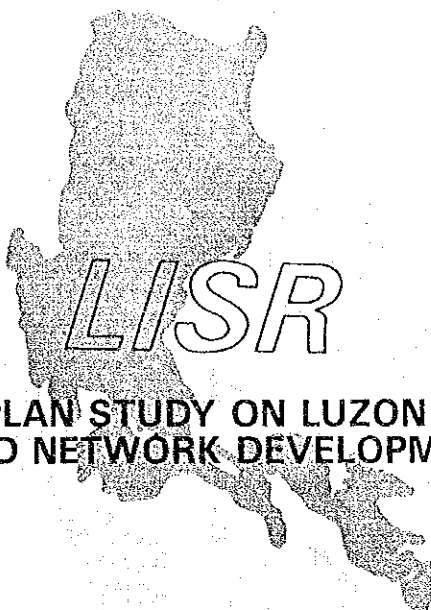


DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES



**MASTER PLAN STUDY ON LUZON ISLAND
STRATEGIC ROAD NETWORK DEVELOPMENT PROJECT**

FINAL REPORT

EXECUTIVE SUMMARY

JULY 1993

**KATAHIRA & ENGINEERS INTERNATIONAL
NIPPON KOEI CO., LTD.**



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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

President

Japan International Cooperation Agency

JICA LIBRARY



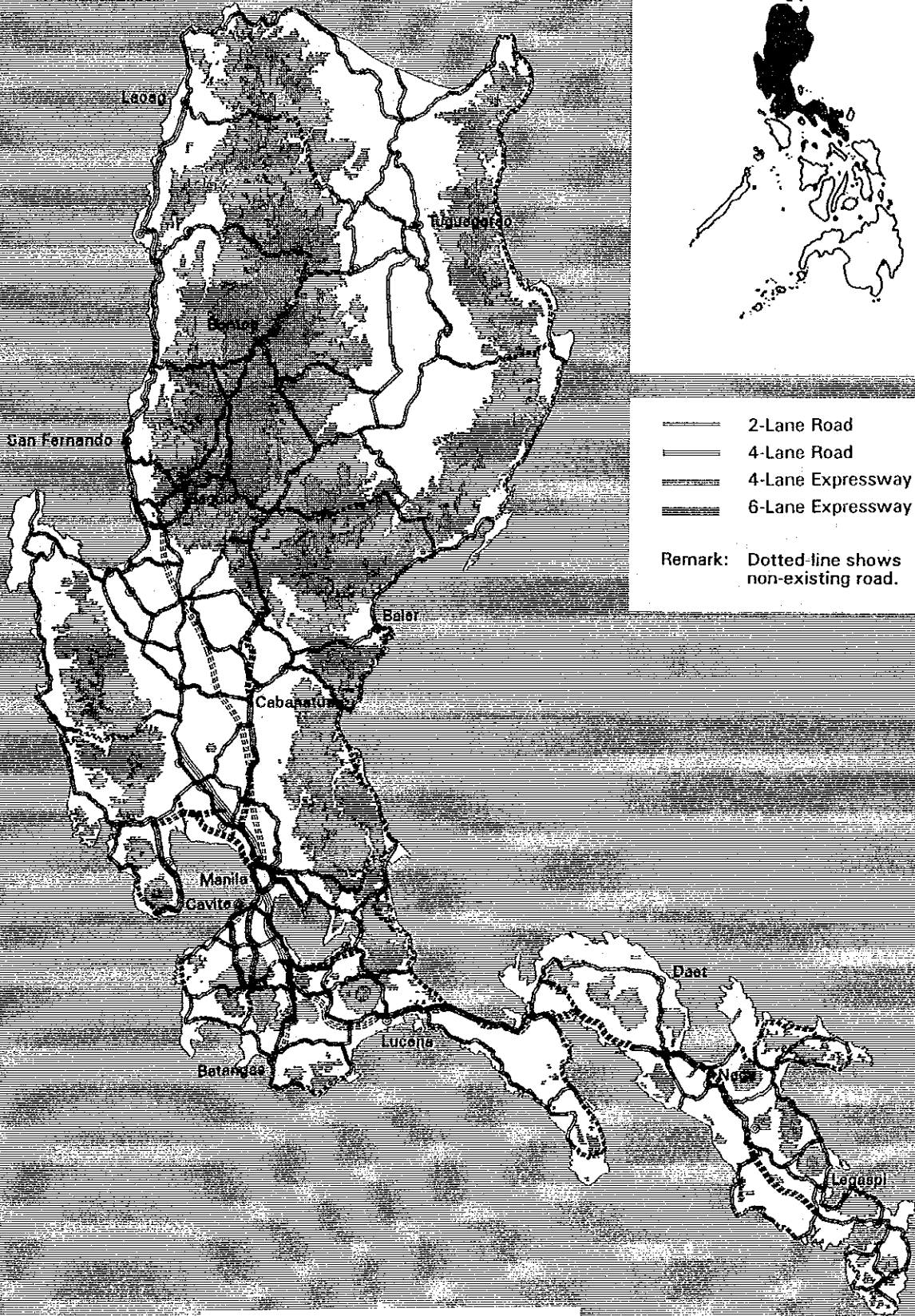
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KEY MAP



- 2-Lane Road
- ==== 4-Lane Road
- ==== 4-Lane Expressway
- ==== 6-Lane Expressway

Remark: Dotted-line shows non-existing road.

LISR NETWORK

LUZON ISLAND STRATEGIC ROAD NETWORK

SUMMARY

OBJECTIVES OF LUZON ISLAND STRATEGIC ROAD (LISR) NETWORK DEVELOPMENT PLAN

Transport system of the Philippines relies highly on road transport which handles 89% of the country's passenger movement and 53% of freight movement. Road network in Luzon Island is basically composed of two north-south arterials (Manila North Road and Pan-Philippine Highway) as backbones and west-east laterals, with other major roads branching off therefrom. North-south arterials are in general well developed but suffering traffic congestion on the sections inside and

near cities and municipal centers. East-west laterals and other major roads are mostly in poor condition, and in many areas no alternative road is available, resulting in isolation of the area when the road is heavily damaged by calamity.

In view of the above situation, the plan is aiming to promote balanced regional development by providing reliable, stable and efficient road network.

LISR NETWORK DEVELOPMENT PLAN

Requirements of the major road network as a physical foundation to support the balanced regional development are the interconnection of administratively and/or economically important regional centers, provision of access to vast agricultural potential areas, coverage of the whole island leaving no vast inaccessible area, securing of substitutive route in case of road disaster, alleviation of traffic congestion, etc. The road network, called LISR NETWORK, composed of 7,761 km of existing roads and 1,329 km of non-existing roads totaling 9,090 km, is established to meet the above requirements.

Of the LISR network, 1,816 km are adequate roads and the remaining 7,274 km are desig-

nated as project roads which are divided into 91 projects. The projects include the following construction/improvement works:

Improvement of 2-lane road	2,640.0 km
New construction of 2-lane road	1,370.1 km
Widening of 2-lane road to 4-lane	701.8 km
New construction of 4-lane road	339.0 km
Widening of 2-lane expressway to 4-lane	21.7 km
Widening of 4-lane expressway to 6-lane	84.6 km
New construction of 4-lane expressway	311.3 km
Do-nothing	1,805.9 km
Total	7,274.4 km

IMPLEMENTATION SCHEDULE

The identified projects are prioritized based on such factors as their roles and functions, present status, economic viability, investment balance between regions, etc. The implemen-

tation schedule is developed for three six-year programs during 1993 to 1998, 1999 to 2004 and 2005 to 2010. Each program covers a group of projects as follows:

	Total Length of Project Roads (km)	Total Cost (Pbillion)	Completion Rate of LISR Network at the End of Program Period
First Six-Year Program (1993-1998)	2,600.8	344	49 %
Second Six-Year Program (1999-2004)	2,246.9	483	73 %
Third Six-Year Program (2005-2010)	2,218.5	485	98 %
Later Years	208.2	224	-
Total	7,274.4	1,536	-

The average annual investment is estimated as ₱ 7.3 billion, which is equivalent to 1.5 times as much as the portion of 1992 DPWH budget allocated to the trunk road projects in

Luzon Island. The proposed investment plan is considered to be in the achievable range when taking into account the future economic growth of 4.8 % per annum.

EVALUATION OF LISR PLAN

Three significant benefit components are estimated up to the year 2020 for the whole plan as well as for individual projects.

1. Savings in vehicle operating cost, accumulating to ₱ 348.2 billion.
2. Regional development benefit (increase in GRDP as a result of improvement in labor productivity due to road development), accumulating to ₱ 221.0 billion.
3. Disaster prevention benefit (savings in extra traffic cost due to detouring and road disaster restoration cost), accumulating to ₱ 33.8 billion.

Using a discount rate of 15 % which is applied in the Philippines, the following economic evaluation indicators for the whole plan are estimated to show high economic viability.

Economic Internal Rate of Return (EIRR) 23 %
Benefit/Cost Ratio (B/C) 1.68
Net Present Value (NPV) ₱ 21.4 billion

Economic evaluation of individual projects shows that out of 90 projects (as one project is scheduled for later years), 83 projects are economically justified with EIRR more than 15 %. The 7 projects with EIRR less than 15 % are mountainous road projects in the northern region. These projects are included in the plan as strategical links and to support the regional development.

In addition to the above benefits, indirect impacts of the whole plan, such as time-distance reduction, price stabilization, settlement in rural areas, etc., are evaluated and the effectiveness of the plan is verified.

RECOMMENDATIONS

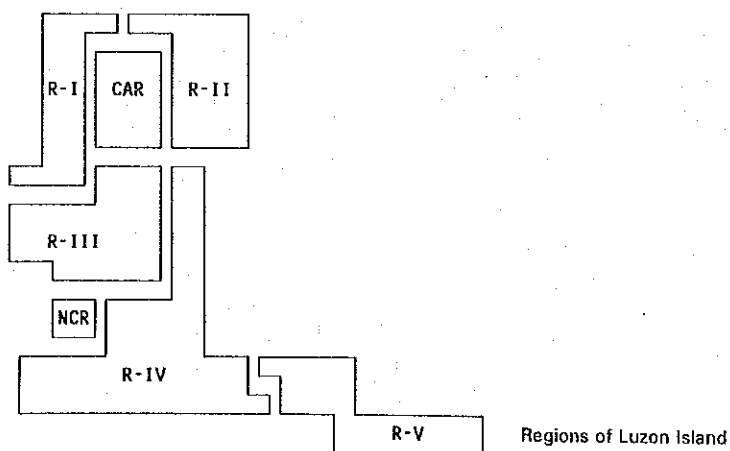
1. To establish an organization for LISR Plan management including planning, coordination and control.
2. To establish an organization exclusively for management of expressway projects, as they are presently managed by URPO (Urban Road Projects Office).
3. To apply the principle of "beneficiaries-to-pay" in order to cope with the increasing demand for road investment.
4. To develop a more efficient maintenance system by establishing a road condition rating system and criteria for applying measures based on the rating.
5. To develop a database system to handle data of road condition and traffic.
6. To early execute feasibility studies for the projects planned to be implemented in the first 6-year program, with high priority on the following projects:
 - Enrile - Lubuagan - Narvacan Road Improvement (248.7 km)
 - Cabanatuan - Baler Road Improvement (114.4 km)
 - Rosales - Sta. Fe Road Improvement (76.0 km)
 - Pan Philippine Highway Upgrading, Sta. Rita - San Jose Section (122.3 km)
 - Calamba - Tagaytay - Talisay - Lemery Road Improvement (74.5 km)
 - Malicboy - Mulanay Road Improvement (120.4 km)

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

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Photographs



1 INTRODUCTION

BACKGROUND

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.

Due to the continuous effort of the Government since early 1970's, road network was substantially improved. However, even 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.
- Due mainly to topographical constraints, north-south links are in general well developed, however, east-west links are still underdeveloped. 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 the areas with poor accessibility inspite of high development potential.
- Many major roads are seriously deteriorated as a result of initial substandard design, heavy axle loads and insufficient road maintenance efforts.
- Some roads, particularly those located near Metro Manila, suffer traffic congestion due to insufficient road capacity to meet 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.

REPORTS

The final report is organized to include the following:

- Executive Summary
- Main Text
- Appendix
- Road Inventory
- Project Profile
- Maps

2 PHYSICAL PROFILE

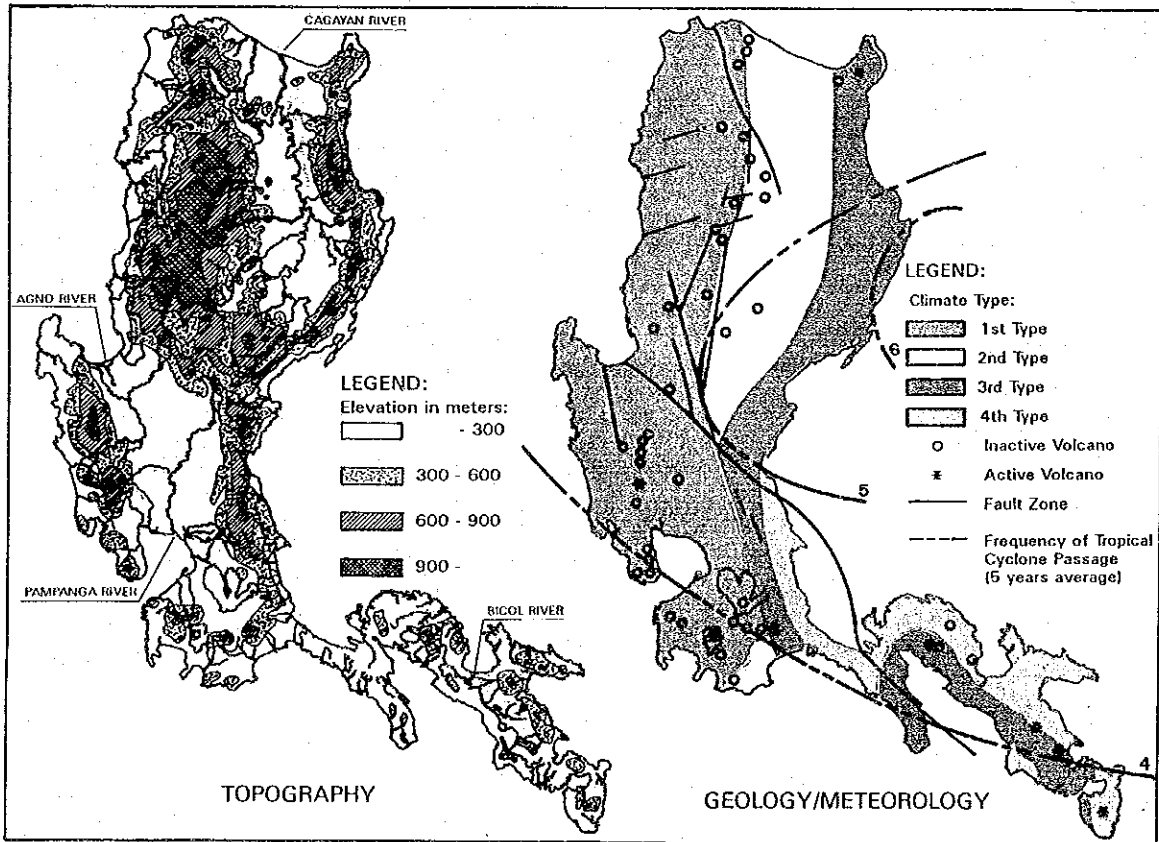
The study area is composed of 29 provinces with a total land area of 107,534 square kilometers. It is the largest island in the Philippines with lofty highlands and numerous valleys. The major lowland plains are the Central Plain of Luzon and Cagayan Valley while the major mountain ranges are the Sierra Madre, Cordillera and Caraballo Mountains. Moreover, there are also several major river basins in the island, the biggest of which is the Cagayan River.

Geologically, Luzon is bounded on both side by deep trenches composing of series of ridges and troughs generally parallel to the trenches.

The northern segment of the Philippine Fault Zone (PFZ) branches out into three major faults namely: Digdig, Lupao and San Manuel Faults. There are also plenty of volcanoes scattered all over the island, seven of them were classified as active.

