e c t o r	Philippines	NCR	Region II	Regoin III	Region IV	Region V
No. of Workers (In Thousand)						
Agricultural	7,295	123	469	556	840	609
Industrial	2,153	627	41	297	358	93
Service	4,560	1,316	123	512	566	318
Not Defined	165	31	9	23	16	9
T o t a l	14,173	2,097	642	1,388	1,780	1,029
	(29.5%)	*(35.4%)*	*(29.0%)*	*(28.9%)*	*(29.1%)*	*(29.6%)*
Distribution (%)						
Agricultural	51.5	5.9	73.0	40.1	47.2	59.2
Industrial	15.2	29.9	6.4	21.4	20.1	9.0
Service	32.2	62.8	19.2	36.9	31.8	30.9
Not Defined	1.1	1.4	1.4	1.6	0.9	0.9
T o t a l	100.0	100.0	100.0	100.0	100.0	100.0

SU SOURCE: 1980 Census of Population and Housing, NCSO
NOTE : Figure in ( ) shows percentage share of workers to Region's population.

3.4 ECONOMY

3.4.1 National Economy

The decade of the 1970's witnessed substantial growth in the Philippine economy. Real Gross National Product (GNP) increased at an average yearly rate of 6.1 percent from 1970 to 1980. However, the early 1980's was a period of relatively slower growth in the Philippine economy, from 4.4 percent in 1980 real GNP growth rate dropped down to 1.6 percent in 1982. This have been brought about partly by the worldwide economic recession precipitated by the oil crisis and partly by the continued structural inefficiencies in the national economy. Moreover, this situation continued. As a result of tight financial situation, the real GNP growth went down to 1.1 percent in 1983. Due to the worsening effect of financial crisis the Philippine economy experienced a negative growth of 6.8 percent in 1984. However, the growth in 1985 shows a gradual recovery of the economy at negative 3.8 percent. This recovery pace continued until the latter part of 1986 giving a positive growth of 1.0 percent for the Philippine economy, as the government effort to attain economic recovery has slowly been achieved. (See Figure 3.4-1).

Figure 3.4-2 shows the annual growth rate by industrial origin. All industrial sector's growth rates declined at almost the same pace for the period of 1980-1983. In 1984 and 1985, sharp aggravation of economic performance of the industrial and the service sectors brought down Gross Domestic Product (GDP) to negative growth, although the agricultural sector accomplished positive growth.

3.4.2 Regional Economy

Gross Regional Domestic Product (GRDP) of NCR shares about 30% of GDP, followed by Region IV (14%), Region III (8.8%), Region V (3.4%), and Region II (2.7%). In 1985, NCR's GRDP was contributed by the industrial and the service sectors, each sharing about 50%. In Regions III and IV, each industrial sector contributed almost evenly to GRDP. In Regions II and V, the agricultural sector shared about 56% and the industrial sector's accomplishment was still low, sharing only about 10%.

NCR's economic growth rate went down drastically to negative 10% in 1985, which consequently brought down the nation's economic growth. Regions III and IV also had negative economic growth of 3.8%, however, Regions II and V accomplished positive growth due to contribution of the agricultural sector.

Per capita GRDP of every Region is in a state of gradual decline. This trend is especially predominant in NCR. The economic growth could not catch up with the population growth, thus affecting people's standard of living.