Meteorologically, the climate in Luzon is classified into four (4) types: i) Type 1-Two pronounced seasons: dry from November to April, wet during the rest of the year; ii) Type 2-No dry season with a very pronounced maximum rainfall from November to January; iii) Type 3-Seasons not very pronounced, relatively dry from November to April and wet during the rest of the year and iv) Type 4-Rainfall is more or less evenly distributed throughout the year. It is also controlled by the southwest and northeast monsoon. The southwest monsoon falls from May to October bringing heavy rainfall in western Luzon. The northeast monsoon falls from November to February inducing heavy rainfall along the Sierra Madre mountain.

Weather condition, however, differs from one place to another due to the variation in topography and geography. The figure shows the topographical, geological and meteorological conditions of the study area.

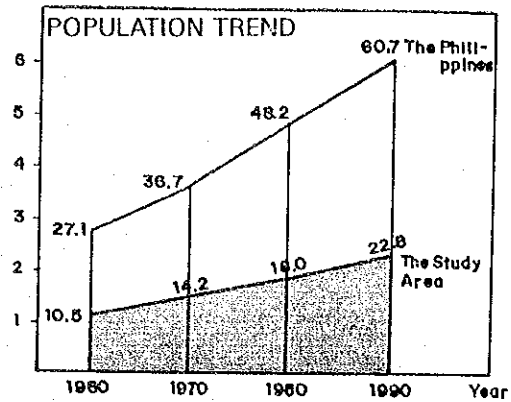


3 SOCIO-ECONOMIC PROFILE

In the decade of 1980s, Luzon Island has increased its population at 2.67% per annum, which is slightly higher than the national average of 2.3%. The 1990 census 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 a half of the national total. Two persons out of three in Luzon inhabit in the urban areas.

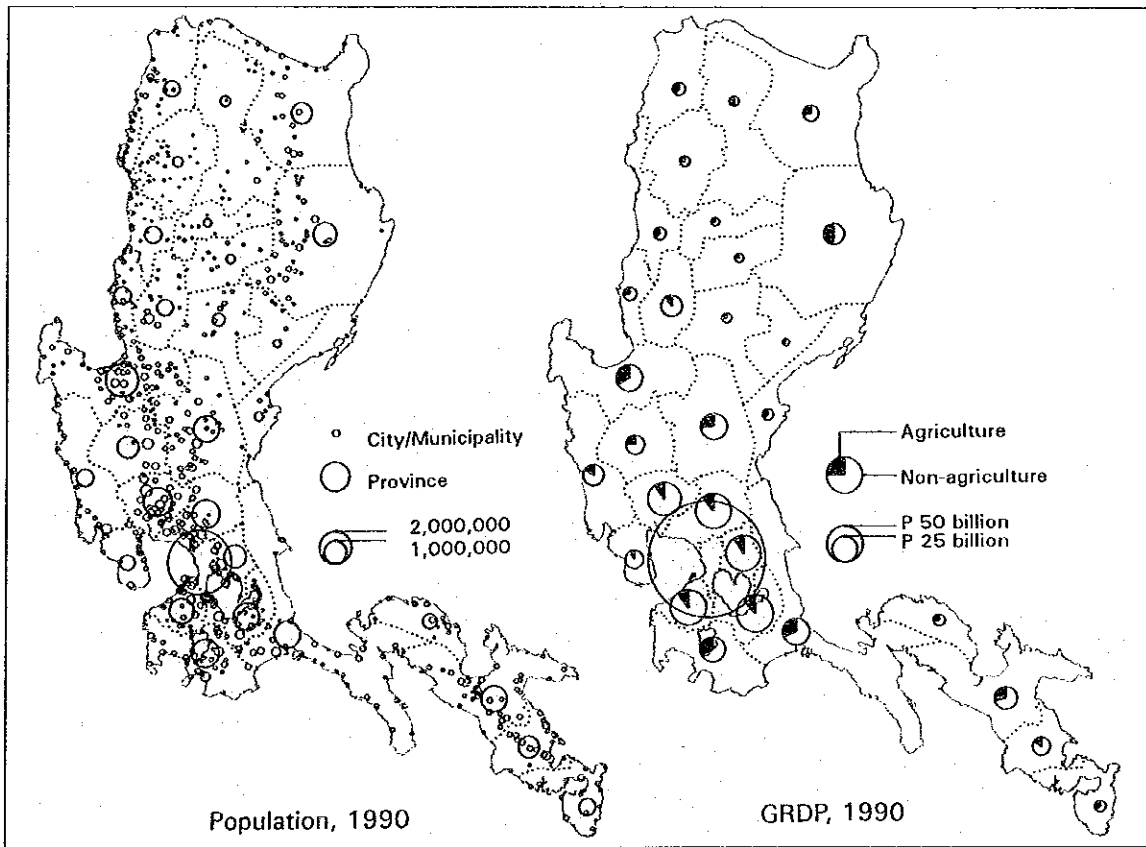
Economic activities concentrate at NCR. The GRDP of NCR was 345.9 billion pesos, 32% of GDP in 1990, while the Study Area produced 341.9 billion pesos of GRDP. Thus, the labor productivity of the Study Area is about one third of NCR's. Sectoral share is 31% in agriculture and 69% in non-agriculture in the Study Area.

Labour force in Luzon island is 13.5 million, 44% of the total population. 37% of them are engaging in agriculture, 57% in non-agriculture and 6% unemployed. In 1988, annual



average household income was estimated at 45,912 pesos at 1990 price in the Study Area, while 99,936 pesos in NCR.

Of the Study Area of 107,534 km², 48% is habitable or arable land with less than 18% of slope degrees. Actually, 54% of the total area is utilized for agricultural purpose including pasture and grassland, 35% is forestry and 11% is built-up area and idle land.



4. EXISTING ROAD NETWORK

ROAD CLASSIFICATION

The Department of Public Works and Highways (DPWH) classifies roads into the following five (5) classes:

National Roads - all roads that form part of the main trunkline system continuous in extent.

Provincial Roads - those roads connecting one municipality with another municipality.

City Roads - those roads/streets within the urban area of a city.

Municipal Roads - those roads/streets within the poblacion area of a municipality.

Barangay Roads - rural roads located either outside the urban area of a city or outside industrial, commercial or residential subdivision which act a feeder farm-to-market roads.

ROAD DISASTER

Roads in the Philippines are situated in the severe natural environment such as mountainous topography, fragile geology, heavy rain etc. and often hit by natural calamities.

Road disasters are classified into five (5) types according to location and nature of failure. Potential disaster sections of each disaster type along the surveyed roads are identified during initial disaster survey and summarized as follows:

•Cut Slope Failure	317,626 m
•Embankment Slope Failure	181,197 m
•Debris Flow	960 m
•Sour/Washout of Roadbed	1,000 m
•Flood.	57,058 m

ROAD LENGTH

As of 1990, the public road network in the study area(Luzon Island excluding NCR) has a total length of 61,385.2 km, consisting of 9,989.7 km of national, 10,480.7 km of provincial, 1,011.9 km of city, 5,015.9 km of municipal and 34,887.7 km of barangay road as shown below. 17.8% is paved with concrete or asphalt, remaining 82.2% is still unpaved.

EXISTING ROAD NETWORK

Road network in Luzon Island is basically composed of two north-south backbones (Manila North Road and Pan-Philippine Highway) and east-west laterals. Major activity centers are more or less connected by existing roads but some of them are in poor condition. In many cases, no detour road is available resulting in complete isolation of the area when road is damaged by calamity.

ROAD LENGTH BY ROAD CLASS - 1990

	National	Provincial	City	Municipal	Barangay	Total
All Philippines	26,260.5	29,156.2	3,949.4	12,819.5	88,363.0	160,548.6
Whole Luzon	9,989.7	10,480.7	1,011.9	5,015.9	34,887.7	61,385.2
excluding NCR	(16.3%)	(17.1%)	(1.6%)	(8.2%)	(56.8%)	(100%)
NCR	888.0	-	1,273.7	554.3	271.3	2,987.4
CAR	1,592.6	1,402.0	142.2	435.2	3,661.4	7,233.4
Region I	1,454.4	1,783.5	167.5	1,079.6	8,002.5	12,487.6
Region II	1,588.7	1,629.7	-	1,007.2	6,502.8	10,728.4
Region III	1,701.0	2,365.7	258.5	1,008.3	7,770.8	13,104.3
Region IV	2,284.4	1,869.9	226.1	873.6	5,447.9	10,701.1
Region V	1,368.6	1,429.9	217.6	612.0	3,502.3	7,130.4

ROAD LENGTH BY PAVEMENT TYPE - 1990

	Concrete	Asphalt	Gravel	Earth	Total
All Philippines	10,320.2	12,660.6	129,071.2	8,496.6	160,548.6
Whole Luzon	4,778.4	6,163.9	47,680.5	2,762.8	61,385.2
excluding NCR	(7.8%)	(10.0%)	(77.7%)	(4.5%)	(100%)
NCR	1,148.0	1,386.3	441.3	11.8	2,987.4
CAR	98.2	610.4	5,616.8	907.9	7,233.4
Region I	600.2	1,310.7	10,112.5	464.1	12,487.6
Region II	572.3	266.8	9,585.1	304.1	10,728.4
Region III	1,484.7	1,203.3	10,023.0	393.3	13,104.3
Region IV	1,151.3	1,890.8	7,298.8	360.9	10,701.8
Region V	871.7	881.9	5,044.3	332.5	7,130.4

Remarks: Road length of island provinces other than Luzon Island is not included.

ROAD DENSITY

Road requirement generally depends on both land area and population. Therefore, the road density defined as follows is used as an indicator to assess the adequacy of road.

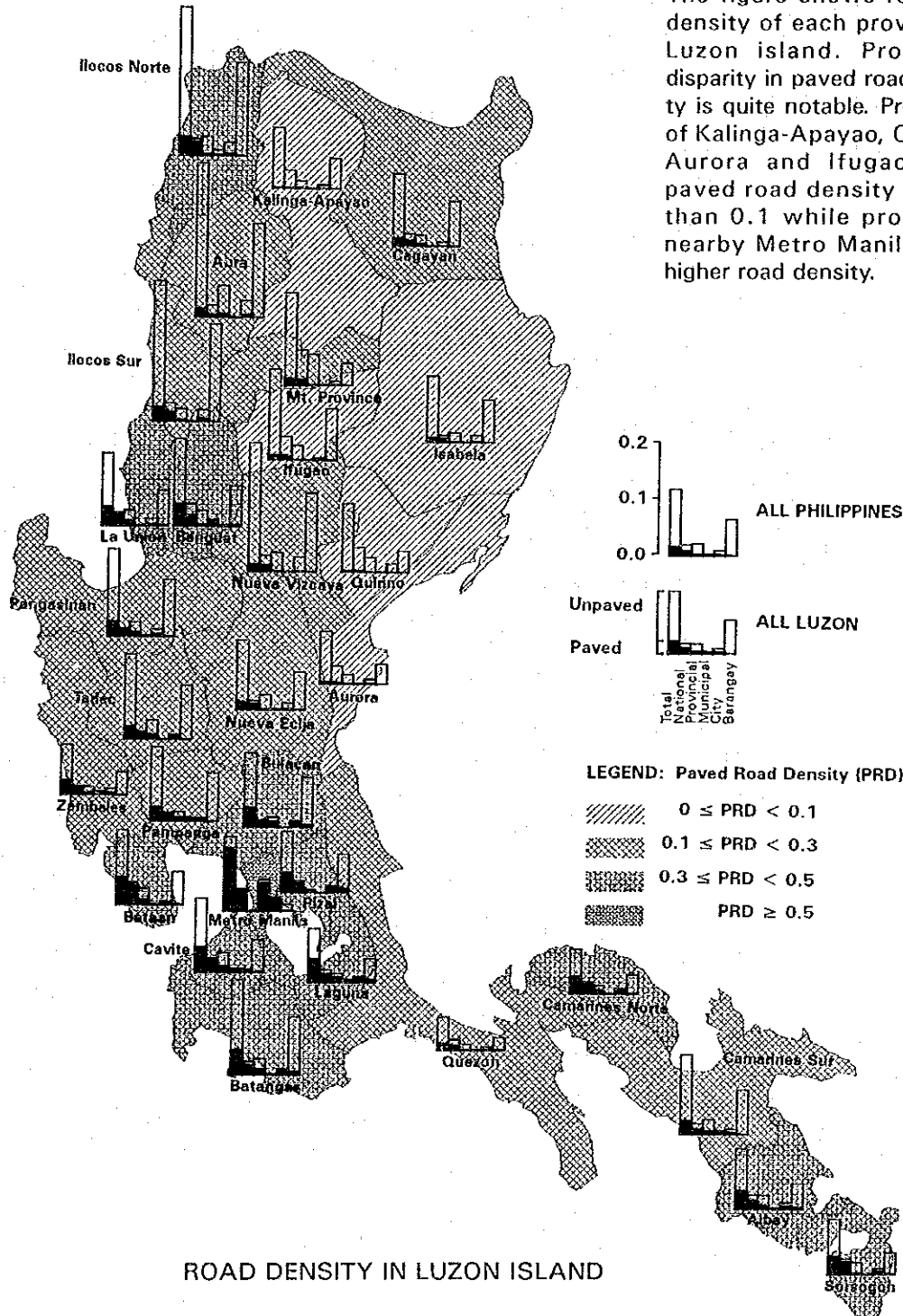
$$\text{Road Density} = L/\sqrt{PA}$$

where; L = road length in km

A = land area in km²

P = population in 1,000

The figure shows road the density of each province in Luzon island. Provincial disparity in paved road density is quite notable. Provinces of Kalinga-Apayao, Quirino, Aurora and Ifugao have paved road density of less than 0.1 while provinces nearby Metro Manila have higher road density.

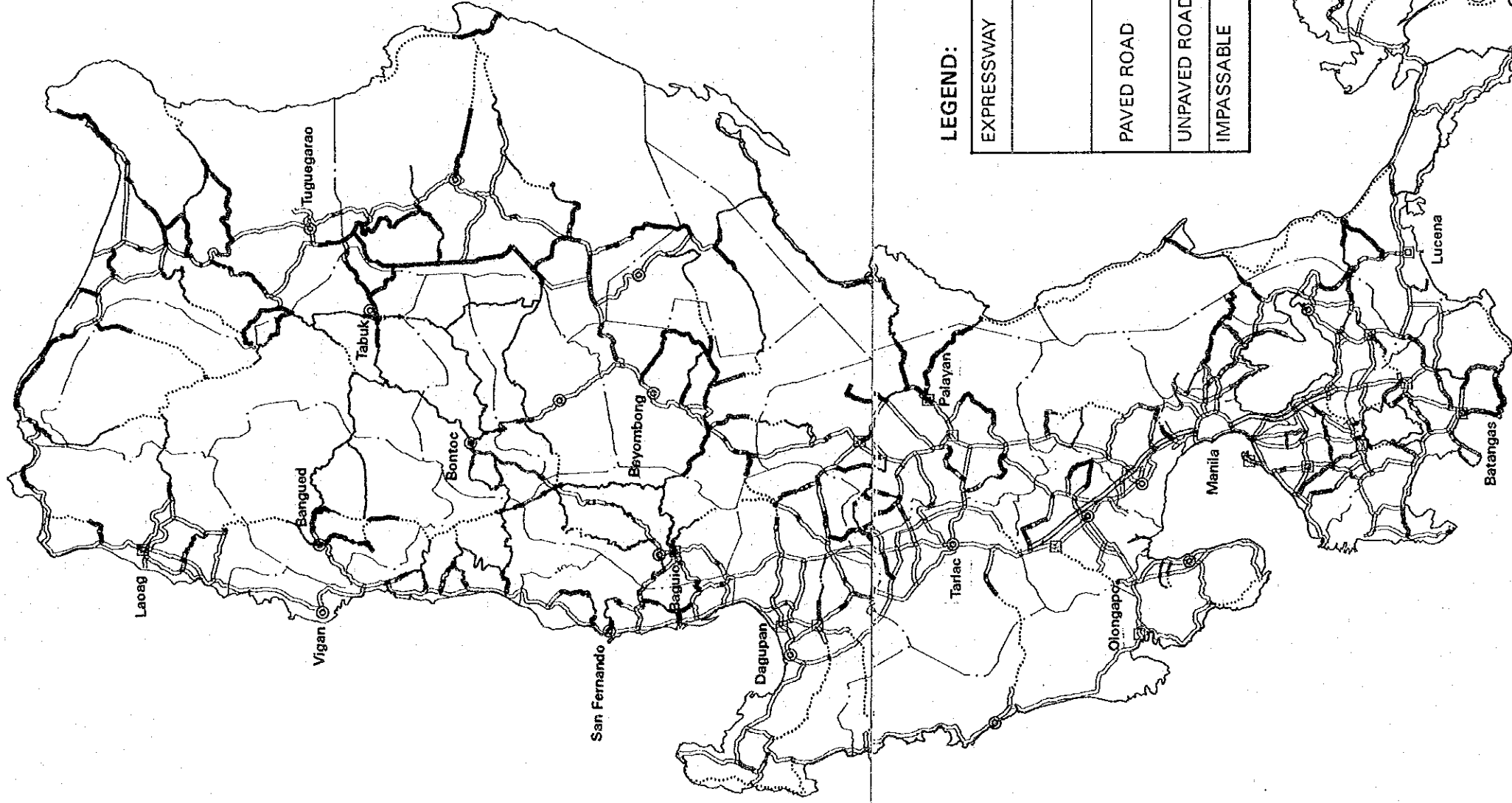


ROAD CONDITION

Road condition survey was conducted by study team over approximately 12,000 km of national roads and some provincial roads. Result of survey is illustrated in the figure.