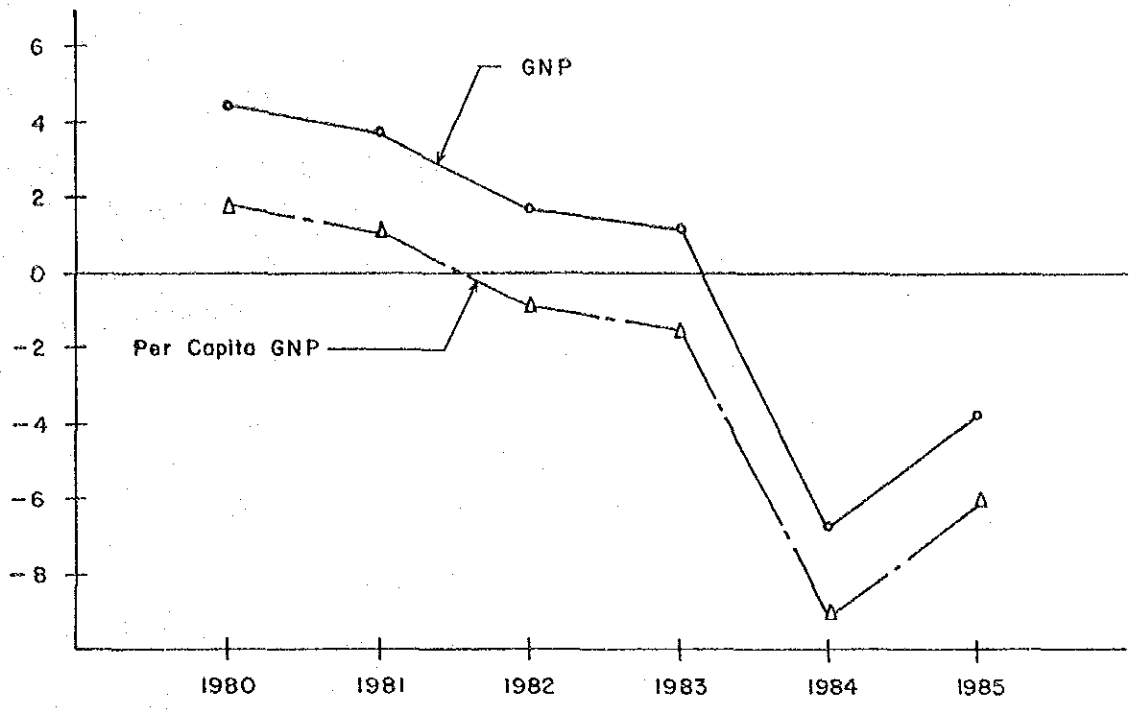


FIGURE 3.4-1 ANNUAL GROWTH RATE OF GNP AND PER CAPITA GNP

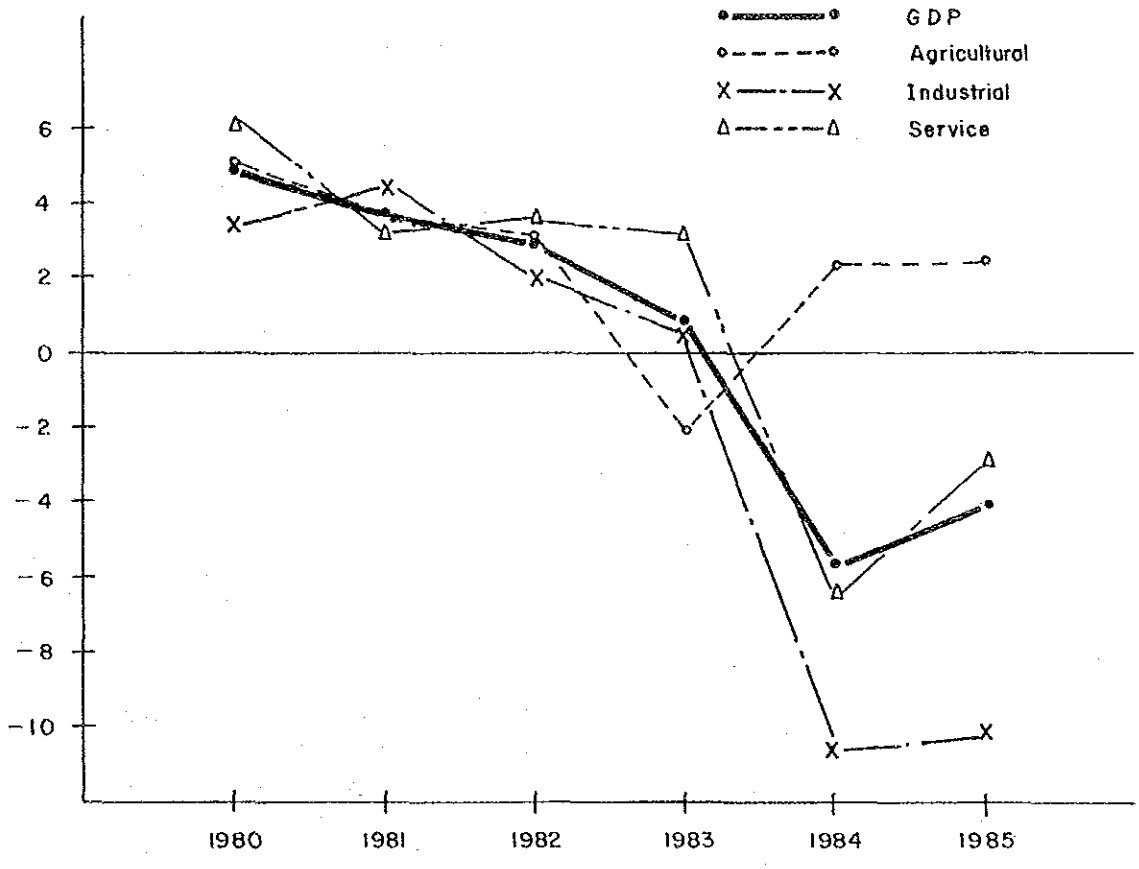


FIGURE 3.4-2 ANNUAL GROWTH RATE OF GDP BY INDUSTRIAL ORIGIN

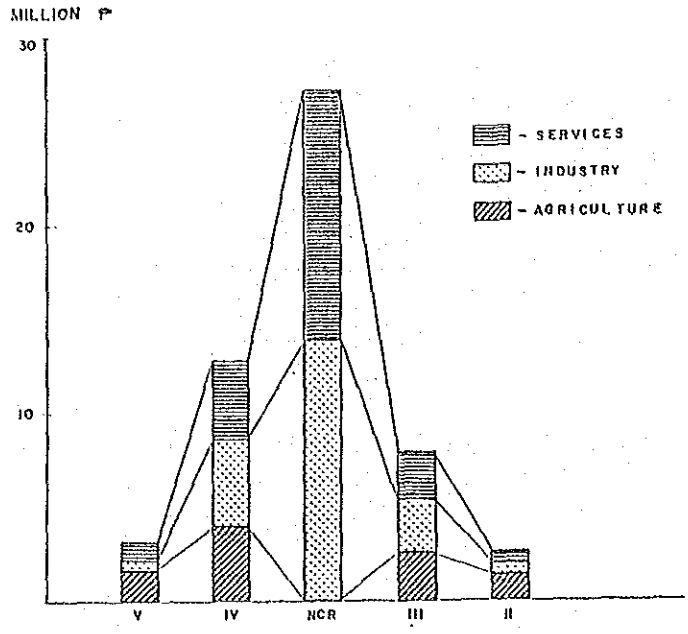


FIGURE: 3.4-3 GRDP BY SECTOR, 1985

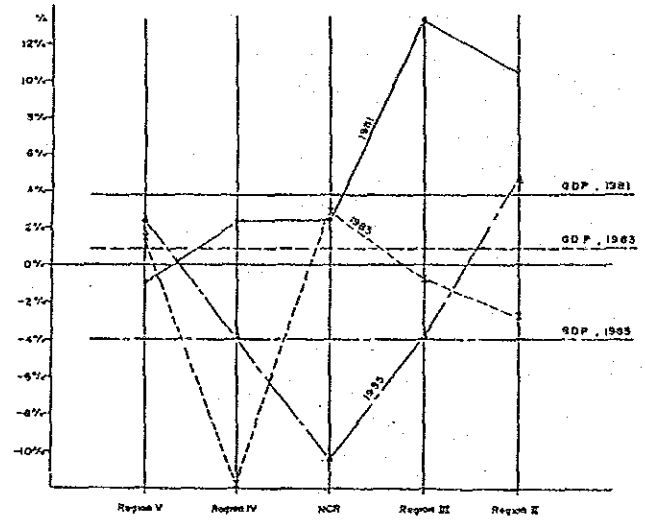


FIGURE 3.4-4 GRDP GROWTH RATE

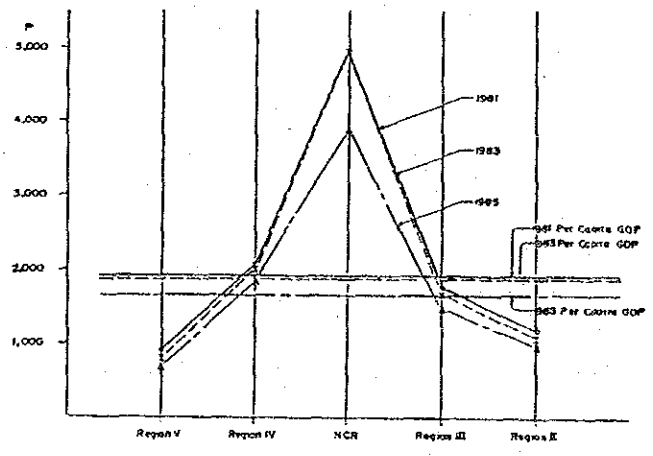


FIGURE 3.4-5 PER CAPITA GRDP

3.5 MAJOR PRODUCTS

3.5.1 National Level

The Philippines is basically an agricultural country in which most of its economic activities rely on agriculture. Agriculture plays a dominant role in country's economy sharing about 29% of Gross Domestic Product. The sector employs about one-half of the country's 19 million members of the labour force. The sector's production base consists of about 12 million hectares of farmland, a million hectare of inland fishing waters and 170 million hectares marine coastal fishing zone.

The Philippines is also endowed with vast natural and mineral resources that also help sustain its economic stability and growth. A total of about 14 million hectares of timberland areas and 31 million tons of mineral ore reserves have been the country's logs and mineral production base. Mining and forestry industry employ a total of about 224 thousand members of the labor force and contribute about 5% of the country's gross export earnings.

Agricultural Crops

The country's seven major agricultural crops are palay, corn, fruits, sugar, coconuts, coffee and tobacco. The leading crop in terms of production was palay with a total of 8.20 million metric tons produced. Next is fruits with a total production of 5.83 million metric tons, while corn ranked third with a total of 3.44 million metric tons.

Sugar production has also been a major industry in the country until a major setback was experienced in the later part of 1984 wherein world market for sugar had decline, this brought about the national policy of severe retrenchment of the sugar industry. Despite this setback, sugar still ranked fourth in terms of production in 1985 posting a total sugarcane production of 2.75 million metric tons. Another major commercial crop is coconut, which is evident because of the presence of large coconut lands in the countrysides, provided the country a total of 2.96 million metric tons of coconuts. These, including minor agricultural crops, earned for the Philippines a total of ₱81.545 billion pesos in 1985.

Logs and Lumber

Logs and lumber production are also one of the major income generating activities in the country considering that 14.02 million hectares or 47 percent of its total land area are covered with forests. Total volume of sawtimber harvested from forest lands in 1985 was 2.98 million cubic meters. This, in fact, is 27.5 percent higher than the previous years production of 2.16 million cubic meters. The general favorable weather condition and the relaxation of the total logging ban into selective logging probably contributed to this increase in timber production.

Mineral Resources

Mining industry is another country's significant income generating activities. It has contributed immensely to the national economy and in the development of remote localities where the mines are located. The export of precious mineral products such as gold, silver, iron, copper concentrates, chromites, cement and manganese has brought in the foreign exchange much needed for development.

As of 1985, the Philippines has produced an aggregate of about 91 million bags of cement, 33 tons of gold, 52 tons of silver, 222 thousand tons of copper ore and 134 thousand dried tons of refractory chromite ore, among others.

3.5.2 Regional Level

Figure 3.5-1 shows major products by Region. Among the influence regions, except NCR, the major crops grown are palay, corn, fruits, sugarcane and coconut. Region III is notably the highest producer of palay with 1.418 million metric tons which accounts for 17% of the country's total palay production, followed by Region II (13%), Region IV (11%) and Region V (9%).

On corn production, the leading corn producer is Region II accounting for about 9% of the country's total corn production. Region IV, leads in the production of sugar and coconut providing the country a total of about 312 thousand metric tons of sugarcane and 552 thousand metric tons of coconut in 1985. This contributed about 11% to the total sugarcane production of the country and about 19% to the country's coconut production.

Log production occurs in most regions of the Philippines, but particularly concentrated in certain areas such as Cagayan Valley (Region II) and the Northern and Southern Mindanao regions (Regions X and XI). Region II produced 24% of country's total log production in 1984.

Another important product in the Study Area is cement. Regions III and IV produce cement about 29% and 27% of the country's total production, respectively.

FIGURE 3.5-1 MAJOR PRODUCTS BY REGION: 1985

PRODUCTS	UNIT	PHILIPPINES (x 1000)	PRODUCTION BY REGION IN % TO TOTAL, PHILIPPINES			
			Region II	Region III	Region IV	Region V
AGRICULTURAL CROP						
• Palay	M.T.	8,200	(12.7)	(17.3)	(11.2)	(8.6)
• Corn	M.T.	3,439	(9.4)		(6.7)	(3.3)
• Sugar Cane	M.T.	2,749	(1.2	(9.5)	(11.3)	(1.1)
• Coconut	M.T.	2,965			(18.6)	(6.8)
LIVESTOCK						
• Hog	Head	7,304	(6.9)	(12.6)	(12.5)	(8.3)
• Chicken	Head	52,098	(5.9)	(14.5)	(18.5)	(7.0)
FORESTRY						
• Logs	cu.m.	2,982	(23.9)		(4.9)	
• Lumber	cu.m.	924	(15.7)	(9.8)	(23.9)	
OTHERS						
• Cement	Bag	91,560		(28.9)	(26.8)	

3.6 FAMILY INCOME AND EXPENDITURE

The NCSO's survey conducted in 1985 shows that the nation's average monthly family income and expenditures were 2,562 pesos and 2,226 pesos, respectively. NCR's average monthly family income was higher by 1.89 times than the national average. Families in Region V had quite low income of only 1,666 pesos per month, which was only 65% of the national average. Table 3.6-1 shows the average family income and expenditures for 1985.

TABLE 3.6-1 AVERAGE FAMILY INCOME AND EXPENDITURES: 1985

	Income			Expenditures		
	Average Annual (₱)	Average Monthly (₱)	Ratio of Philippines (₱)	Average Annual (₱)	Average Monthly (₱)	Ratio of Philippines
Philippines	30,748	2,562	1.00	26,714	2,226	1.00
N C R	58,197	4,850	1.89	48,475	4,040	1.81
Region II	26,992	2,249	0.88	22,590	1,883	0.85
III	38,052	3,171	1.24	34,358	2,863	1.29
IV	29,432	2,453	0.96	26,126	2,177	0.98
V	19,986	1,666	0.65	19,200	1,600	0.72

SOURCE: 1985 Family Income and Expenditure Survey, NCSO

PART II TRAFFIC

CHAPTER 4

TRAFFIC SURVEY AND ANALYSIS

4.1 APPROACH

Various traffic surveys were planned to obtain traffic characteristics, quantity and quality of traffic, interdependence of regions or provinces, etc. Road user's opinions were also surveyed to obtain their tolerable limit to traffic congestion. Then, these data were utilized to evaluate present level of service of each road section, to estimate future traffic demands and to establish road function improvement level.

Figure 4.1-1 shows the flow chart of traffic survey and analysis. Axle load data obtained by the "Pavement and Axle Load Study" conducted in 1984 and 1985 were utilized for pavement evaluation and design, therefore, no axle load survey was conducted.

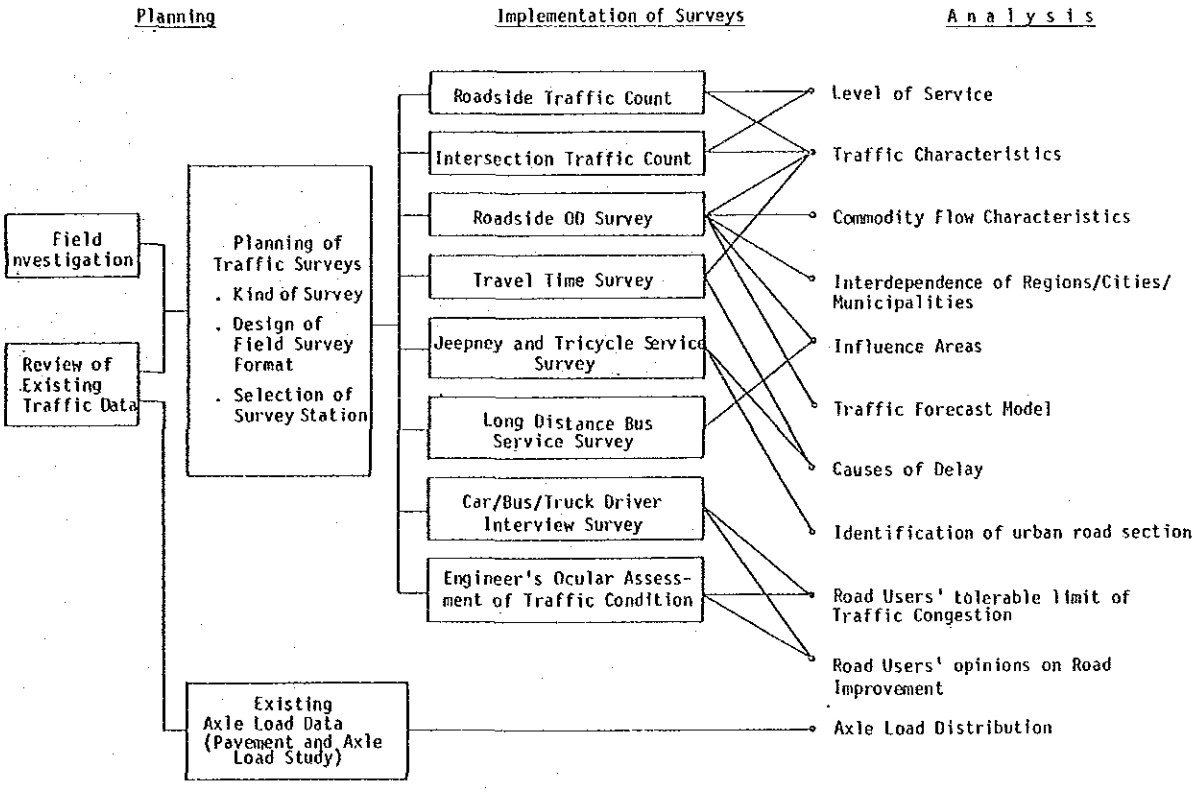


FIGURE 4.1-1 FLOW CHART OF TRAFFIC SURVEY AND ANALYSIS

4.2 TRAFFIC SURVEYS CONDUCTED

As shown in Table 4.2-1, eight (8) kinds of traffic surveys were conducted. Figures 4.2-1 and 2 show locations of survey stations.

The field survey sheets used are presented in Appendix 4-1.

TABLE 4.2-1 TRAFFIC SURVEYS CONDUCTED

	Type of Survey	No. of Survey Stations/Areas North Section:	South Section:	Total
i)	Roadside traffic count	9	13	22
ii)	Intersection traffic count	11	3	14
iii)	Roadside OD Survey	4	2	6
iv)	Travel Time Survey	• Full Stretch • 7 urban areas	• Full Stretch • 6 urban areas	• Full Stretch • 13 urban areas
v)	Jeepney and tricycle service survey	10 town proper	14 town proper	24 town proper
vi)	Long Distance Bus service survey	6 Bus Companies	5 Bus Companies	11 Bus Companies
vii)	Car/Bus Truck Driver Interview Survey	5	1	6
viii)	Engineer's Ocular Assessment of Traffic Condition	Full Stretch	Full Stretch	Full Stretch

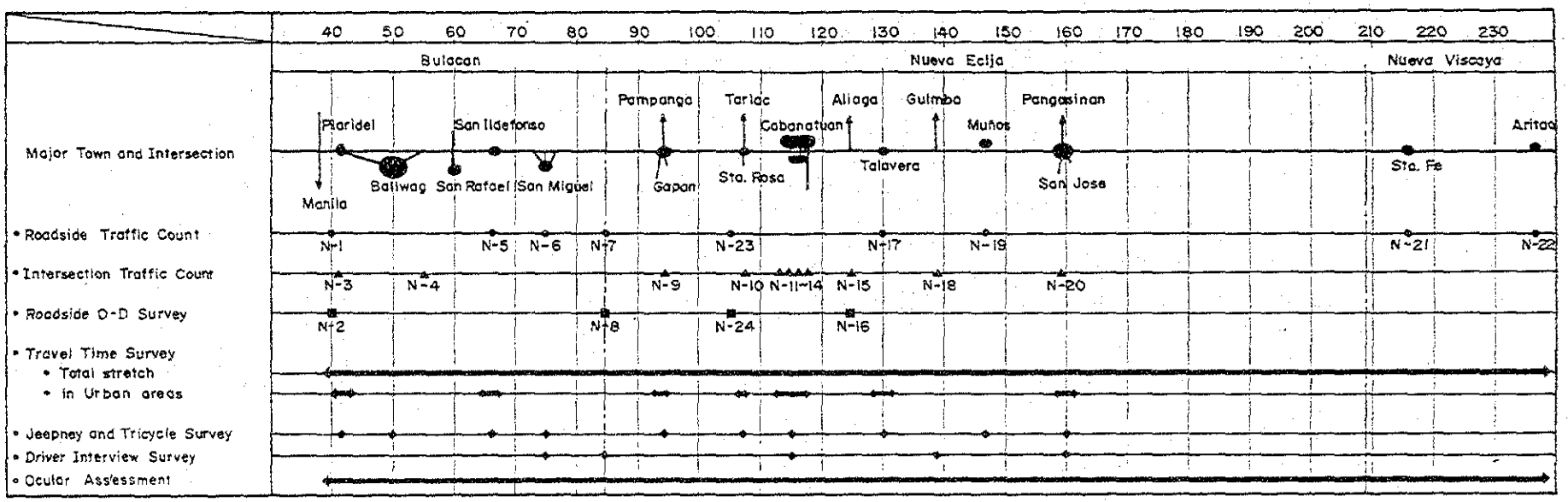


FIGURE 4.2-1 CONDUCTED TRAFFIC SURVEY (STA. RITA–ARITAO)

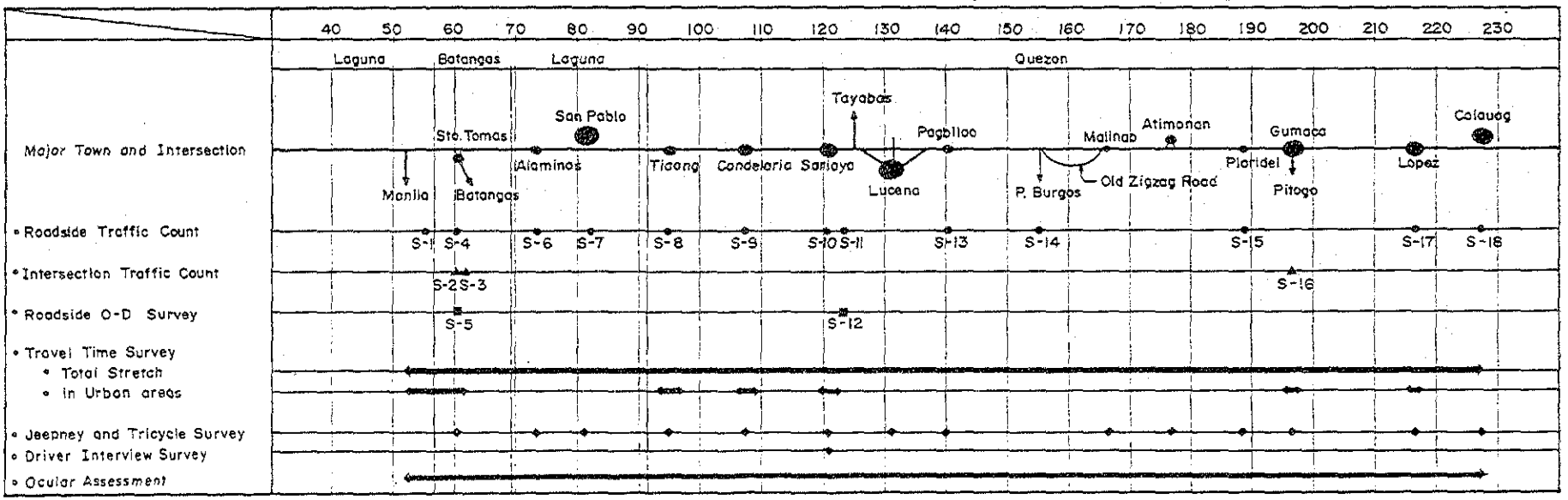


FIGURE 4.2-2 CONDUCTED TRAFFIC SURVEY (Calamba-Calauag)