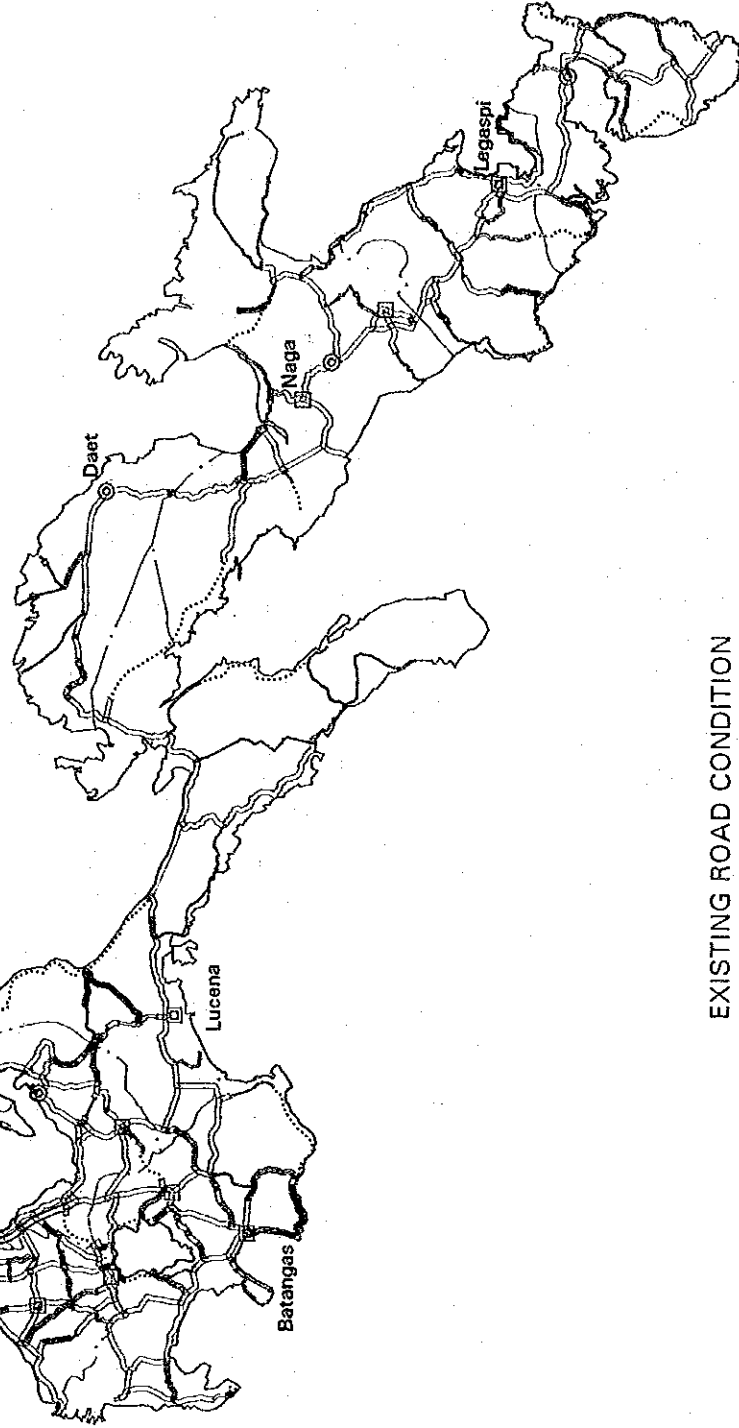
Unpaved roads and/or roads with carriageway width less than 6.0 m are mostly observed in Cordillera Region which typifies in-land provinces with mostly mountainous terrain and in provinces along eastern coast whose terrain is also mountainous.

Paved roads in good/fair condition with 6.0 m or more carriageway width are observed mainly in provinces in Central Luzon whose terrain is generally flat.



LEGEND:

EXPRESSWAY	CONDITION	WIDTH	
		W ≥ 6.0 m	W < 6.0 m
PAVED ROAD	Good/Fair	—————	—————
	Bad/Very Bad	—————	—————
UNPAVED ROAD		—————	—————
IMPASSABLE	



EXISTING ROAD CONDITION

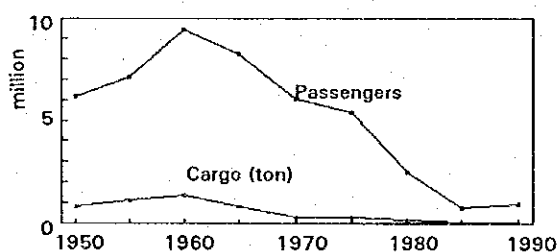
5 EXISTING TRANSPORT FACILITIES

Estimations of different transport mode shares in the total movement of commodities and passengers in the Philippine show that the road transport has the highest share comparing with other modes of water, air and rail.

TRANSPORT MODE SHARES (%)

Mode	1980		1987	
	Ton-km	Pax-km	Ton-km	Pax-km
Road	65	90	53	89
Water	35	7	47	9
Air	-	2	-	2
Rail	-	1	-	-

Statistical component of the rail transport, which is existing only in the Luzon Island, does not show significant share comparing with other transport modes. At present, and due to the damage and deteriorated condition of the tracks, the Main Line North (266 km) is temporarily closed for long distance operation. The Main Line South (479 km) is the only operated long distance railway line with regular service of three daily passenger trains between Metro Manila and Albay Province. Trend of passenger and cargo data shows continuous declining over the last 30 years.



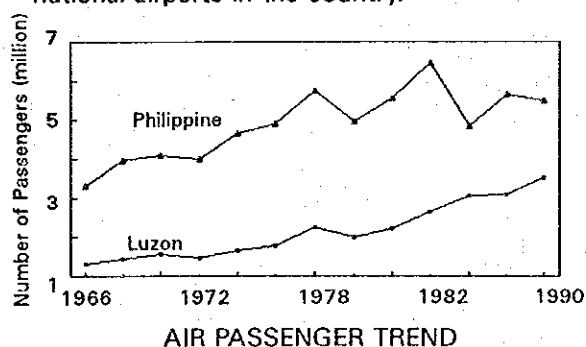
RAIL PASSENGERS AND CARGO (1950-1990)

Sea transport has the second highest share in the Philippine specially for the cargo movement, however, intra-island coastwise traffic is almost non-existing and there are no regular shipping routes connecting ports together in Luzon Island. Ports in the island handle a few of the intra-island cargo shipments but their main activities are to handle inter-island domestic and international cargo. The island has 2 Port District Offices (PDOs), out of 5 in the country, 5 base ports, 11 terminal ports and 15 municipal ports.

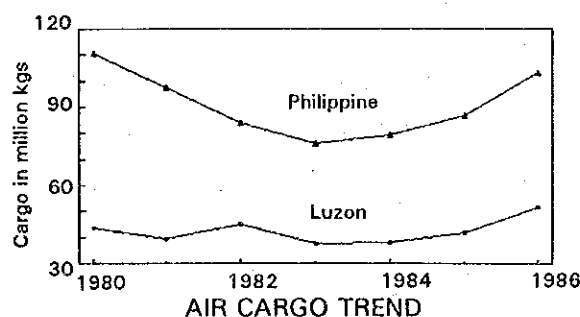
SEA CARGO MOVEMENT - 1990 (Ton)

Port	Inward		Outward		Total
	Domestic	Foreign	Domestic	Foreign	
1. Base Ports					
Batangas	528122	113275	382590	3533	1027520
Legaspi	202957	-	30939	-	233896
San Fernando	83396	263509	1388	-	348293
Manila N	1165659	-	368983	-	1534642
Manila S	1448	2220688	-	75707	2297843
2. Terminal Ports					
Siain	4188	-	279	-	4467
Bulan	8320	-	26741	-	35061
Matnog	295300	-	302291	-	597591
Pasacao	8470	-	2498	-	10968
Tabaco	55967	-	45351	-	101318
Aparri	8	-	235	-	243
Irene	28647	-	54928	-	83575

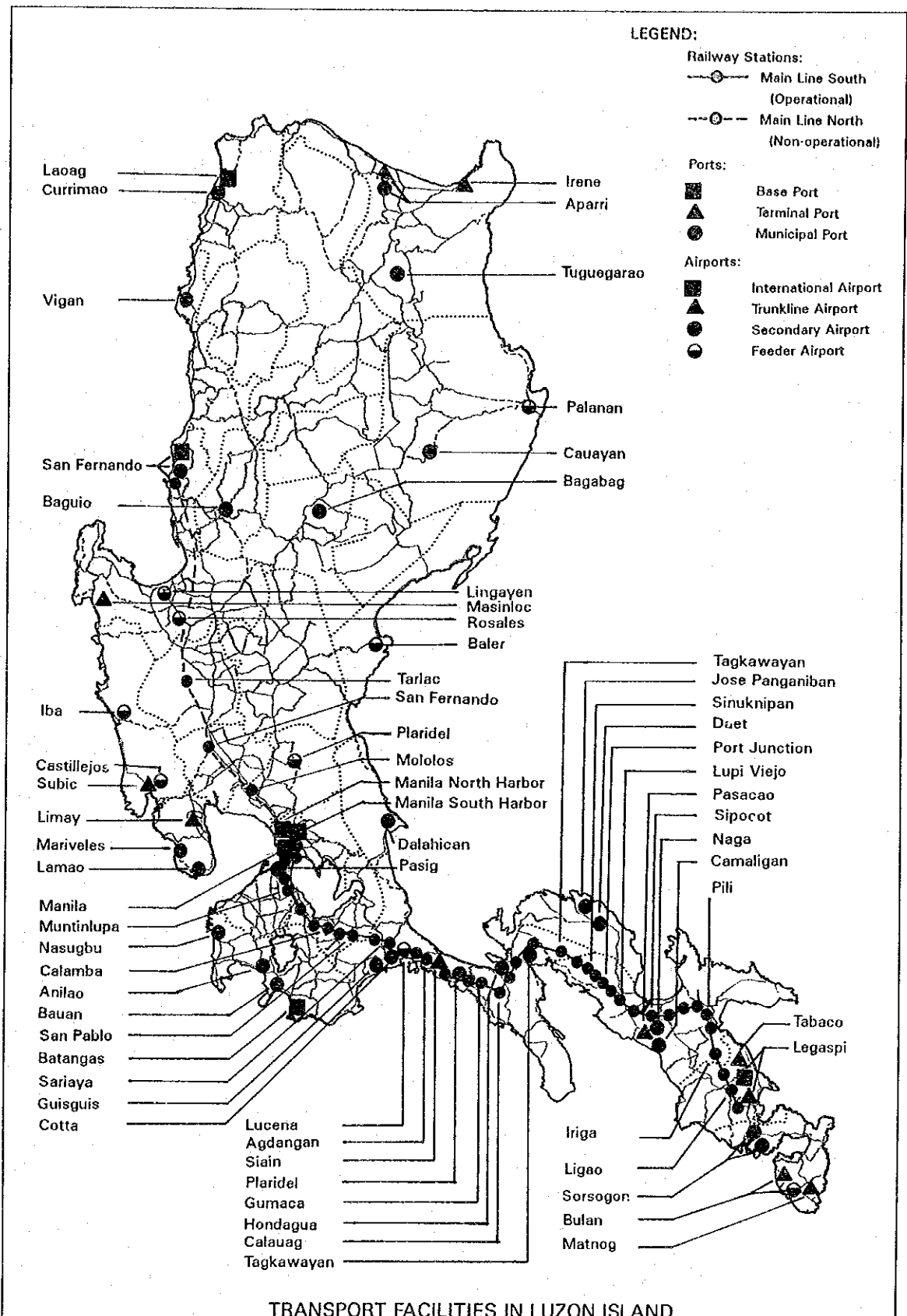
As for the air transport mode, the number of total domestic air passengers in the Philippines has increased steadily for the past 25 years with an average annual growth rate of about 2% for the whole country and 4% for Luzon Island. The growth trend is expected to continue with steady increase in the future due to the geographical nature and growth in socioeconomics. Growth in cargo movement is not significant with agricultural products and printed matters as the main commodities. The island has 22 national airports out of 87 national airports in the country.



AIR PASSENGER TREND



AIR CARGO TREND

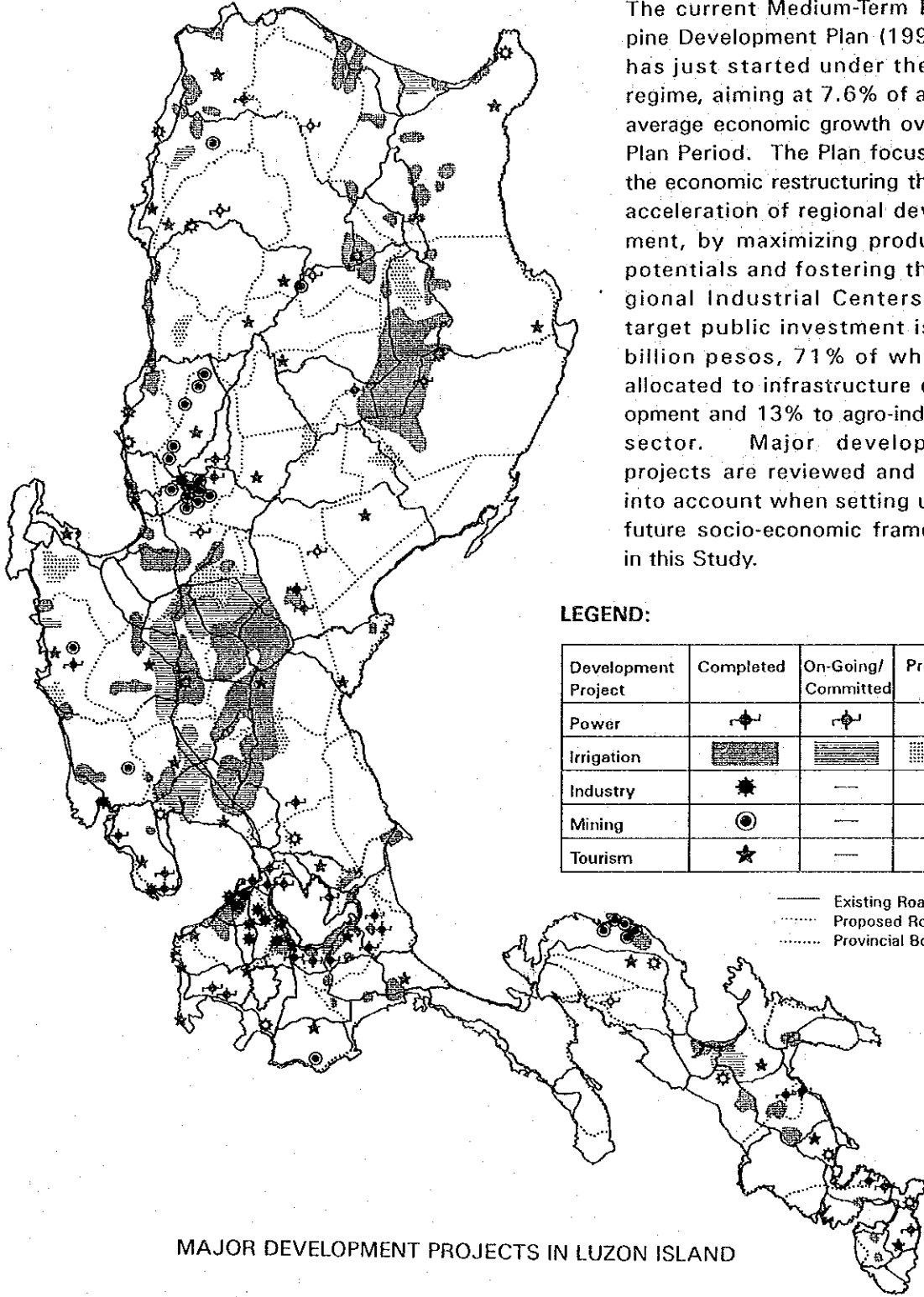


TRANSPORT FACILITIES IN LUZON ISLAND

6 REGIONAL DEVELOPMENT PLAN AND FUTURE SOCIO-ECONOMIC FRAMEWORK

DEVELOPMENT PLAN

The current Medium-Term Philippine Development Plan (1993-98) has just started under the new regime, aiming at 7.6% of annual average economic growth over the Plan Period. The Plan focuses on the economic restructuring through acceleration of regional development, by maximizing production potentials and fostering the Regional Industrial Centers. The target public investment is 772 billion pesos, 71% of which is allocated to infrastructure development and 13% to agro-industrial sector. Major development projects are reviewed and taken into account when setting up the future socio-economic framework in this Study.