4.3 TRAFFIC CHARACTERISTICS

4.3.1 Daily Traffic Volume

1) North Study Section

Figure 4.3-1 shows daily traffic volume (excluding tricycle) and Figure 4.3-2 shows daily traffic volume by vehicle type on the North Study Section. Daily traffic volume characteristics are as follows:

a) Traffic on the North Study Section is strongly influenced by two major urban centers: Metro Manila and Cabanatuan City.

b) Among the rural sections (the inter-city sections), the Sta. Rita-Plaridel section which is located nearest to Metro Manila has the heaviest traffic volume of 10,750 vehicle per day, followed by the Sta. Rosa-Cabanatuan section with traffic volume of about 8,800 vehicle per day.

c) Traffic volume on the sections north of San Jose City becomes quite light and is about 2,400 vehicle per day. Another section with light traffic volume of about 3,800 vehicle per day is the San Miguel-Gapan section where the boundary of Bulacan and Nueva Ecija Provinces is located. This low volume of traffic is due to no franchise was given to jeepneys beyond the provincial boundary.

d) Buses and trucks generally have their origins or destinations at Metro Manila, therefore, traffic volume of buses and trucks becomes heavier as the section is closer to Metro Manila.

e) Traffic volume of cars and jeepneys are closely related not only with Metro Manila's but also with major urban center's socio-economic activities along the Section. Traffic volume of these two types of vehicles is high on the urban sections of Plaridel, Gapan, Cabanatuan City and San Jose City. Especially Cabanatuan City which is the Provincial Capital of Nueva Ecija is a quite big traffic generation/attraction source.

f) One of the outstanding traffic characteristics on the North Study Section is huge number of tricycles operating on the urban sections. Tricycles traffic volume per day exceeds 10,000 on the Gapan, Cabanatuan and San Jose urban sections, and 4,000 to 5,000 on the Plaridel, San Ildefonso, Sta. Rosa and Talavera urban sections. Although tricycle is quite convenient mode of transport for the public, huge number of tricycles are affecting smooth flow of traffic.

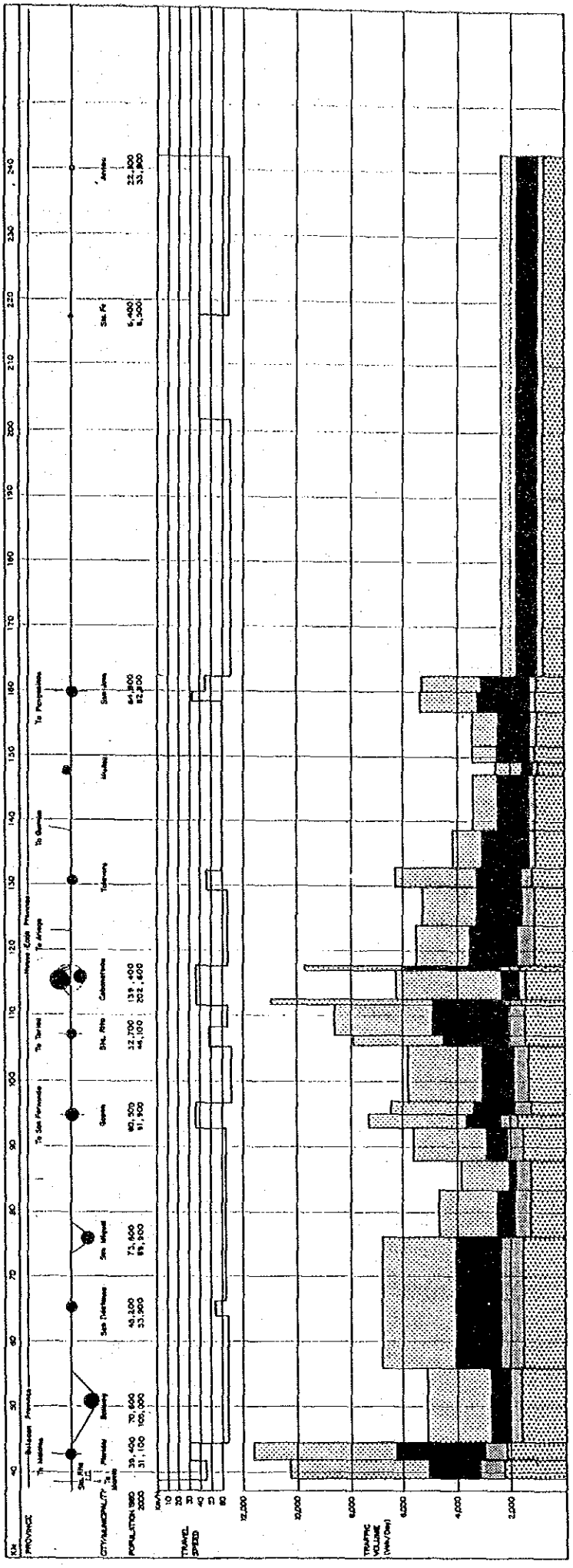


FIGURE 4.3-1 TRAFFIC VOLUME (NORTH SECTION)

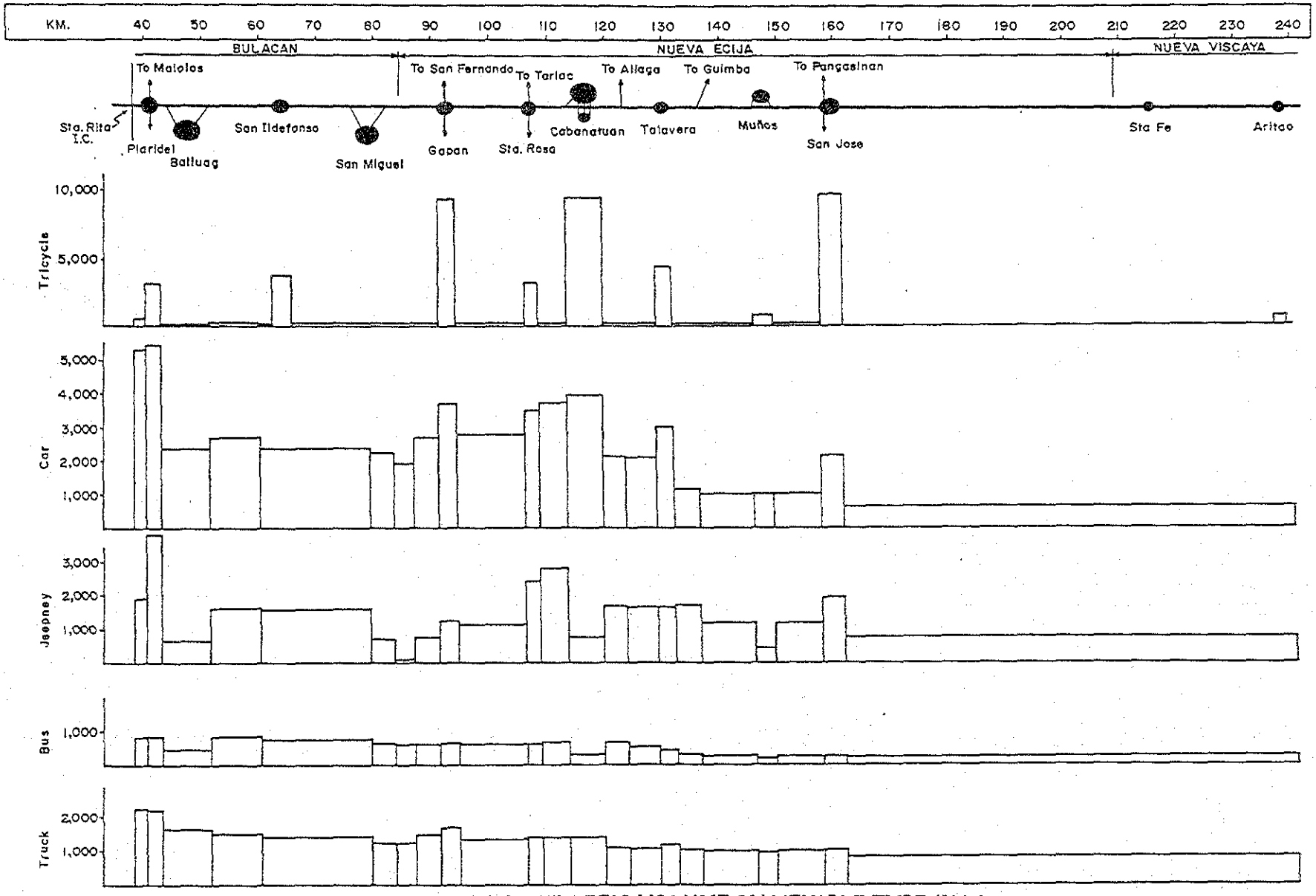


FIGURE 4.3-2 TRAFFIC VOLUME BY VEHICLE TYPE (NORTH SECTION)

2) South Study Section

Figure 4.3-3 presents daily traffic volume (excluding tricycle) and Figure 4.3-4 shows daily traffic volume by vehicle type on the South Study Section.

a) It is clear characteristics that the total traffic volume (excluding tricycle) becomes heavier as the section is located closer to Metro Manila. Unlike the North Study Section, traffic on the South Study Section is strongly related with Metro Manila. Socio-economic activities of major cities/ municipalities such as Sto. Tomas, San Pablo City, Candelaria and Lucena City have strong linkages with Metro Manila, otherwise activities are completed within the city or municipality, therefore, influence of major cities/municipalities on adjacent communities is minimal.

b) Among the rural sections, the Calamba-Sto. Tomas section located nearest to Metro Manila has the heaviest traffic volume of about 12,000 vehicle per day. At the end of this section, the Highway branches off to two (2) directions. One goes towards the Bicol Region which is the Pan-Philippine Highway and the other goes to Batangas City. Traffic volume on the Pan-Philippine Highway south of the Calamba-Sto-Tomas Section, gradually decreases to about 4,000 vehicle per day on the section near Lucena City and to about 2,000 vehicle per day on the sections south of Pagbilao.

c) Car traffic sharply increases as the section is located closer to Metro Manila, due mainly to influence of Metro Manila's socio-economic activities.

d) Bus traffic is grouped into three (3) in terms of volume. The Calamba-Sto. Tomas section has the heaviest bus traffic of about 1,100 per day. The section between Sto. Tomas and Atimonan has almost same bus traffic of about 450 to 680. The sections south of Atimonan has less than 400 buses per day.

e) Trucks on this Study Section have long-distance trips and mostly have their origins or destinations at Metro Manila. Volume of trucks do not change drastically and ranges from 500 to 1800 trucks per day.

f) Jeepneys serve for short and medium distance trips. Volume of jeepney traffic between Sto. Tomas and Pagbilao ranges from 1,200 to 700, then decreases to about 250 to 400 per day on the sections south of Pagbilao.

g) Compared to urban sections along the North Study Section, tricycle traffic on urban sections along the South Study Section is very low, amounting to 3,700 per day at Candelaria, 2,900 at Gumaca and 1,800 at Lopez.