LEGEND:

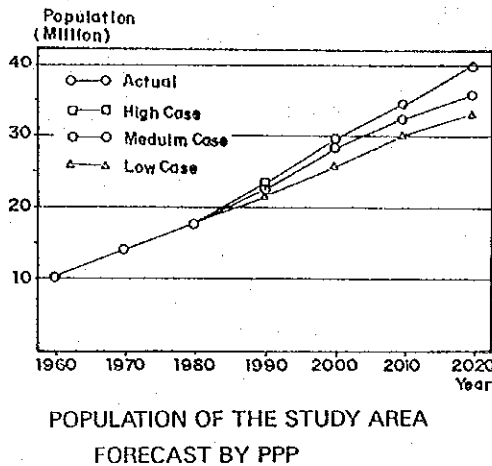
Development Project	Completed	On-Going/ Committed	Proposed
Power	⊕	⊕	⊕
Irrigation	▨	▨	▨
Industry	⊛	—	⊛
Mining	⊙	—	—
Tourism	★	—	—

— Existing Roads
 Proposed Roads
 Provincial Boundary

MAJOR DEVELOPMENT PROJECTS IN LUZON ISLAND

DEMOGRAPHIC FRAMEWORK

Long-term population projection (1990-2030) made by NCSO in 1985 was used as the demographic framework, with modification based on the 1990 census result. Adopting the medium case, the population of the Study Area will increase 1.6 times from 22.8 million in 1990 to 36.6 million in 2020.

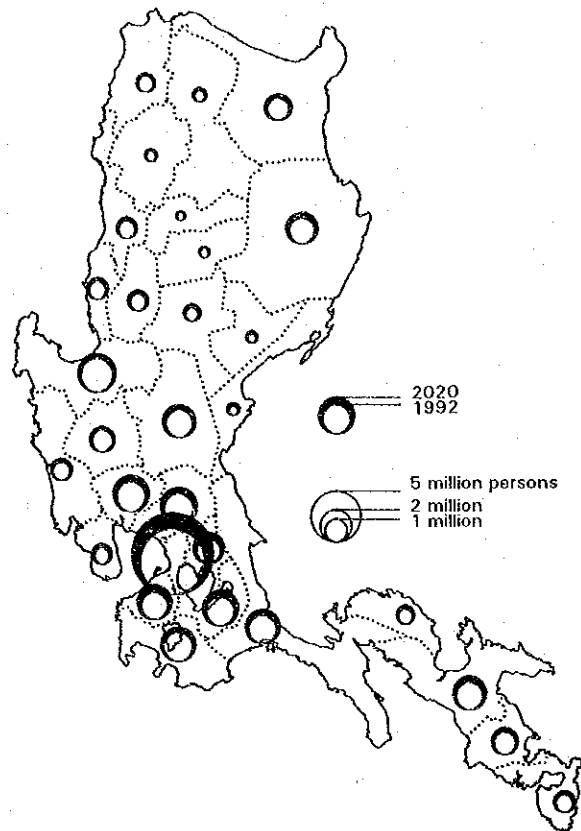


In the same period, NCR population will also increase at the same rate, which means that the number of migrants from the Study Area to NCR would decrease in the future, due to the effort of regional development.

Both of fertility and mortality are forecast to become lower in the future, which will lower the dependent population rate (productive-age population = 100) from present 77 to 44 in the year 2020.

ECONOMIC FRAMEWORK

In accordance with the balanced regional development concept of the MTPDP, target economic growth rates are set up, so as to lessen the regional disparities, at the present NCR level for CAR, Region III and IV, and at the present Luzon average for Region I, II and V. To attain this, regional economy needs to grow at 4.1 to 5.1% per annum and GRDP per capita will become 2.5 times as much as the present in 2020.



As the result of urbanization continuously taking place in Luzon Island, the urban population rate will rise from 65% at present up to 77% in 2020.

Economic Growth Target, 1990-2020 (million ₱ at 1990 price)

Region	Growth Rate (% p.a.)	GRDP per capita		GRDP	
		1990	2020	1990	2020
NCR	4.61	43,600	108,100	354,841	1,371,514
CAR	4.94	15,500	43,600	17,843	75,809
I	4.17	8,700	20,600	31,025	105,680
II	4.60	8,700	20,600	20,392	78,509
III	5.11	15,200	43,600	94,156	419,926
IV	4.77	17,900	43,600	147,599	597,302
V	4.83	7,900	20,600	30,875	127,103
Total	-	-	-	696,731	2,775,843
Average	4.72	22,600	56,300	-	-

7 PRESENT TRAFFIC

To develop a strategic master plan for the road network in Luzon Island, information on present traffic characteristics are required. Data of roadside OD and traffic count surveys are collected and analysis as follows.

VEHICLE COMPOSITION

In the vehicle composition, car/taxi/jeep category has the highest share of 32%, followed by pick-up/van 27%. Buses and trucks as the heavy vehicles have a share of 24%. Commodities by tonnage are nearly distributed between construction materials, agricultural products and manufactures. As for trip purpose, private trips form about two-thirds, being the main purpose for light passenger vehicles.

Road condition has a big influence on vehicular composition. Jeepney passengers have high share on bad roads while bus passengers share increases with better road conditions. Trucks have higher share than other vehicles in handling commodities on fair and good condition roads.

PAYLOAD AND OCCUPANCY

Commodity vehicles have an average payload of about 56% of capacity with a high empty ratio of 64% which indicates their inefficient performance and management. The average occupancy rate of passenger vehicles is 26% which is also considered as a low rate.

COMMODITY VEHICLE CHARACTERISTICS

Vehicle Category	Average Capacity	Average Payload	Empty Vehicles
Pick-up/Van	3.4 ton	0.9 ton	73.2 %
2-axle	7.1	5.5	53.4
3-axle	11.6	14.4	48.3
4- or more axle	19.6	18.1	38.1
Average	10.8	6.0	63.9

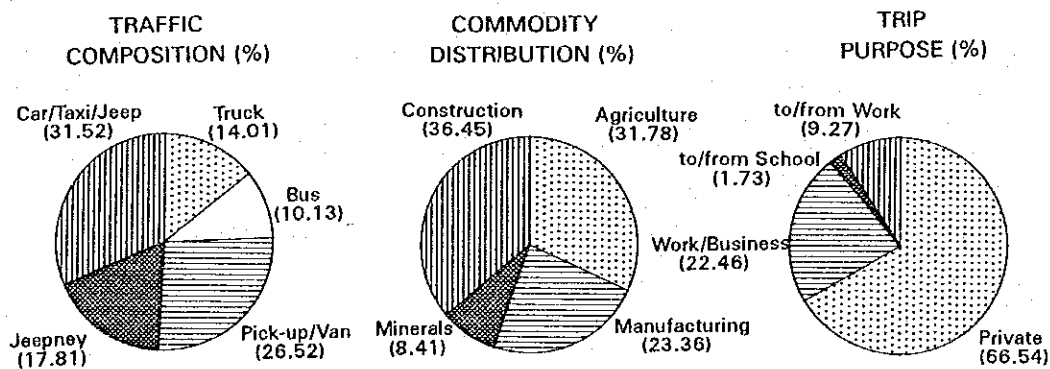
PASSENGER VEHICLE CHARACTERISTICS

Vehicle Category	Average Capacity	Average Occupancy
Car/Taxi/Jeep	3.96	2.63 person
Jeepney	18.61	11.66
Pick-up/Van	12.79	3.59
Mini Bus	36.68	19.59
Large Bus	54.72	38.31
Average	35.24	9.14

TRIP PATTERN

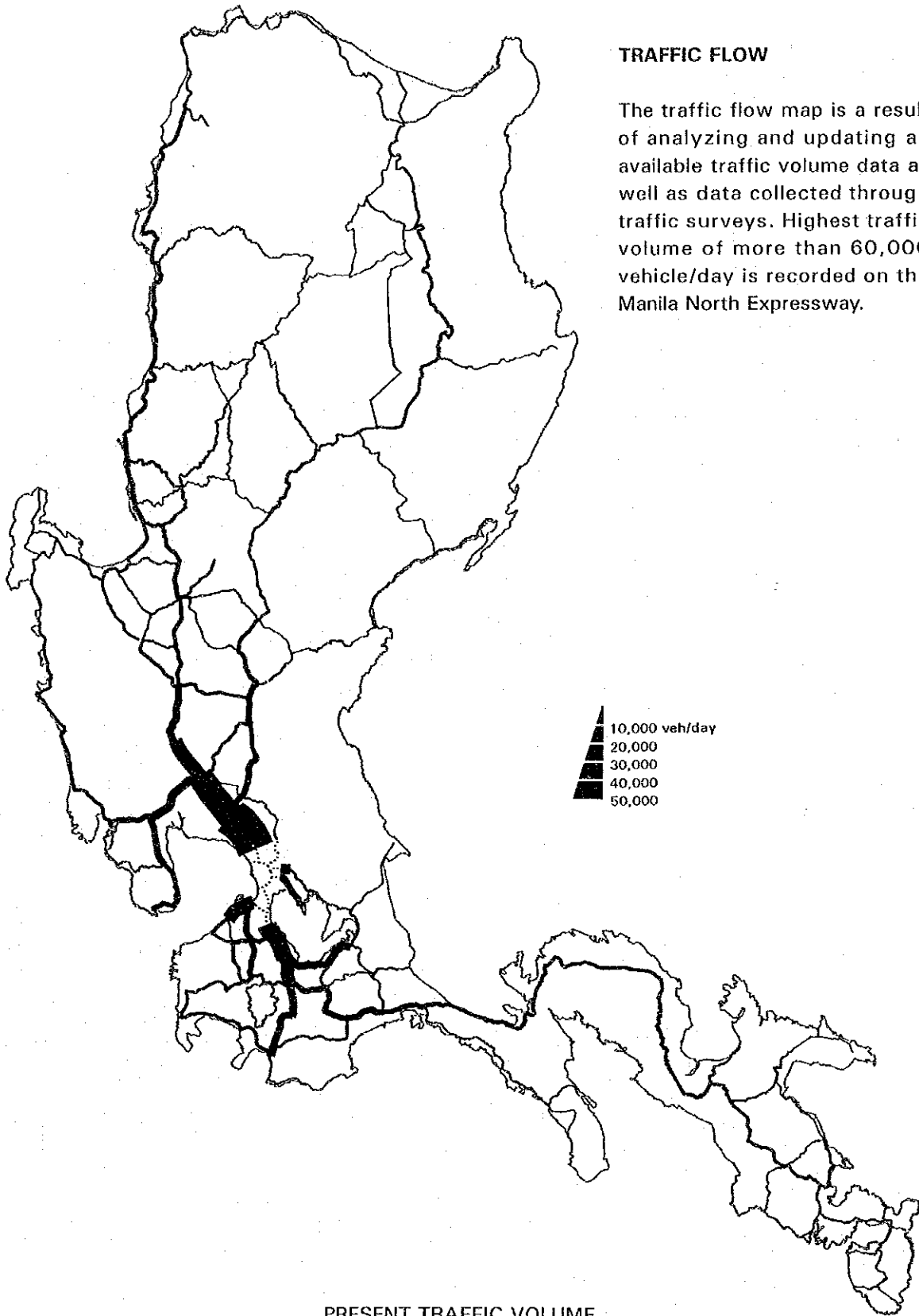
Present provincial OD tables for the movement of commodities show that Manila is the main trip attractor. Bulacan and Cagayan are the main trip generators for agricultural products, Manila and Pampanga for manufacturing products, Batangas for mineral products, and Rizal for construction materials. For passengers movement, Manila is the biggest attractor/generator followed by Cavite then Pampanga, and for vehicles movement, Manila is followed by Pampanga then Cavite.

Regionally, the highest interaction of all kinds of trips is between Manila and Region IV then Region III. Significant numbers of trips are shown between Regions I and III in the north, and between Regions IV and V in the south.



TRAFFIC FLOW

The traffic flow map is a result of analyzing and updating all available traffic volume data as well as data collected through traffic surveys. Highest traffic volume of more than 60,000 vehicle/day is recorded on the Manila North Expressway.