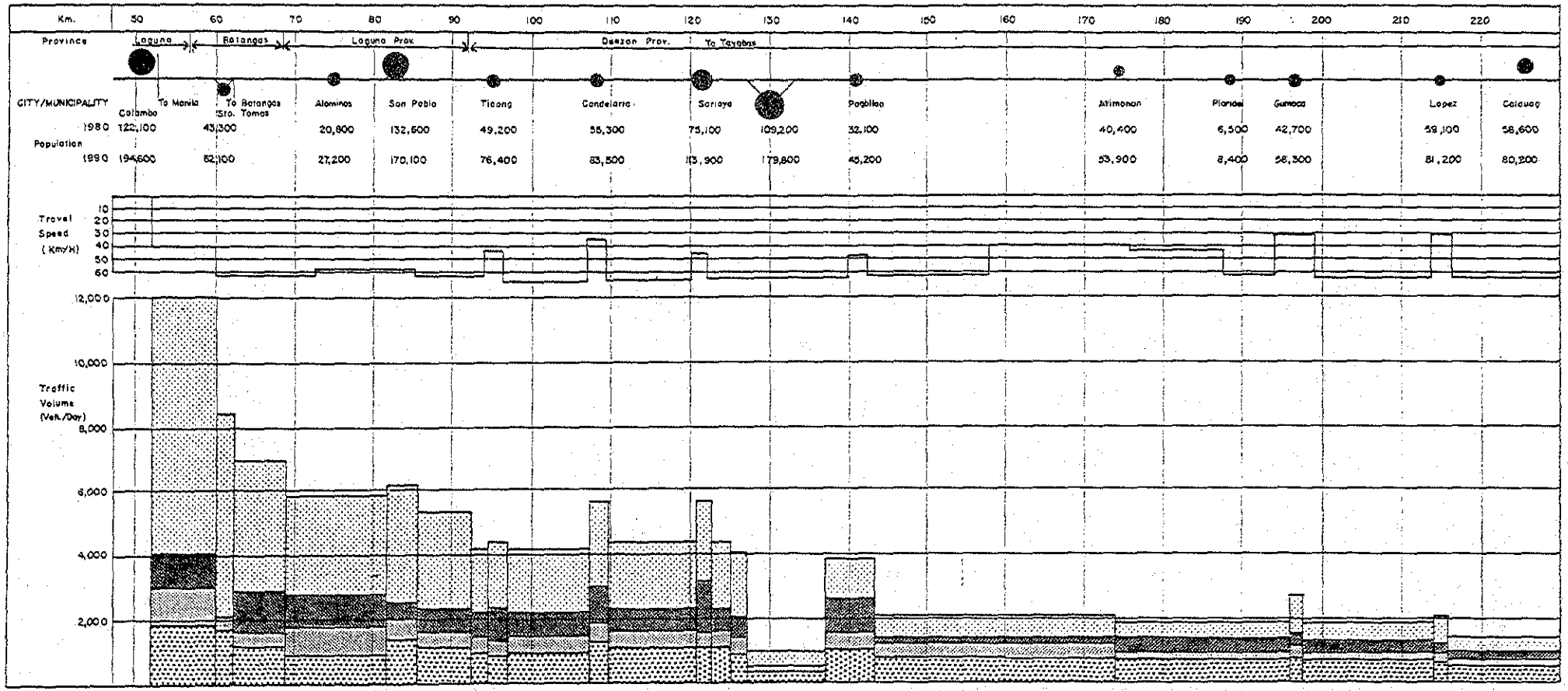


FIGURE: 4.3-4 TRAFFIC VOLUME (SOUTH SECTION)

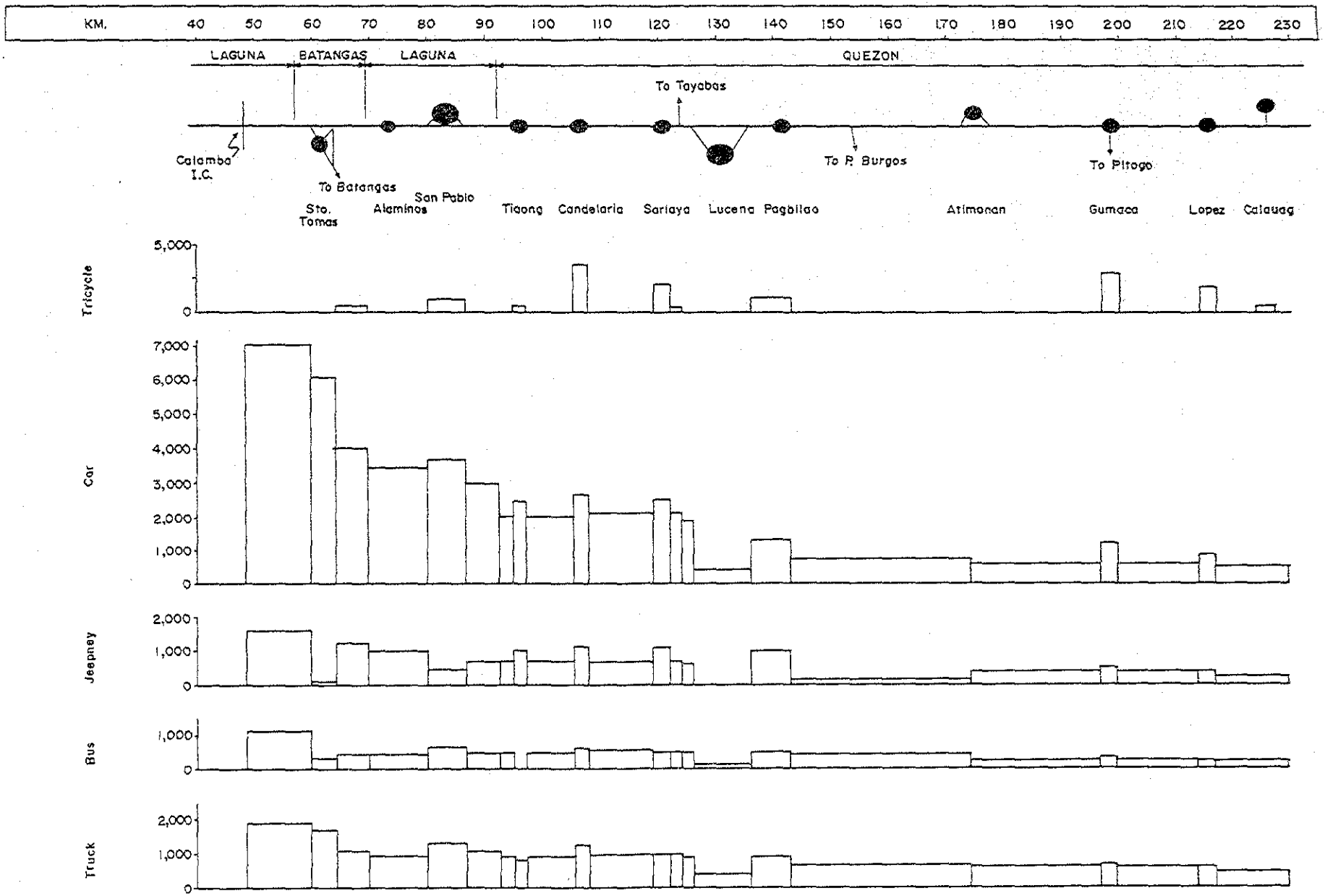


FIGURE: 4.3-3 TRAFFIC VOLUME BY VEHICLE TYPE (SOUTH SECTION)

4.3.2 OD Characteristics

1) North Study Section

The roadside OD survey was conducted at four (4) survey stations along the North Study Section. OD patterns at each survey stations are presented in Appendix 4-2. These survey results were integrated and the OD table representing the OD pattern along the North Study Section was developed, which is graphically shown in Figure 4.3-5.

a) Vehicle movements are predominantly along the corridor of the Pan-Philippine Highway (north-south direction). East-west direction flow such as traffic going to the Manila North Road is still minimal.

b) Municipalities in Bulacan Province have strong linkage with Metro Manila. Of 11,632 vehicles per day on the Sta. Rita-Plaridel section, about 6,100 vehicles (or about 52%) are traffic between Metro Manila and Bulacan Province.

c) Cities and municipalities in Nueva Ecija Province are strongly related with Cabanatuan City. About 64% of traffic on the Sta. Rosa-Cabanatuan Section which is located South of Cabanatuan City have their origins or destinations at Cabanatuan City. This tendency is more clear on the section north of the City, where about 75% of vehicles have their trip ends at Cabanatuan City.

d) Traffic on the section north of San Jose City is mostly between Region II and Metro Manila, therefore, has quite long distance trip.

e) Local trip (intra-zonal or municipal trip) sharply increases at urban centers of Plaridel, Gapan, Cabanatuan City and San Jose City. In these urban centers, long distance traffic (or through traffic) which requires faster travel and short distance traffic (or local traffic), of which major purpose is access to roadside facilities, are simultaneously utilizing the Pan-Philippine Highway.