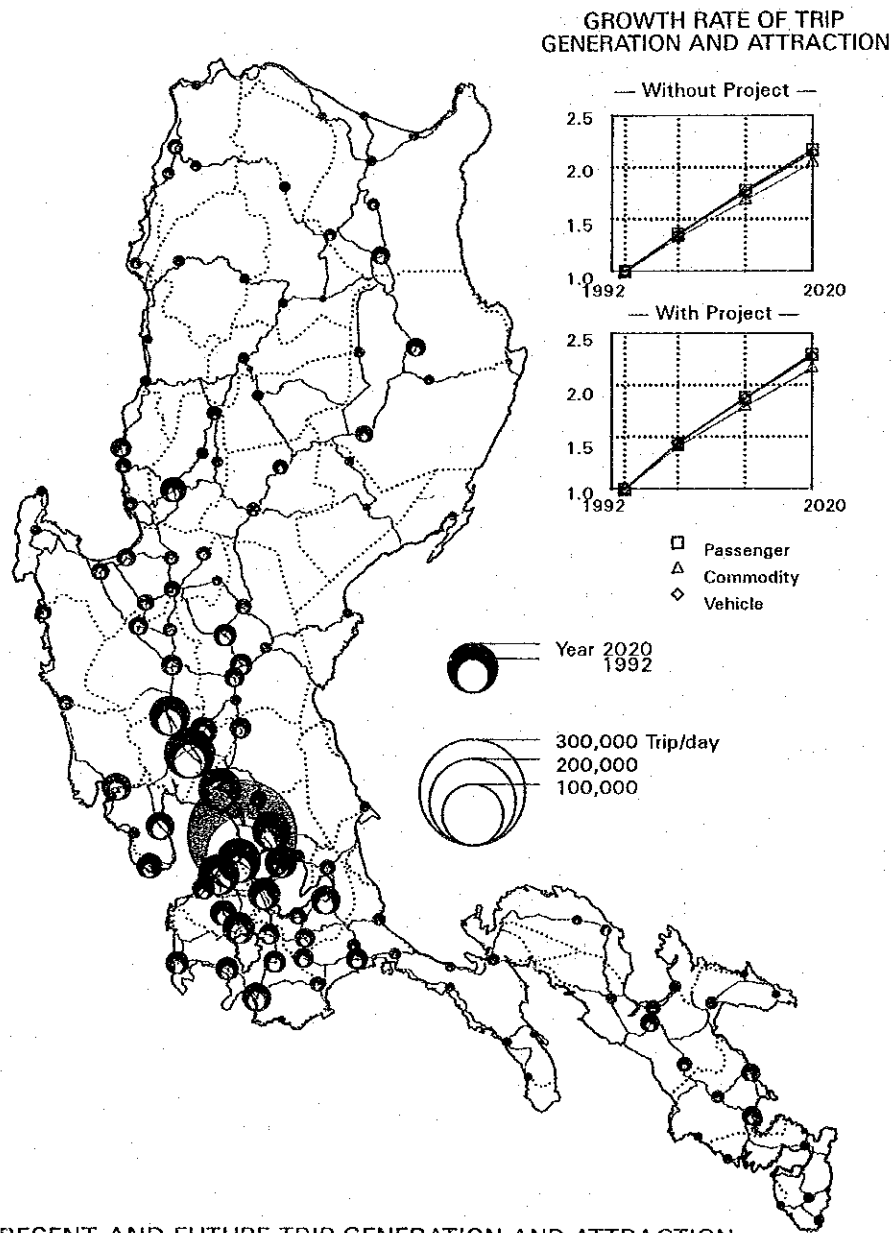


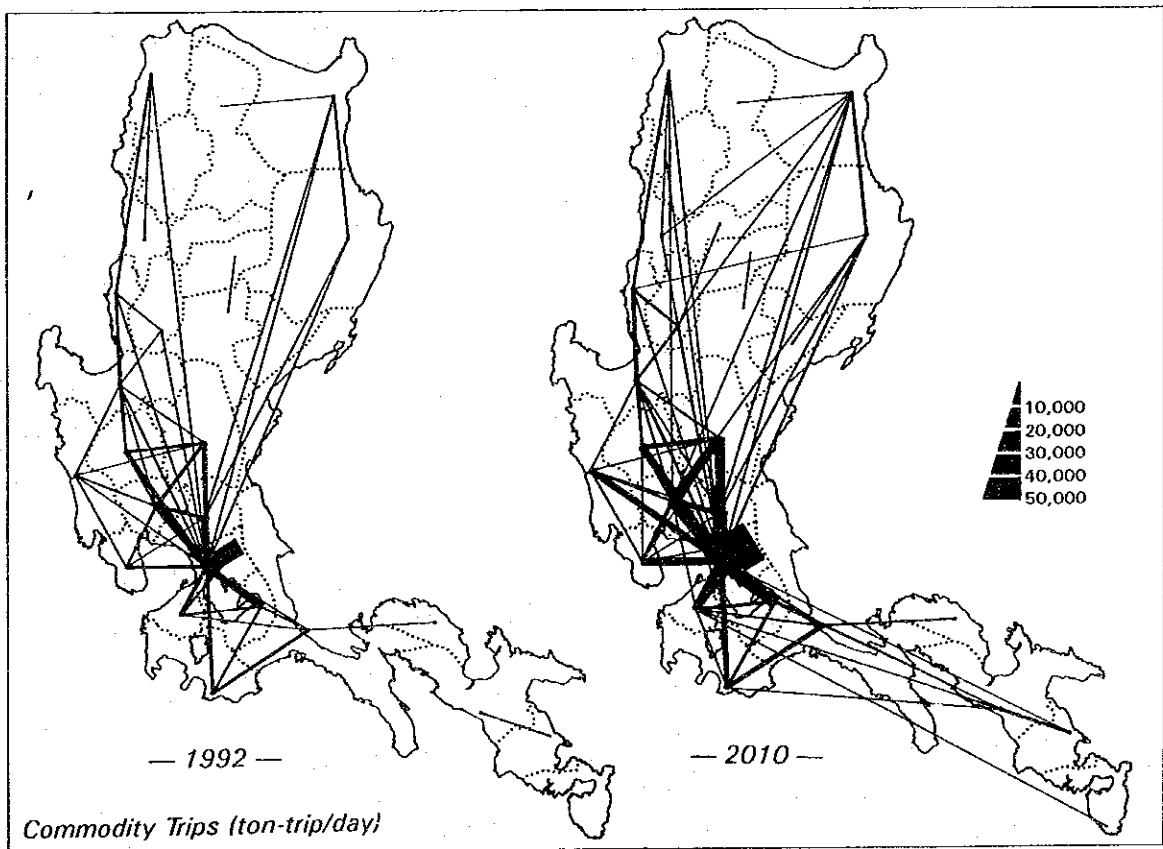
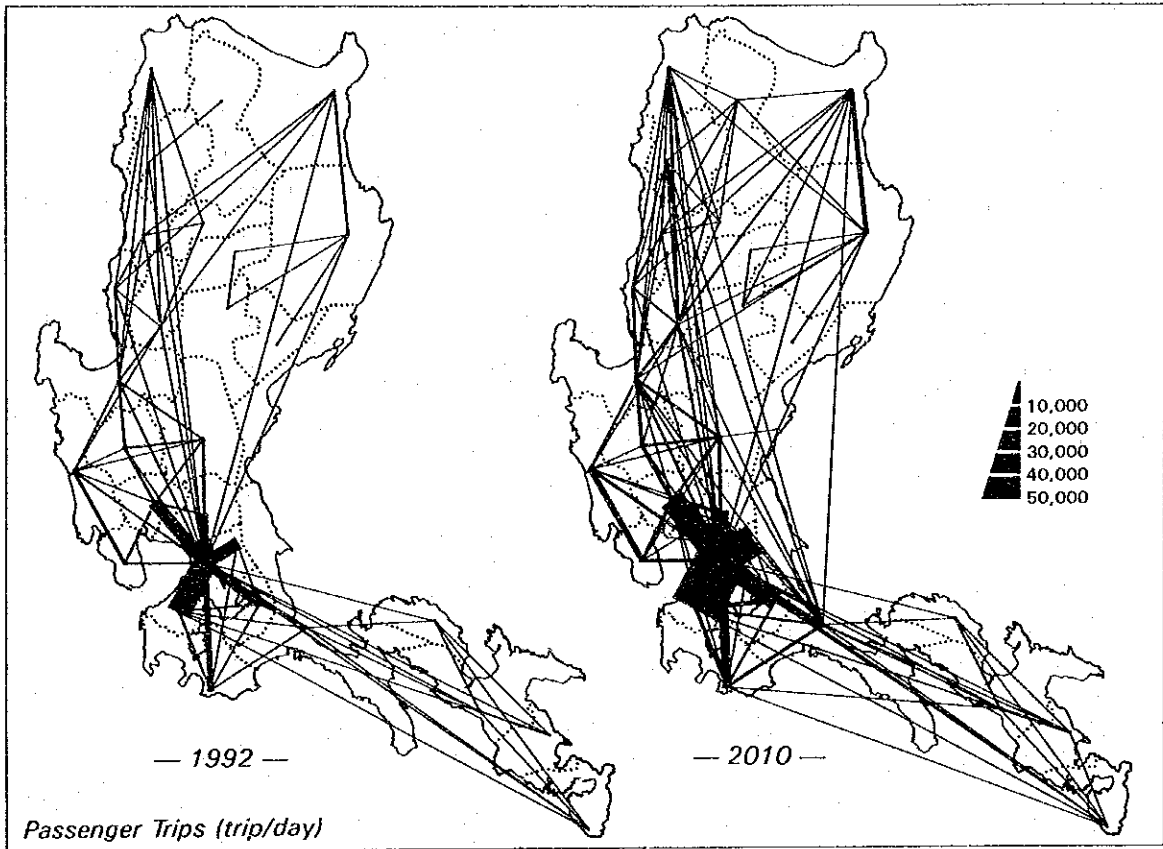
PRESENT TRAFFIC VOLUME

8 FUTURE TRAFFIC DEMAND

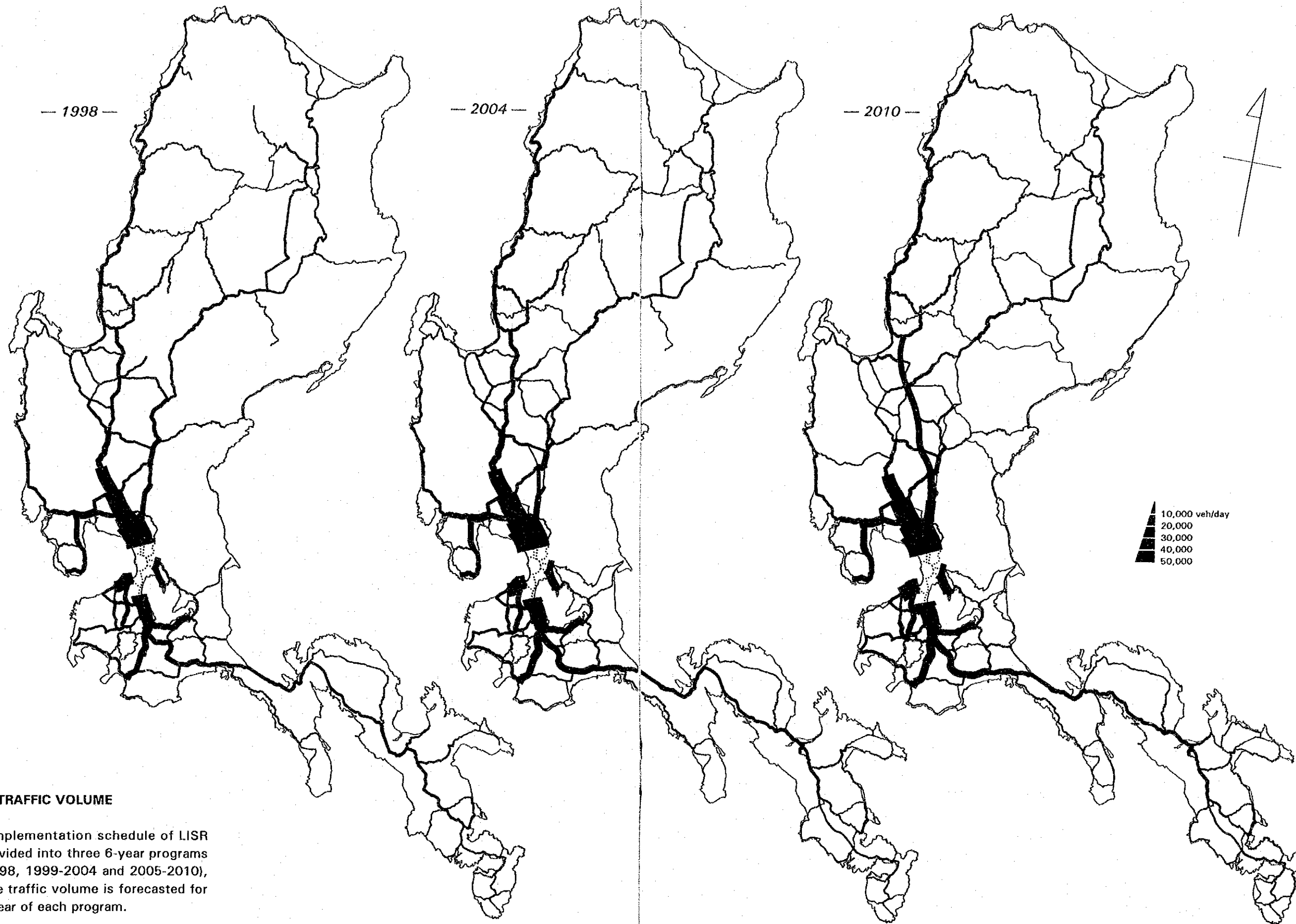
Based on the present traffic pattern and future socio-economic framework, future trip generation and attraction for vehicles is estimated to have a growth rate of 2.3 up to 2020. NCR, and provinces in Regions III and IV are the most trip generators and attractors. Regions II and V have high potential specially for commodity trips.

Per population, Cavite is expected to have the highest rate of passenger trip generation, and is followed by Bataan. For future commodity trips, Manila will remain as the main trip attractor but the second to Rizal as trip generator. For future vehicle trips, Cavite and Pampanga have the highest share after Metro Manila.





PRESENT AND FUTURE DESIRE-LINE CHART



FUTURE TRAFFIC VOLUME

As the implementation schedule of LISR Plan is divided into three 6-year programs (1993-1998, 1999-2004 and 2005-2010), the future traffic volume is forecasted for the last year of each program.

9 PROPOSED LISR NETWORK

Basic LISR Network is a skeleton network which interconnects important regional centers and covers the areas of importance for balanced regional development. **LISR Network** is a major road network which includes upgrading of a part of roads and

additional roads to reinforce the basic LISR network. Basic LISR network can be considered as a skeleton showing the routes, and LISR network is a concrete network proposed in this Study to be developed.

OBJECTIVES OF LISR NETWORK DEVELOPMENT

- To enlarge and reinforce the physical foundation of the regional economy;
- To promote the regional development in the areas where sound development is presently restrained due to poor accessibility;
- To promote the effective use of land and contribute to unity of nation and preservation of peace;
- To minimize the disturbance to people's activity and economic loss in case of closure of road due to disaster.

BASIC LISR NETWORK

Basic LISR network is composed of the following four categories of roads:

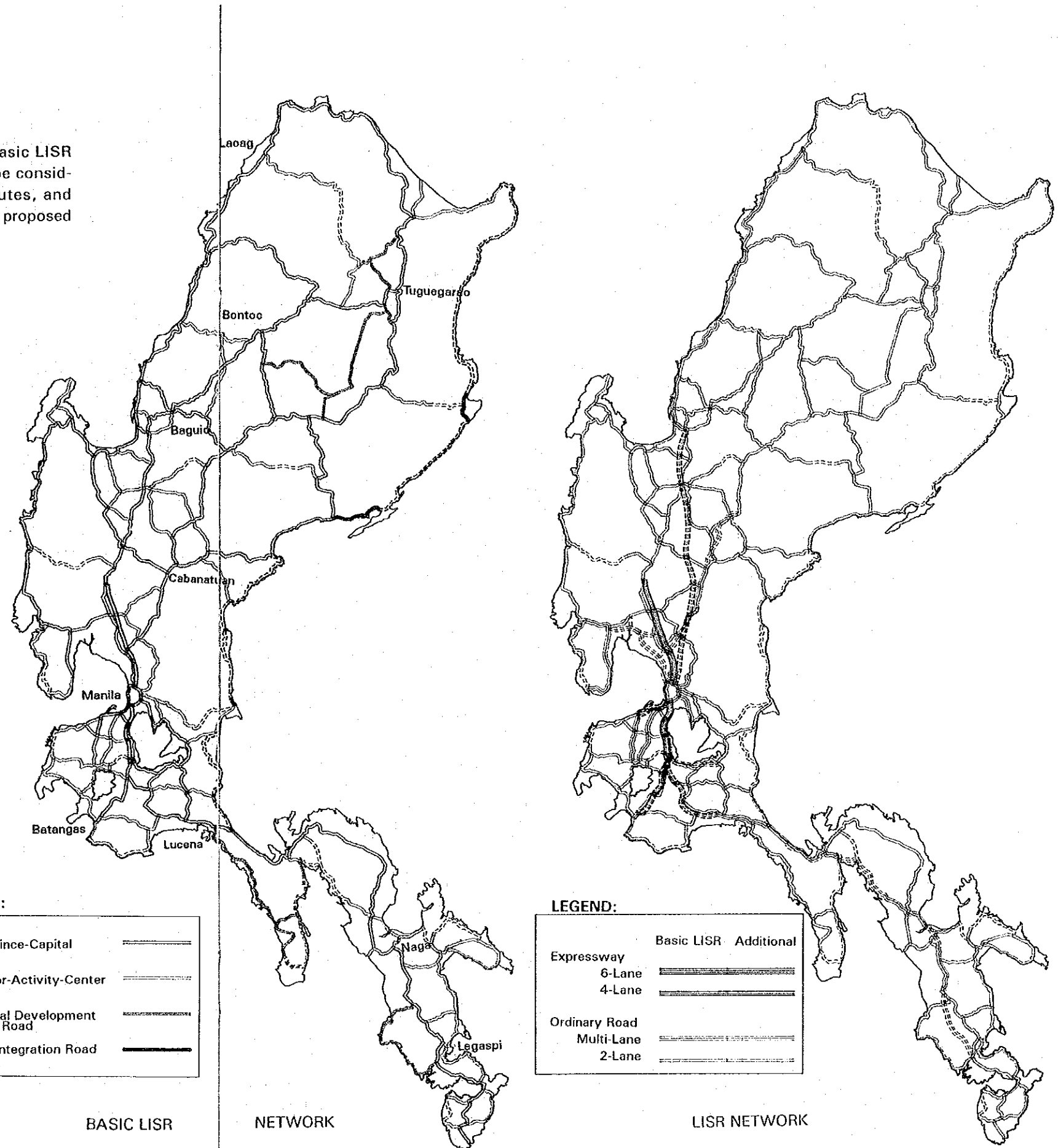
- **Inter-Province-Capital Roads** which interconnect provincial capitals through the shortest routes as possible.
- **Inter-Major-Activity-Center Roads** which connect the major activity centers to the inter-province-capital roads.
- **Agricultural Development Support Roads** which penetrate vast agricultural areas not covered by the above two categories of roads.
- **National Integration Roads** which run along the coasts which are not covered by the above three categories of roads over a wide area.

LISR NETWORK

LISR network is established by reinforcing the basic LISR network to secure substitutive roads in case of occurrence of disaster and to increase traffic capacity of congested sections. The LISR network is composed of the following roads:

	(km)		
	Existing Road	Non-existing Road	Total
2-lane Road	6,865.2	636.7	7,501.9
4-lane Road	764.9	380.9	1,145.8
4-lane Expressway	21.7	311.3	333.0
6-lane Expressway	109.8	0.0	109.8
Total	7,761.6	1,328.9	9,090.5

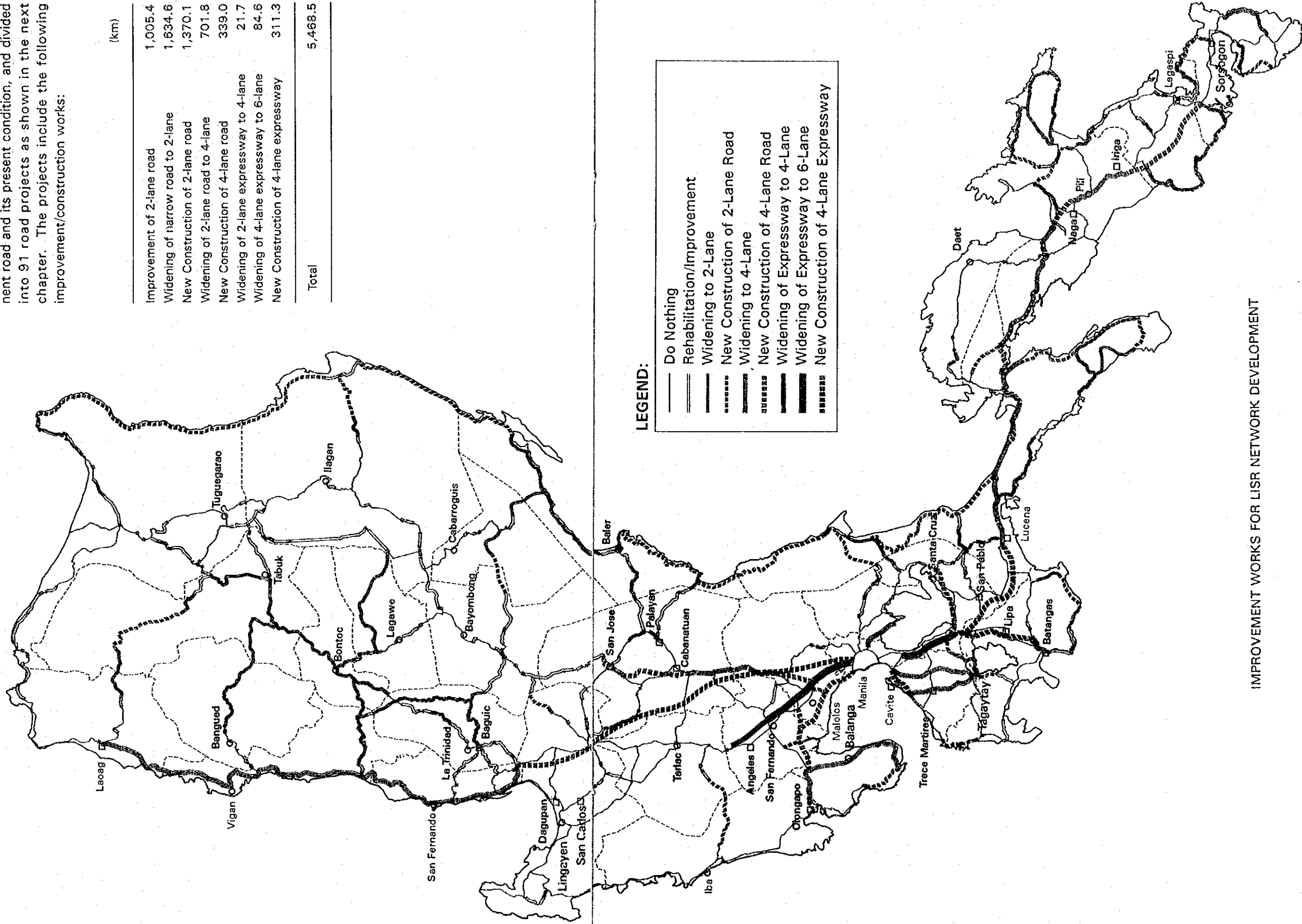
Note: Existing roads include narrow/impassable roads to be widened/reconstructed.



10 LISR NETWORK DEVELOPMENT PLAN

Road improvement/construction works necessary to complete the LISR network were identified depending on target grade of each component road and its present condition, and divided into 91 road projects as shown in the next chapter. The projects include the following improvement/construction works:

	(km)
Improvement of 2-lane road	1,005.4
Widening of narrow road to 2-lane	1,634.6
New Construction of 2-lane road	1,370.1
Widening of 2-lane road to 4-lane	701.8
New Construction of 4-lane road	339.0
Widening of 2-lane expressway to 4-lane	21.7
Widening of 4-lane expressway to 6-lane	84.6
New Construction of 4-lane expressway	311.3
Total	5,468.5



LEGEND:

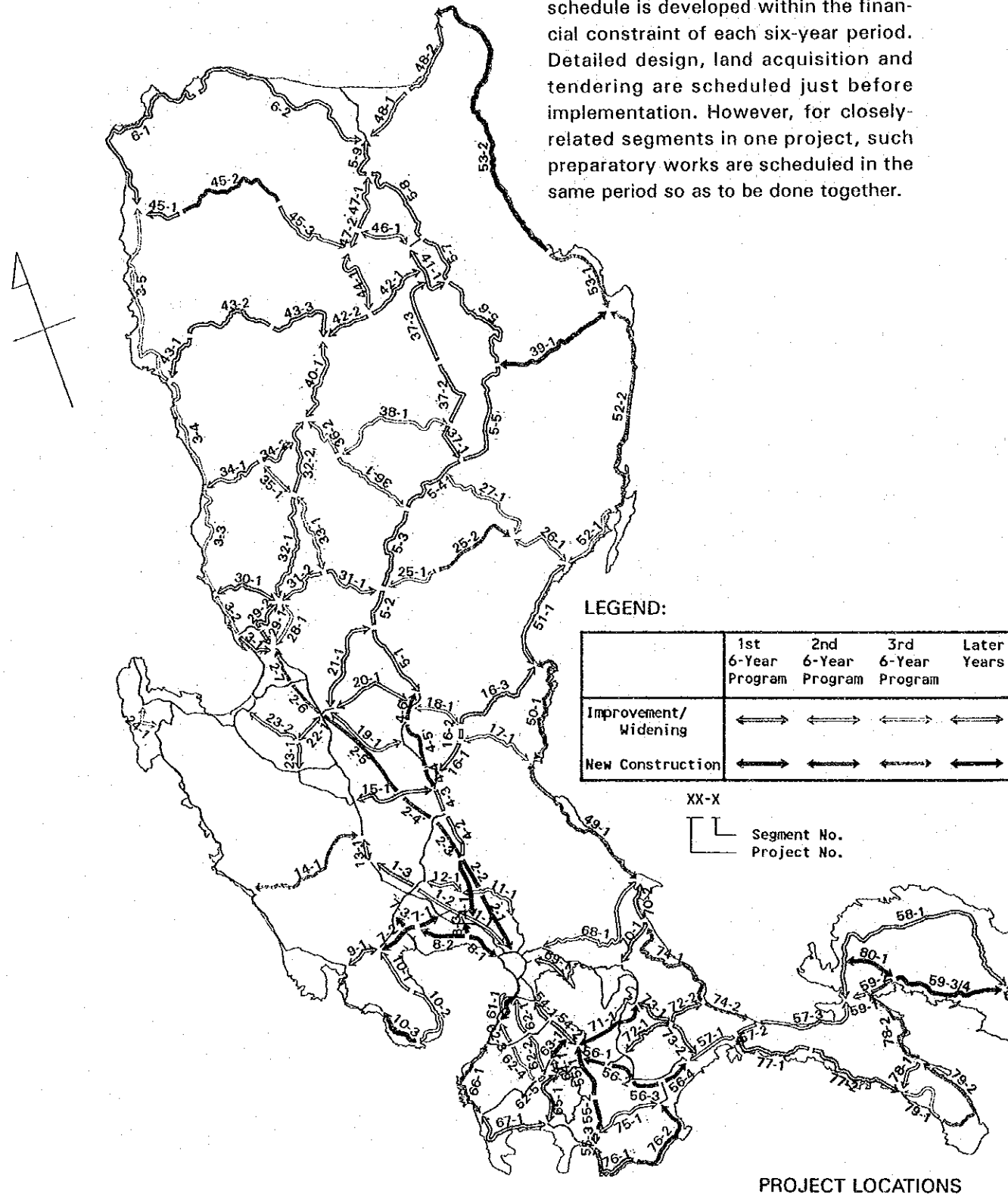
- Do Nothing
- Rehabilitation/Improvement
- Widening to 2-Lane
- New Construction of 2-Lane Road
- Widening to 4-Lane
- New Construction of 4-Lane Road
- Widening of Expressway to 4-Lane
- Widening of Expressway to 6-Lane
- New Construction of 4-Lane Expressway

IMPROVEMENT WORKS FOR LISR NETWORK DEVELOPMENT

11 IMPLEMENTATION SCHEDULE

The identified projects are prioritized by segments, taking into account such factors

as their roles and functions, present status, economic efficiency, regional balance, etc., and the implementation schedule is developed within the financial constraint of each six-year period. Detailed design, land acquisition and tendering are scheduled just before implementation. However, for closely-related segments in one project, such preparatory works are scheduled in the same period so as to be done together.



Project	Cost P million	1st 6-Year Program 1993 - 1998	2nd 6-Year Program 1999 - 2004	3rd 6-Year Program 2005 - 2010
1	3545.3	■■■■■■	■■■■■■	
2	12016.8	■■■■■■	■■■■■■	
3	7055.5	■■■■■■	■■■■■■	
4	3465.2	■■■■■■	■■■■■■	
5	1275.1	■■■■■■	■■■■■■	
6	547.0	■■■■■■	■■■■■■	
7	2856.9	■■■■■■	■■■■■■	
8	18495.2		(Later Years)	
9	886.4	■■■■■■	■■■■■■	
10	1996.1	■■■■■■	■■■■■■	
11	52.0	■■■■■■	■■■■■■	
12	60.6	■■■■■■	■■■■■■	
13	78.5	■■■■■■	■■■■■■	
14	808.4	■■■■■■	■■■■■■	
15	36.4	■■■■■■	■■■■■■	
16	1087.6	■■■■■■	■■■■■■	
17	387.1	■■■■■■	■■■■■■	
18	430.2	■■■■■■	■■■■■■	
19	125.9	■■■■■■	■■■■■■	
20	57.3	■■■■■■	■■■■■■	
21	782.8	■■■■■■	■■■■■■	
22	72.9	■■■■■■	■■■■■■	
23	57.0	■■■■■■	■■■■■■	
24	108.3	■■■■■■	■■■■■■	
25	2000.0	■■■■■■	■■■■■■	
26	840.7	■■■■■■	■■■■■■	
27	50.6	■■■■■■	■■■■■■	
28	3708.6	■■■■■■	■■■■■■	
29	795.2	■■■■■■	■■■■■■	
30	467.4	■■■■■■	■■■■■■	
31	3481.8	■■■■■■	■■■■■■	
32	3528.8	■■■■■■	■■■■■■	
33	1432.6	■■■■■■	■■■■■■	
34	2028.6	■■■■■■	■■■■■■	
35	722.1	■■■■■■	■■■■■■	
36	1292.2	■■■■■■	■■■■■■	

Project	Cost P million	1st 6-Year Program 1993 - 1998	2nd 6-Year Program 1999 - 2004	3rd 6-Year Program 2005 - 2010
37	602.6	■■■■■■	■■■■■■	
38	3869.3	■■■■■■	■■■■■■	
39	1294.2	■■■■■■	■■■■■■	
40	2438.7	■■■■■■	■■■■■■	
41	546.3	■■■■■■	■■■■■■	
42	938.4	■■■■■■	■■■■■■	
43	2367.1	■■■■■■	■■■■■■	
44	539.2	■■■■■■	■■■■■■	
45	2906.3	■■■■■■	■■■■■■	
46	110.5	■■■■■■	■■■■■■	
47	630.5	■■■■■■	■■■■■■	
48	615.2	■■■■■■	■■■■■■	
49	2302.7	■■■■■■	■■■■■■	
50	2884.0	■■■■■■	■■■■■■	
51	419.2	■■■■■■	■■■■■■	
52	2779.7	■■■■■■	■■■■■■	
53	4787.8		(Later Years)	
54	573.3	■■■■■■	■■■■■■	
55	3349.0	■■■■■■	■■■■■■	
56	4023.1	■■■■■■	■■■■■■	
57	3150.1	■■■■■■	■■■■■■	
58	88.6	■■■■■■	■■■■■■	
59	4781.8	■■■■■■	■■■■■■	
60	3965.2	■■■■■■	■■■■■■	
61	1413.9	■■■■■■	■■■■■■	
62	1874.6	■■■■■■	■■■■■■	
63	204.7	■■■■■■	■■■■■■	
64	107.1	■■■■■■	■■■■■■	
65	363.3	■■■■■■	■■■■■■	
66	949.8	■■■■■■	■■■■■■	
67	106.6	■■■■■■	■■■■■■	
68	1247.4	■■■■■■	■■■■■■	
69	779.1	■■■■■■	■■■■■■	
70	566.5	■■■■■■	■■■■■■	
71	1572.9	■■■■■■	■■■■■■	
72	411.1	■■■■■■	■■■■■■	
73	216.0	■■■■■■	■■■■■■	
74	2942.4	■■■■■■	■■■■■■	
75	62.3	■■■■■■	■■■■■■	
76	797.1	■■■■■■	■■■■■■	
77	641.3	■■■■■■	■■■■■■	
78	1932.1	■■■■■■	■■■■■■	
79	1954.6	■■■■■■	■■■■■■	
80	498.5	■■■■■■	■■■■■■	
81	613.4	■■■■■■	■■■■■■	
82	25.4	■■■■■■	■■■■■■	
83	1593.3	■■■■■■	■■■■■■	
84	1193.9	■■■■■■	■■■■■■	
85	1698.5	■■■■■■	■■■■■■	
86	569.3	■■■■■■	■■■■■■	
87	80.0	■■■■■■	■■■■■■	
88	830.7	■■■■■■	■■■■■■	
89	1183.5	■■■■■■	■■■■■■	
90	349.3	■■■■■■	■■■■■■	
91	685.5	■■■■■■	■■■■■■	