2) South Study Section

The roadside OD survey was conducted at two (2) survey stations along the South Study Section. OD patterns at each survey stations are presented in Appendix 4-3. Two OD survey results were integrated and the OD pattern along the South Study Section was developed as shown in Figure 4.3-6. As two survey stations are located far away each other, traffic which was not surveyed (or originated and terminated within two survey stations) was treated as local traffic.

a) Vehicle movements are predominantly along the corridor of the Pan-Philippine Highway, except the Calamba-Sto. Tomas Section.

b) Major traffic generation/attraction centers are Metro Manila, Tanauan Batangas, San Pablo City and Lucena City.

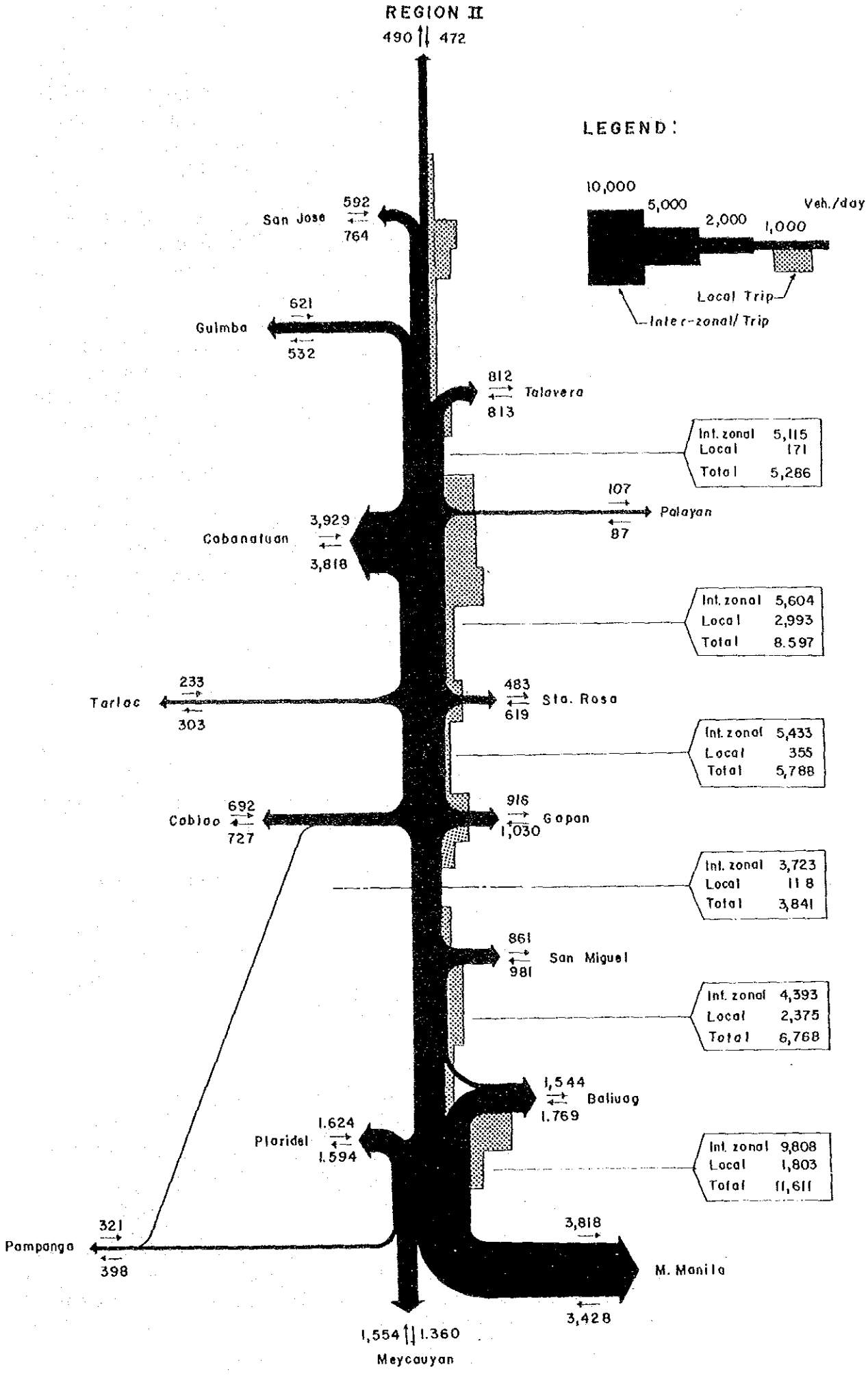


FIGURE 4.3-5 EXISTING TRAFFIC FLOW ON THE NORTH SECTION

c) The Calamba-Sto. Tomas Section has daily traffic volume of about 12,000 vehicles, of which 71% or 8,560 vehicles have their origins or destination at Metro Manila, 36% (4,300 vehicles) at Tanauan Batangas, 11% (1,330 vehicles) at San Pablo City and 8% (920 vehicles) at Lucena City.

d) Traffic on the Sto. Tomas-San Pablo Section is also predominantly Metro Manila related traffic. Of the daily traffic of 6,900 vehicles 44% or 3,040 vehicles have their origins or destinations at Metro Manila. Tanauan, Batangas related traffic accounts for 11% (750 vehicles).

e) Daily traffic on the San Pablo-Lucena Section is about 4,300 vehicles. Most of traffic (about 70%) ends at Lucena and the rest goes beyond Lucena towards Bicol Region. Manila-Lucena traffic is about 810 vehicles followed by San Pablo-Lucena (210 vehicles) and Batangas-Lucena (190 vehicles).

f) Traffic on the section south of Lucena is mostly Metro Manila related traffic.

g) Outstanding difference between the North and the South Study Sections is volume of local traffic on urban sections. Volume of local traffic on urban sections along the South Study Section is very low compared with the North Survey Section.

4.3.3 Commodity Flow

1) North Study Section

Commodities transported through the Sta. Rita-Plaridel Section, the nearest section to Metro Manila, are shown in Table 4.3-1. A total of 11,632 tons of commodities are transported daily through this section, of which 8,635 tons (or 74%) are Manila bound and the rest (2,997 tons) are Cagayan bound.

Major commodities bound for Manila in terms of weight are 3,465 tons of building and construction materials (gravel and sand), 2023 tons of forestry and mining products (logs and lumber) and 1,405 tons of processed agricultural products (milled rice). Major commodities bound for Cagayan Region are 821 tons of mineral and oil products (gasoline and diesel), 433 tons of manufactured food stuff (groceries and daily products) and 362 tons of manufactured producers goods (fertilizer).

OD patterns of major commodities are graphically shown in Figure 4.3-7. Gravels and Sands quarried in Bulacan Province, logs and lumber produced in Region II and rice produced in Regions II and III are transported to Metro Manila.

2) South Study Section

Commodities transported through Sto. Tomas are shown in Table 4.3-2. A total of 9,667 tons of commodities are transported, of which 3,456 tons (36%) are from Metro Manila to Bicol or Batangas, 2,831 tons (29%) from Bicol to Metro Manila or Batangas and 3,380 tons (35%) from Batangas to Metro Manila or Bicol.

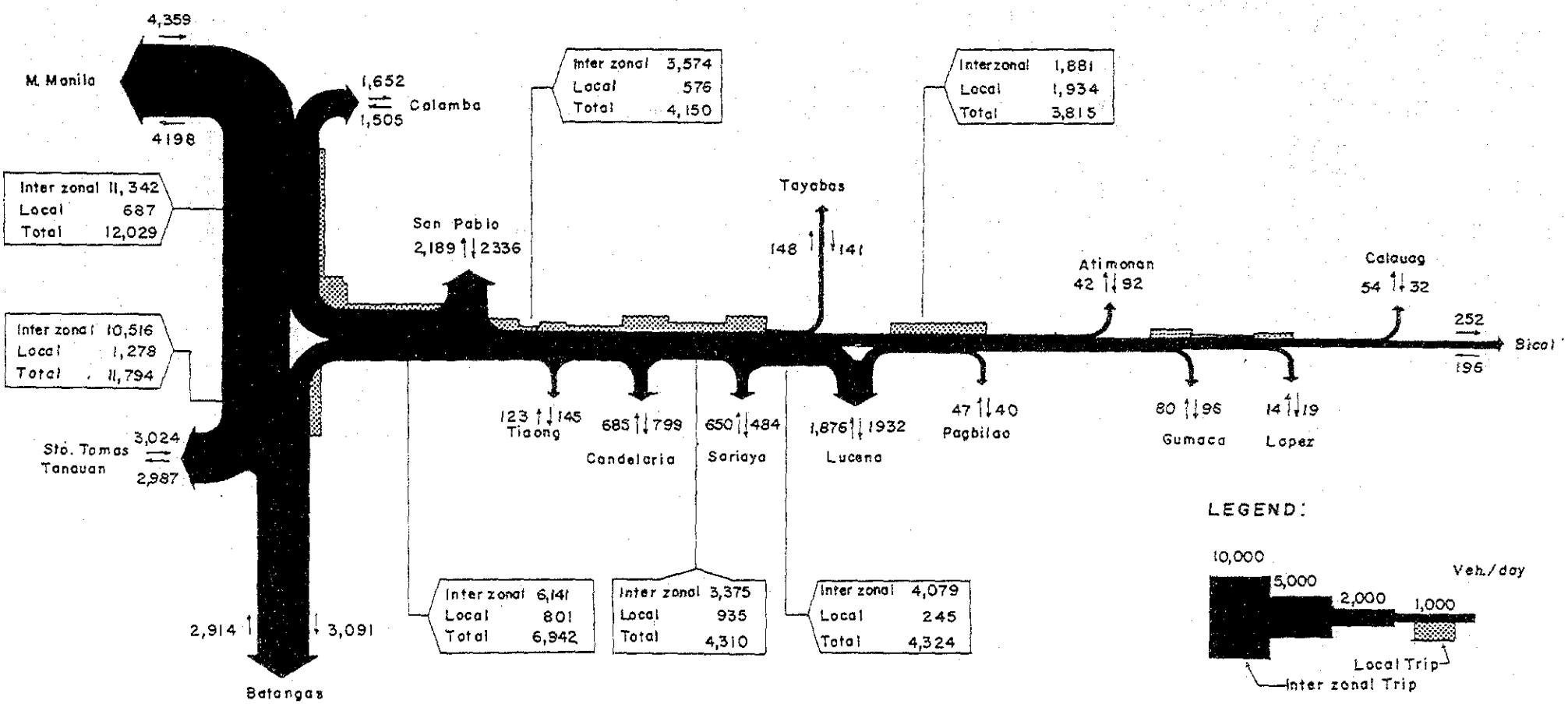


FIGURE 4.3-6 EXISTING TRAFFIC FLOW ON THE SOUTH SECTION

TABLE 4.3-1 COMMODITY FLOW IN 1986
(STATION: N - 02)

	from Manila to Cagayan		from Cagayan to Manila	
	Main Commodity	Volume (ton/day)	Main Commodity	Volume (ton/day)
Un-processed Cereals	Maize (unmilled corn)	80	Palay	740
Other Un-processed Agricultural Foodstuff	Fruit and Vegetables	39	Fruit and Vegetables	191
Un-processed Agricultural Cash Crops	Foodstuff for animals	334	Foodstuff for animals	331
Processed Agricultural Products	Centrifugal and refined sugar	290	Milled rice	1,405
Manufactured Foodstuff	Groceries, dairy products, bakery etc.	433	Soft drinks, beer	320
Other Manufactured Consumer Goods	Household goods, medicines	63	Household goods medicines	11
Forestry and Mining Products	Lumber	313	Lumber	2,023
Mineral Oil Products	Gasoline, automotive diesel	821	Gas	2
Building and Construction Materials	Stone, gravel, sand	262	Stone, gravel, sand	3,465
Manufactured Producers Goods	Fertilizer, insecticides, empty bottles	362	Empty containers,	147
Total Commodity Volume (tons/day)		2,997		8,635
Empty Trucks (veh./day)		771		371

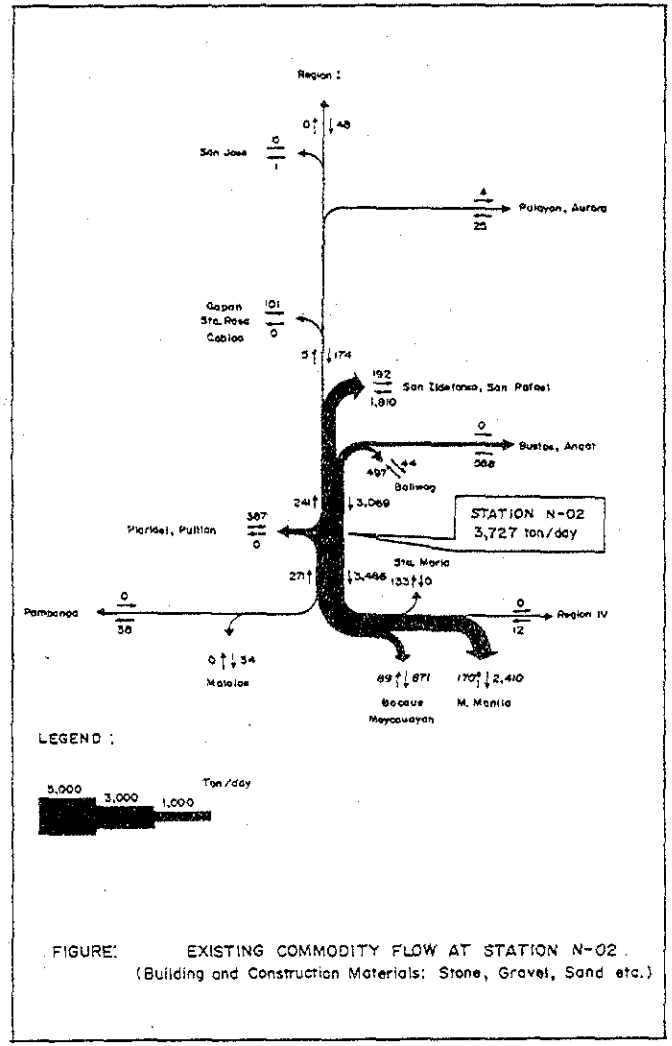


FIGURE: EXISTING COMMODITY FLOW AT STATION N-02
(Building and Construction Materials: Stone, Gravel, Sand etc.)

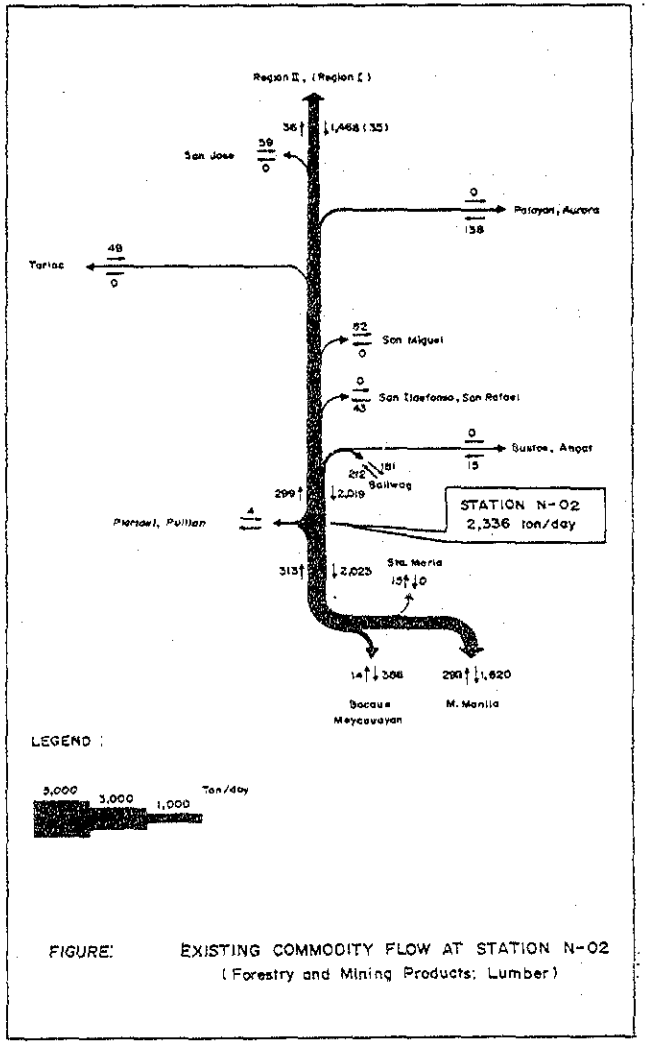


FIGURE: EXISTING COMMODITY FLOW AT STATION N-02
(Forestry and Mining Products: Lumber)