LEGEND: ■■■■ Detailed Engineering ——— Construction

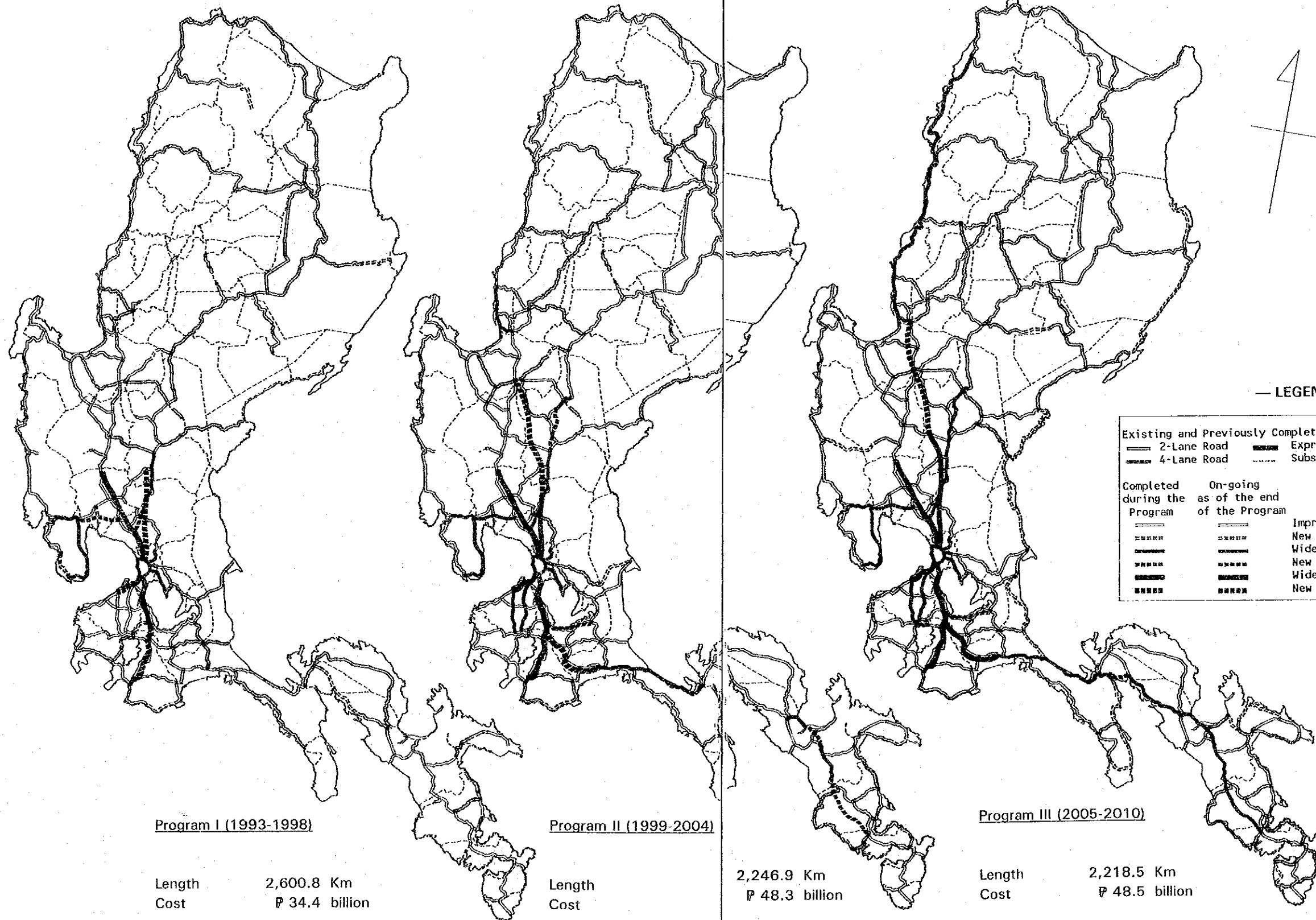
DEVELOPMENT OF ROAD NETWORK

The recommended LISR network is composed of 9,090.5 km road sections, of which 7,274.4 km are designated as the project

sections. Taking into account the good or fair condition segments, net construction length is 5,468.5 km in total.

According to the proposed schedule, LISR network will be completed by 49% in the year 1998, 73% in 2004 and 98% in 2010 in

terms of extension, with the total investment amount of 131.2 billion pesos based on 1992 price.



Program I (1993-1998)
 Length 2,600.8 Km
 Cost P 34.4 billion

Program II (1999-2004)
 Length 2,246.9 Km
 Cost P 48.3 billion

Program III (2005-2010)
 Length 2,218.5 Km
 Cost P 48.5 billion

— LEGEND —

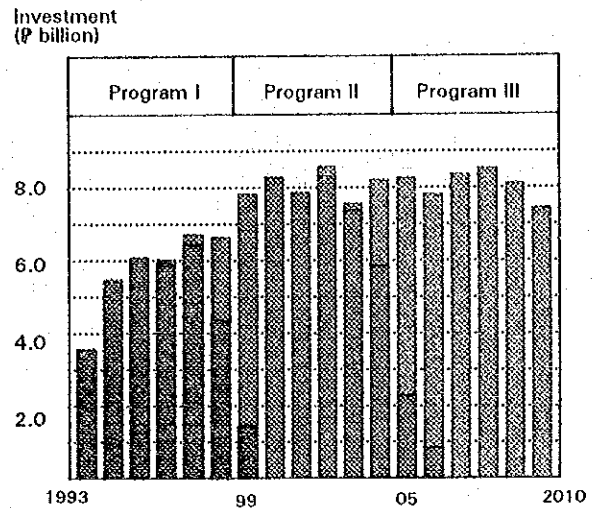
Existing and Previously Completed Roads		
—	2-Lane Road	—
—	4-Lane Road	—
—	Expressway	—
—	Substandard/Deteriorated Road	—
Completed during the Program		On-going as of the end of the Program
—	Improvement of 2-Lane Road	—
—	New Construction of 2-Lane Road	—
—	Widening to 4-Lane Road	—
—	New Construction of 4-Lane Road	—
—	Widening of Expressway	—
—	New Construction of Expressway	—

FINANCIAL REQUIREMENT

Out of the total cost of the 91 LISR projects of ₱ 154.1 billion, ₱ 131.2 billion will be required during the period from 1993 to 2010, 26% of which is scheduled for Program I (1993-1998), 37% for Program II (1999-2004) and 37% for Program III (2005-2010), respectively. Project No. 8 and a part of project No. 53 (segment 53-2) are carried over to the period after 2010.

The average investment amount is ₱ 7.3 billion per annum, equivalent to 1.5 times of the actual investment achieved in 1992 to the trunk road in the Luzon island. The planned investment is considered still to be in the possible range when taking into account the future economic growth of 4.8% per annum, even though some policy measures would be needed to expand the financial sources.

Looking for the financial resources for road development, such systems as objective taxes



ANNUAL INVESTMENT AMOUNT

and toll facilities should be carefully revised based on the "beneficiaries-to-pay" principle and "causer-to-pay" principle.

12 EVALUATION OF LISR PLAN

ECONOMIC EVALUATION OF OVERALL PLAN

Economic benefit of the Plan is estimated by accounting (i) savings in vehicle operating cost (VOC), (ii) regional development benefit and (iii) benefit by disaster prevention works, through the "with and without" comparison.

Savings in VOC is the most direct visible benefit, of which accumulate amount will reach 348.2 billion pesos in year 2020. Development benefit is the increase in GRDP accruing by labor productivity improvement caused by road development. This benefit will accumulate 221.0 billion pesos in 2020.

Disaster prevention works will result in less frequent road damages and by this, savings are expected in VOC of traffic forced to detour and in disaster restoration cost. These benefit will be accumulated to 33.8 billion pesos in 2020.

Financial project costs are converted to

economic cost taking into account various factors, of which deduction of transfer cost (taxes) and shadow wage rate to unskilled labor cost are applied in this study as remarkable factors. Total economic cost of the LISR projects (1993-2010) is estimated to be 105.7 billion pesos, which corresponds to about 80% of the financial cost.

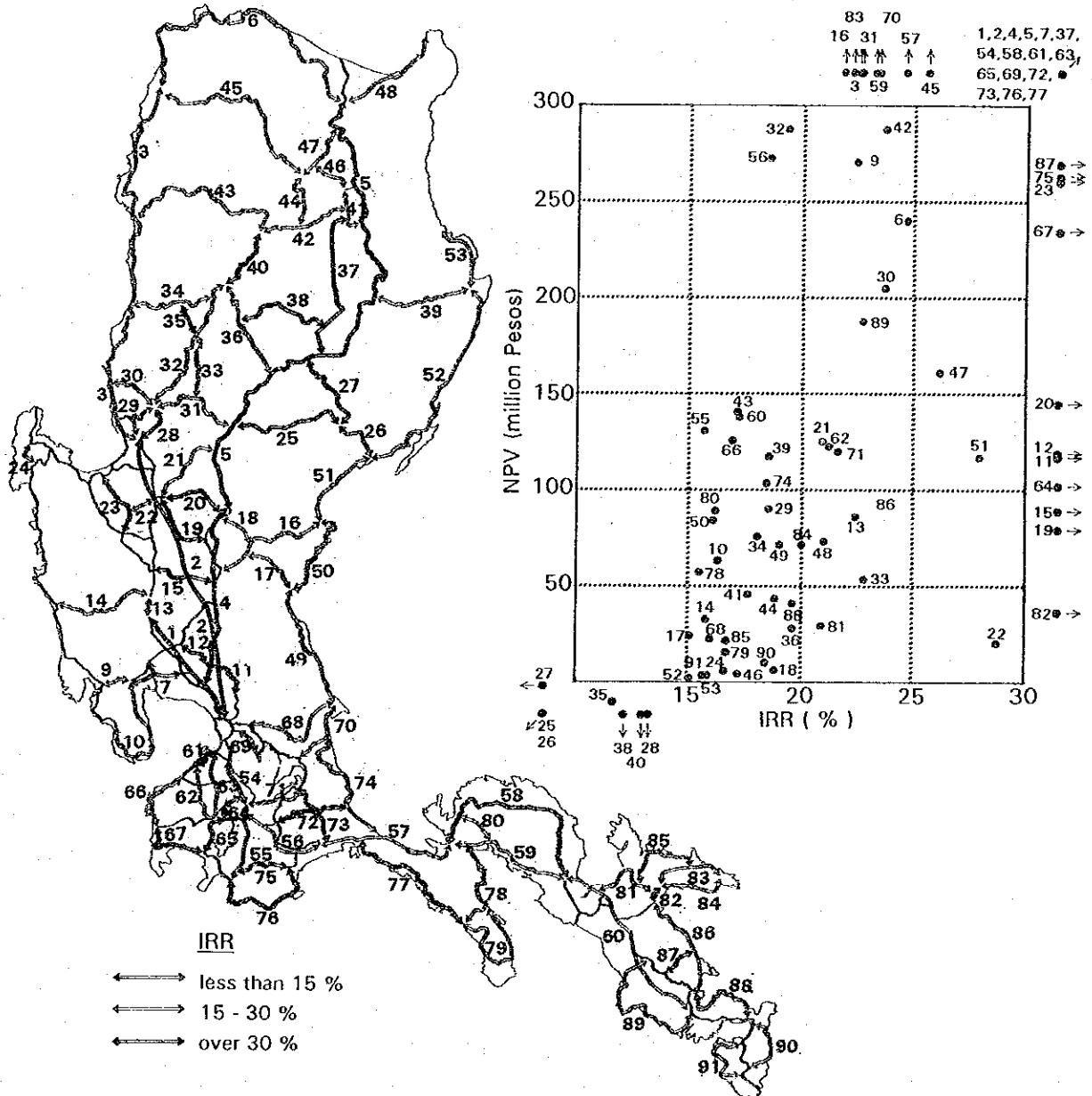
By comparing the benefit to the cost annually, evaluation indicators are calculated as shown in the table, which shows extremely high economic efficiency of the plan.

ECONOMIC EVALUATION INDICATORS

	IRR (%)	B/C	NPV (million P)
Masterplan	23.0	1.68	21,431.8
Program I	32.7	2.11	4,702.4
Program II	24.4	1.71	7,602.8
Program III	18.0	1.68	4,418.9

Each project is evaluated by comparing its economic cost with the said three kinds of economic benefit generated year by year according to the planned schedule. Granting a project with IRR higher than 15% as a feasible one, 83 projects out of 90, excluding

project No. 8, are economically justified. Especially, 27 projects show extremely high economic return over 30%. Unfeasible roads are in mountainous areas in the northern region, and included in the plan as strategical links and to support the regional development.

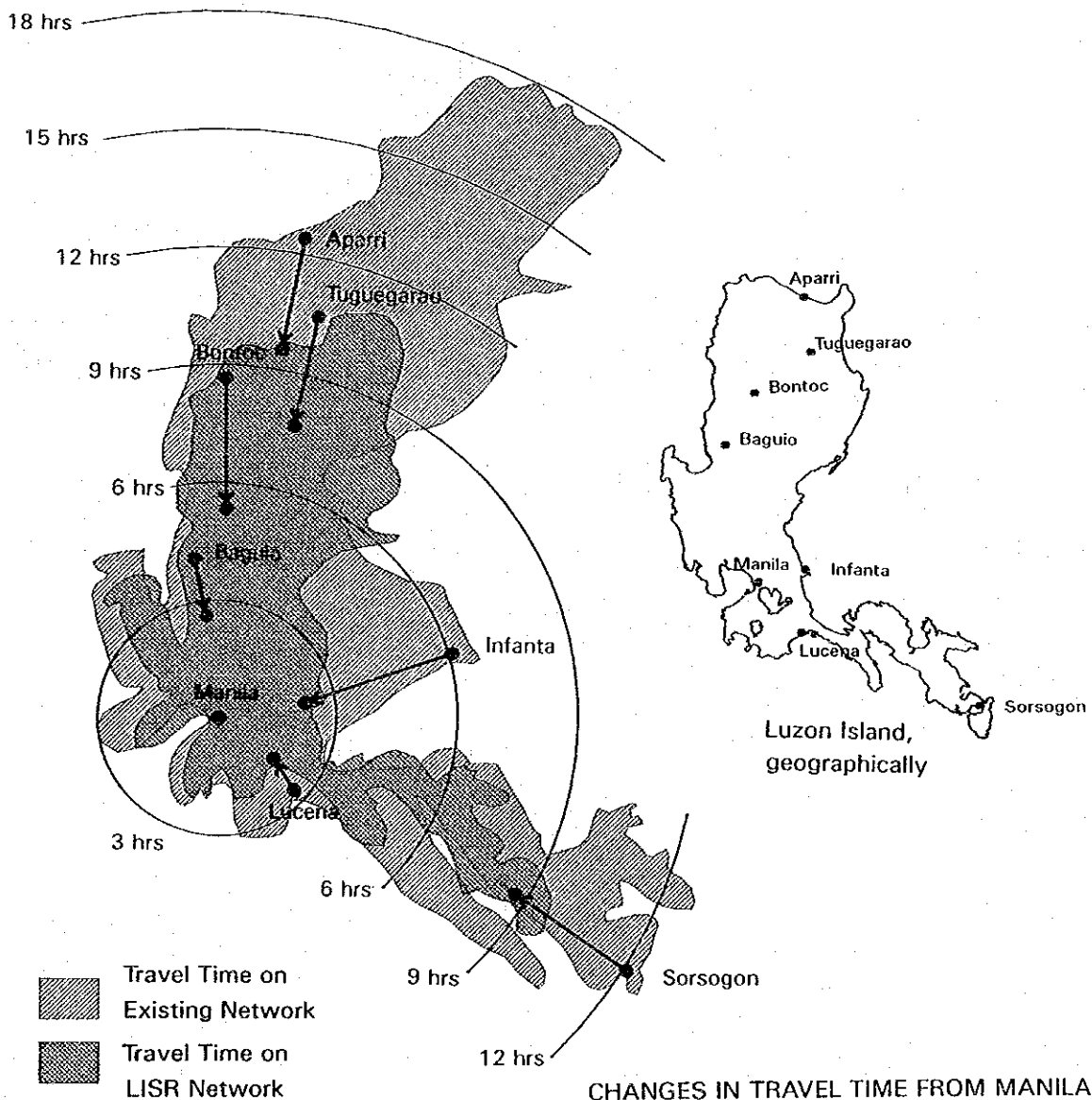


ECONOMIC EVALUATION OF LISR PROJECTS

TIME-DISTANCE REDUCTION

It is about 550 km from Manila to Aparri, the northernmost town of Luzon Island in road distance and 630 km to the southernmost Sorsogon. On the present network, it will take 12.6 hours and 12.0 hours, respectively, to reach there by car even running without a rest. The most remote area from Manila in terms of travel time is the east coast of Cagayan and Isabela, taking more than 18 hours.