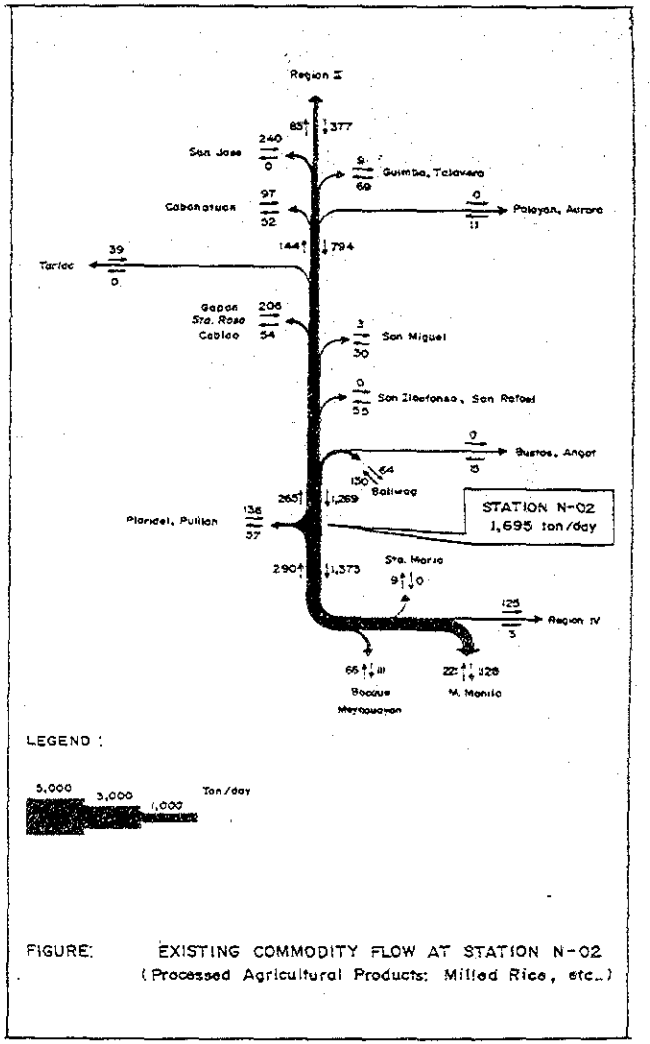
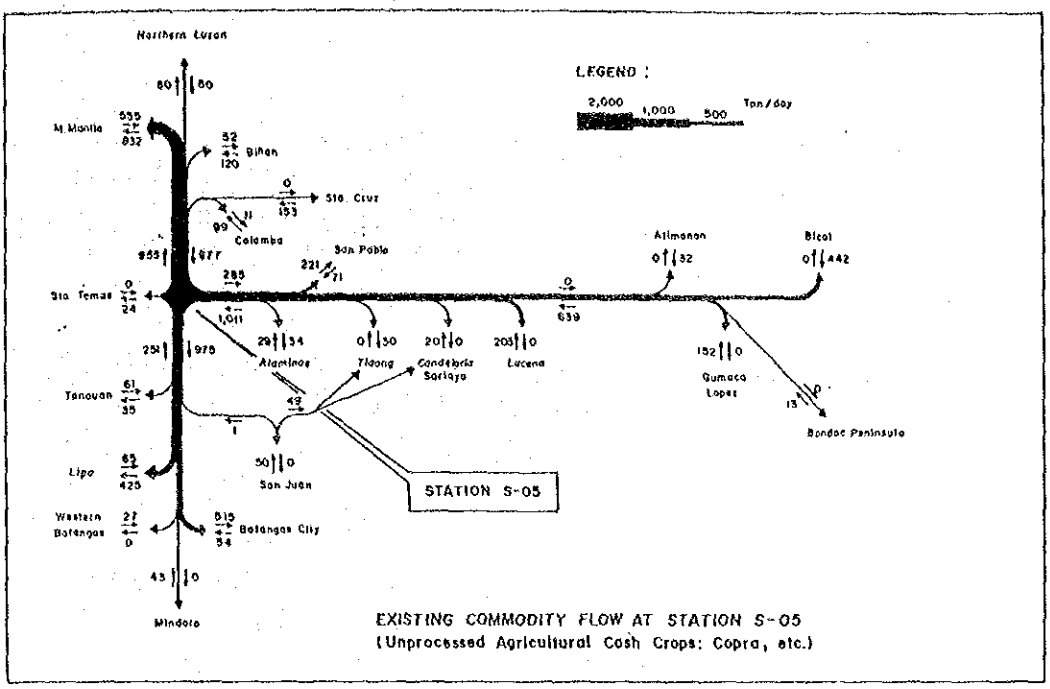


FIGURE: EXISTING COMMODITY FLOW AT STATION N-02
(Processed Agricultural Products: Milled Rice, etc.)

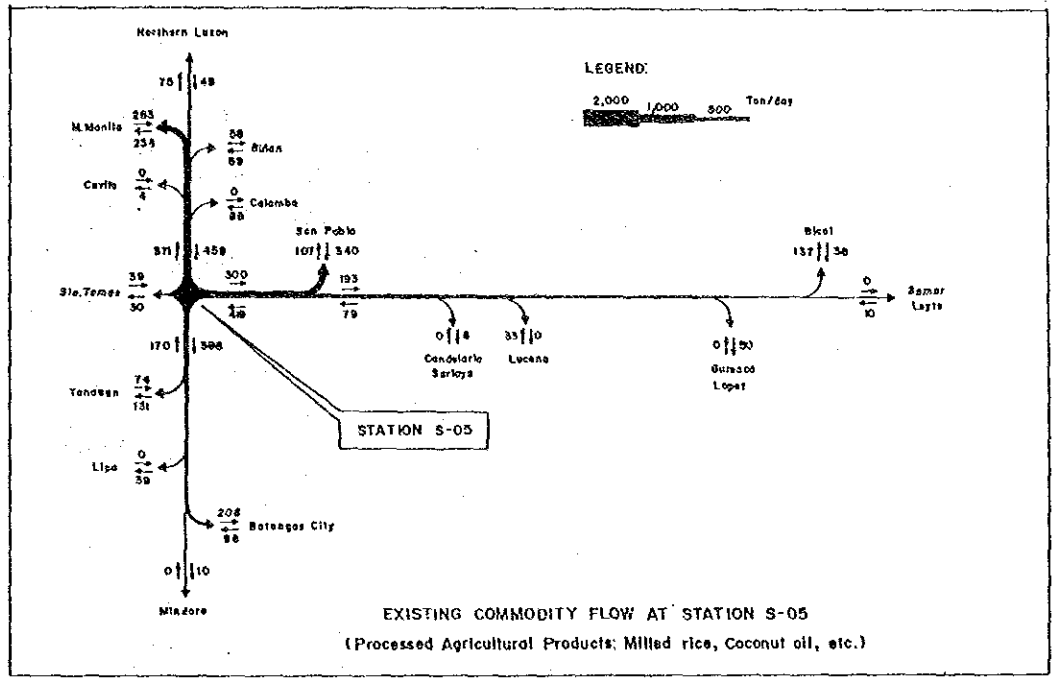
FIGURE 4.3-7 FLOW OF 3 MAJOR COMMODITIES (SURVEY STATION N-02)

TABLE 4.3-2 COMMODITY FLOW IN 1986
(STATION: S - 05)

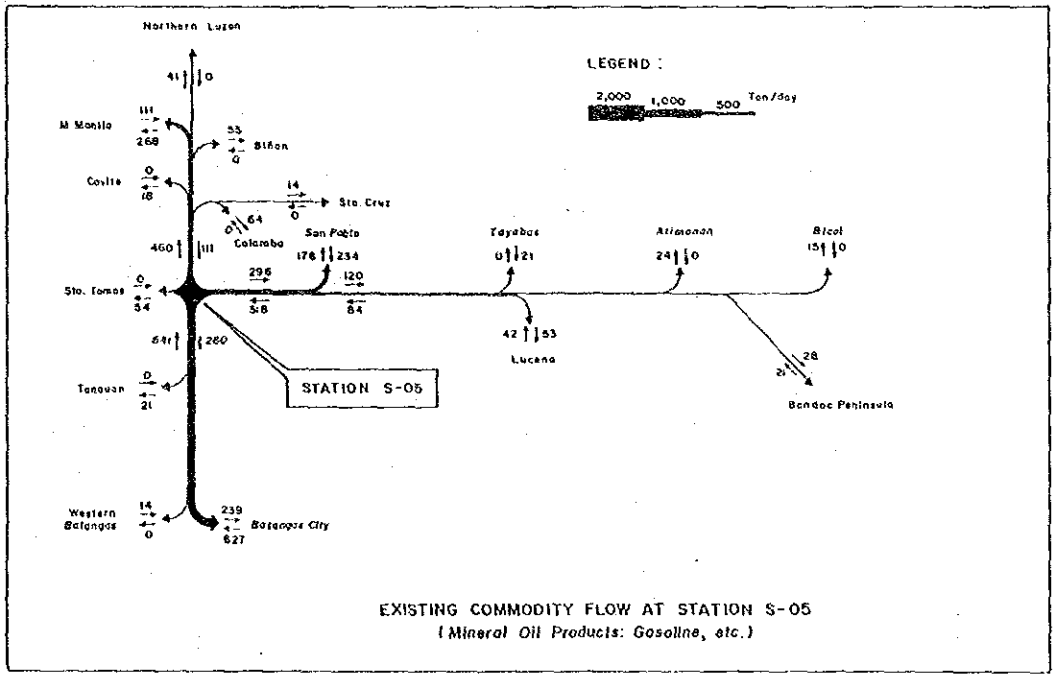
	from MNL to Bicol/Batangas		from Bicol to MNL/Batangas		from Batangas to MNL/Bicol	
	Main Commodity	Volume (ton/day)	Main Commodity	Volume (ton/day)	Main Commodity	Volume (ton/day)
Un-processed Cereals	Maize (unmilled corn)	166	Maize (unmilled corn)	37	Palay	588
Other Un-processed Agricultural Foodstuff	Fruit and vegtables	124	Fruit and vegetables	425	Fruit and vegetables	340
Un-processed Agricultural Cash Crops	Foodstuff for animals	977	Copra	1,011	Copra	251
Processed Agricultural Products	Milled rice	498	Vegetable oil and fats (including coconut oil)	419	Milled rice Wheat flour	170
Manufactured Foodstuff	Groceries, dairy products, bakery, Beer	682	Soft drinks	161	Wines, Soft drinks	93
Other Manufactured Consumer Goods	Drugs, medicines	104	Drugs, medicines Printed matters	127	Rubber tyres and other rubber products	14
Forestry and Mining Products	Lumber	108	Charcoal, Sawdust Firewood, Coconut shell	128	Coal, lignite, peat, briquettes	532
Mineral Oil Products	Gasoline, automotive diesel	111	Gasoline, automotive diesel	318	Gasoline, automotive diesel	641
Building and Construction Materials	Stone, gravel, sand	457	Concrete and concrete products	18	Cement	279
Manufactured Producers Goods	Fertilizer, insecticides, Empty Containers	229	Empty containers, bottles, etc.	187	Empty containers, bottles, etc.	472
Total Commodity Volume		3,456		2,831		3,380
Empty Trucks (veh./day)		562		213		399



EXISTING COMMODITY FLOW AT STATION S-05
(Unprocessed Agricultural Cash Crops: Copra, etc.)



EXISTING COMMODITY FLOW AT STATION S-05
(Processed Agricultural Products: Milled rice, Coconut oil, etc.)



EXISTING COMMODITY FLOW AT STATION S-05
(Mineral Oil Products: Gasoline, etc.)

FIGURE 4.3-8 FLOW OF 3 MAJOR COMMODITIES (SURVEY STATION S-05)