Development of LISR network will reduce significantly these time-distances in Luzon Island. From Manila, it will become possible to reach Aparri in 9.5 hours and Sorsogon in 9.1 hours. Travel time to Infanta will also be shortened from current 6.0 hours to 2.2 hours. Bontoc in the north and Naga in the south will come into the 5 hour sphere from Manila, where a round trip in a day may be practical.

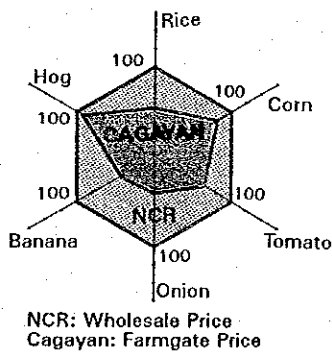


IMPACT ON COMMODITY PRICE AND REGIONAL ECONOMY

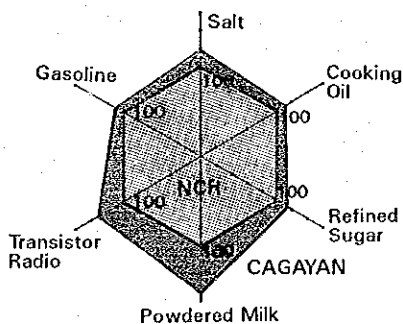
According to the official data, commodity prices differ significantly by location. In general, agro-product prices in Manila are much higher than in rural provinces and vice versa in case of industrial products, because of distributor's margins and costs for storage, handling, losses and transportation.

Comparing wholesale prices of rice in Manila to farm-gate prices in Cagayan province, for example, the former is higher than the latter by 1.8 times. The difference is 4.52 pesos/kg. On the other hand, net transportation cost from Cagayan to Manila is estimated to be 1.70 pesos/kg, which is 38% of the difference, excluding handling cost and transporter's margins.

By completion of the proposed LISR network, the said transportation cost of 1.70 pesos is



PRICE DIFFERENCE IN AGRO-PRODUCTS



RETAIL PRICE DIFFERENCE IN INDUSTRIAL PRODUCTS

LISR IMPACT ON FARM GATE PRICE

	Farm Gate Price (Pesos/kg)	Transport Cost Reduction %				
		2	4	6	8	10
Rice	5.50					
Corn	5.10					
Tomato	5.75					
Onion	6.38					
Banana	4.30					
Hog	41.70					

expectedly reduced to 1.27 pesos. The saved 0.43 pesos/kg accounting for 7.8% of the farm-gate price, will result in lower retail price or higher income of farmers and traders. This impact is bigger on commodities with lower price per unit weight.

Besides the most direct impact mentioned above, LISR network development will cause dynamic socio-economic changes in Luzon Island, through such effects as improving the distribution of farm-inputs, promoting production intensification, diversification and agro-processing industries, in the long run.

IMPACT ON POPULATION REDISTRIBUTION

In many countries, it is observed that the capital region is suffering from the burden of rapid population growth, hardly coping with increasing demand for houses, power, water and transportation facilities, while rural economies are deteriorated, losing young labor forces.

LISR network is expected to raise the GRDP in Luzon Island by an additional 80.0 billion pesos in 2010. Subtracting 25.6 billion pesos, which is the development benefit expected in NCR, the balance of 54.4 billion pesos will be generated in the Study Area as regional development benefit. Dividing this amount by the future GRDP per capita of 32,300 pesos, it can be concluded that LISR development will contribute to human settlement by sustaining a population of about 1.7 million which is one-fourth the population increase.

13 ENVIRONMENTAL CONSIDERATIONS

Environmental management in the Philippines, as a governmental policy, is not long ago and it was only recently that ecosystem management became a topic of concern. As a consequence, environmental laws became the guideposts of law enforcement agencies and citizens. The Philippine Environmental Impact Statement (EIS) System applies to projects planned by any government agency or instrumentality including government-owned or controlled corporations, private corporations, firms, individuals or other entities, which fall within the definition of an Environmentally Critical Project (ECP) or which will be located within an Environmentally Critical Area (ECA). By law, all projects falling within that scope of the EIS System must obtain an Environmental Compliance Certificate (ECC) before project implementation can begin.

In the EIS system and regarding major road projects, the different items of both physical environment and socio-economical environment should be assessed. Luzon Island has multi-environmental characteristics which should be considered during the impact assessment stage. Available data on the main environmental items of the national parks, virgin forests, tourist spots and ethnic groups

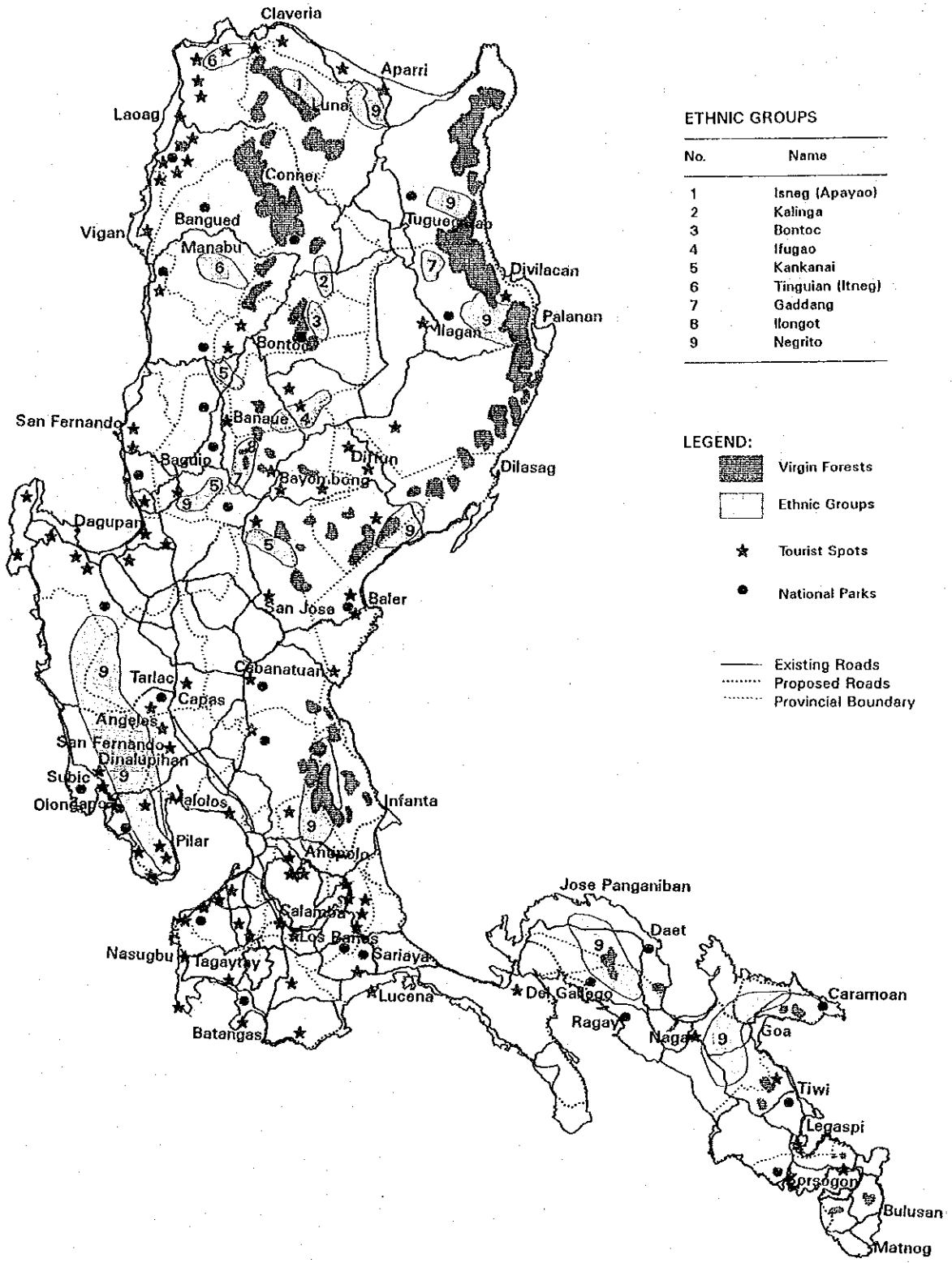
are collected, classified and plotted as shown in the figure.

Out of 91 LISR projects, new road construction projects account for 36. The preliminary screening of the initial assessment results reveals that some of the physical environmental aspects may be subject in general to minor negative impact during the construction stage, and/or after completion.

Economically, road projects have their positive impact on income, employment and development in such sectors of construction, agriculture, industry, commerce and tourism. Socially, new roads may cause the resettlement of people affected within the right-of-way which requires adequate relocation schemes. Expressways and main roads may divide the community cohesion and crossing facilities should be provided. Few roads are planned within areas where ethnic groups have their society, culture and history. Protection plans for the ethnic groups and their ancestral lands should be considered in the route alignment stages in addition to providing educational programs and adequate relocation schemes. Mitigating measures and projects with probable negative impact are shown in the table.

REQUIRED MITIGATING MEASURES FOR AFTER COMPLETION IMPACT

Check Item	Mitigating Measures	Project Nos. with Probable Negative Impact
Air Pollution	• Plantation • Buffer Zone	2, 4, 7, 8, 55, 56, 57, 59, 60, 61, 63
Water Pollution	• Management System • Urban Planning	2, 7, 8, 57
Noise Pollution	• Low Noise Surface • Plantation • Noise Barriers	2, 4, 7, 8, 55, 56, 57, 59, 60, 61, 63, 88
Vibration	• Regulations	2, 4, 7, 8, 55, 56, 57, 59, 60, 61, 63, 88
Soil Contamination	• Waste Disposal Plan	
Land Subsidence	• Soft Ground Treatment	
Soil Erosion	• Vegetation • Drainage	
Ecosystems	• Protection Plan	25, 39, 45, 52, 53, 68, 81
Population Change	• Regional Planning	
Resettlement	• Compensation • Relocation Scheme	
Ethnic Groups	• Educational Policy • Relocation Scheme	14, 21, 81, 85
Community Cohesion	• Crossing Facilities	2, 4, 7, 8, 21, 55, 56, 59, 60, 61
Land-use Pattern	• Management • Planning	
Industrial Activity	• Management • Planning	
Employment & Income	• Regional Planning	
Traffic Build-up	• Management Plan • Detouring	
Traffic Safety	• Management Plan • Safety Measures	
Archaeology	• Untraversed Alignment	



ETHNIC GROUPS

No.	Name
1	Isneg (Apayao)
2	Kalinga
3	Bontoc
4	Ifugao
5	Kankanaï
6	Tinguian (Itneg)
7	Gaddang
8	Ilongot
9	Negrito

- LEGEND:**
- Virgin Forests
 - Ethnic Groups
 - Tourist Spots
 - National Parks
 - Existing Roads
 - Proposed Roads
 - Provincial Boundary

ENVIRONMENTAL CHARACTERISTICS IN LUZON ISLAND

14 RECOMMENDATIONS ON IMPLEMENTATION SYSTEM

ESTABLISHMENT OF ORGANIZATION FOR LISR PLAN MANAGEMENT

LISR plan consists of 91 projects to be implemented over a period of 18 years. Implementation will involve various offices/agencies. For the systematic and successful implementation of the projects, planning, coordination and control are important. Therefore, an organization to carry out these tasks is recommended to be established. Such body may be created as a new division in the existing Planning Service, to be exclusively responsible for LISR Plan management including planning, coordination and control.

ESTABLISHMENT OF ORGANIZATION FOR EXPRESSWAY PROJECTS

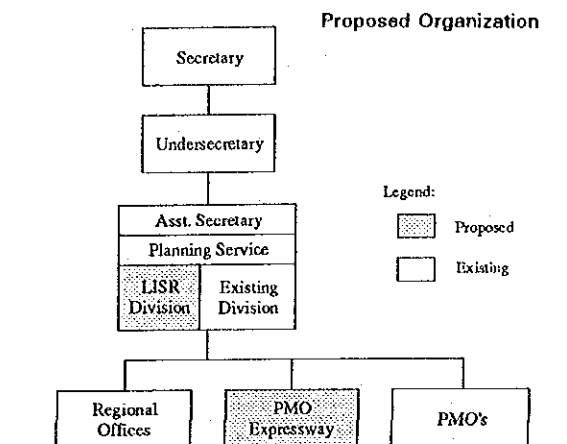
Expressway projects, as government projects, are handled by PMO-URPO (Project Management Office - Urban Road Projects Office), since there is no government agency exclusively responsible for expressway project management, and currently expressway projects are limited within and near Metro Manila. The LISR Plan, however, includes 311.3 km of expressway construction projects, and 106.3 km of expressway widening projects extending over Regions I, III and IV. For effective implementation, a new agency is proposed to be established. It can be, for instance, a new PMO for only expressway projects.

FUND PREPARATION MEANS

To cope with the increasing demand for road investment, current system for taxation on fuel and vehicles and toll system of expressway should be revised to the maximum feasible level based on the principles of "beneficiaries-to-pay" and "causers-to-pay". Revenues derived from such objective taxes and toll facilities must be spent exclusively for road projects. In addition, funds from the private sectors should be utilized wherever possible.

ESTABLISHMENT OF EFFICIENT ROAD MAINTENANCE SYSTEM

Inadequacy in road maintenance due to insufficient fund, poor condition of equipment, unavailability of some materials, etc., is an oftenly pointed-out problem. For a more effective



ive maintenance system and to maintain roads functioning properly, it is recommended to establish a "road condition rating system" and criteria for applying measures based on this system.

DEVELOPMENT OF DATABASE

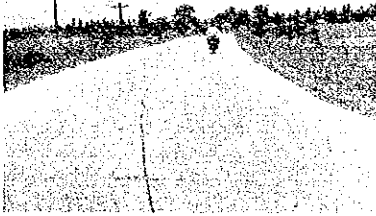
Well arranged basic information such as road condition and traffic data is necessary to develop appropriate plans, implement projects systematically and maintain roads properly. The government effort to develop a computerized database system is expected to be materialized soon, and it is recommended to be an easy updatable system with minimum required information.

EARLY EXECUTION OF FEASIBILITY STUDIES

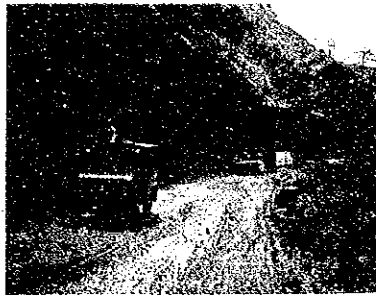
To implement projects as scheduled, feasibility studies, specially those projects included in the 1st 6-Year Program and planned to be implemented in early stage, should be conducted immediately. Studies should include route selection and environmental assessment as well as technical, economical and financial analysis. Major projects to be studied immediately are:

- Enrile - Lubuagan - Narvacan Road Improvement (248.7 km)
- Cabanatuan - Baler Road Improvement (114.4 km)
- Rosales - Sta. Fe Road Improvement (76.0 km)
- Pan Philippine Highway Upgrading, Sta. Rita - San Jose Section (122.3 km)
- Calamba - Tagaytay - Talisay - Lemery Road Improvement (74.5 km)
- Malicboy - Mulanay Road Improvement (120.4 km)

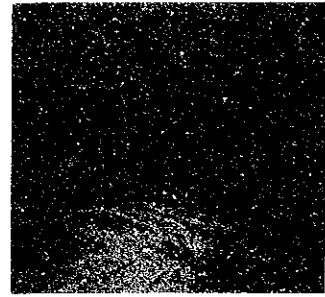
Road Conditions



Pan-Philippine Highway,
Camarines Norte
PCC Pavement in Good Condition



Baguio - Bontoc Road,
Benguet
Gravel Road in Bad Condition



Baguio - Itogon - San Miguel Road,
Benguet
Earth Road in Very Bad/Impassable
Condition

Bridge Conditions



Aritao - Dupax - Kasibu Road,
Nueva Vizcaya
Bailey Bridge



Bagong - Silang - Capalonga Road,
Camarines Norte
Timber Bridge



Cabatuan Enrile Road,
Isabela
Ford Crossing

Disasters



Nanguilian Road,
La Union
Cut Slope Failure



Kennon Road,
Benguet
Scour/Washout of Roadbed



San Fernando, Olongapo Road,
Pampanga
Flooding

JICA