4.2 ROAD MAINTENANCE SYSTEM

The present road maintenance system was studied by the review of previous studies such as "Road Maintenance Sustainability Study, 1997", interviewing relevant bureaus and offices including all Regional Offices and District Offices in the Study Area.

4.2.1 Present Road Maintenance System

"Road Maintenance" is defined as the process of preserving and restoring existing road infrastructure facilities in good operating condition, to lengthen their useful life, and, hence, avoid prematured deterioration and expensive rehabilitation or reconstruction.

Under the current maintenance system of DPWH, the road maintenance is administered by Maintenance Work by Admiistration (MBA) under the Philippine Highway Maintenance Management System (PHMMS) and Maintenance Work by Contract (MBC).

In above both cases, mandated to undertake the necessary and required services for the maintenance of national roads and bridges are the Maintenance Sections of the District/City Engineering Offices (DEO/CEO) in close coordination with the Regional Offices concerned, while the Bureau of Maintenance (BOM) provides technical assistance and guidelines for the efficient and economical implementation of the maintenance functions. The Regional Equipment Services (RES) under the direction and supervision of the Bureau of Equipment (BOE), provides to DEO/CEO the fleet of road maintenance equipment to be used for maintenance works by administration.

(1) Maintenance Organization and Management

Maintenance of national roads and bridges is under the responsibility of DPWH through its concerned agencies as follows (see Figure 4.2-1):

Overall Planning and Technical Asisstance/Guidance to Field Offices
- Bureau of Maintenance (BOM)
- Bureau of Equipment (BOE)

Implementation Arm of Road/Bridge Maintenance
- Regional Offices
- District/City Engineering Offices (DEO/CEO)

Organization chart of BOM, BOE and DEO is presented in Figures 4.2-2, 3 and 4, respectively.

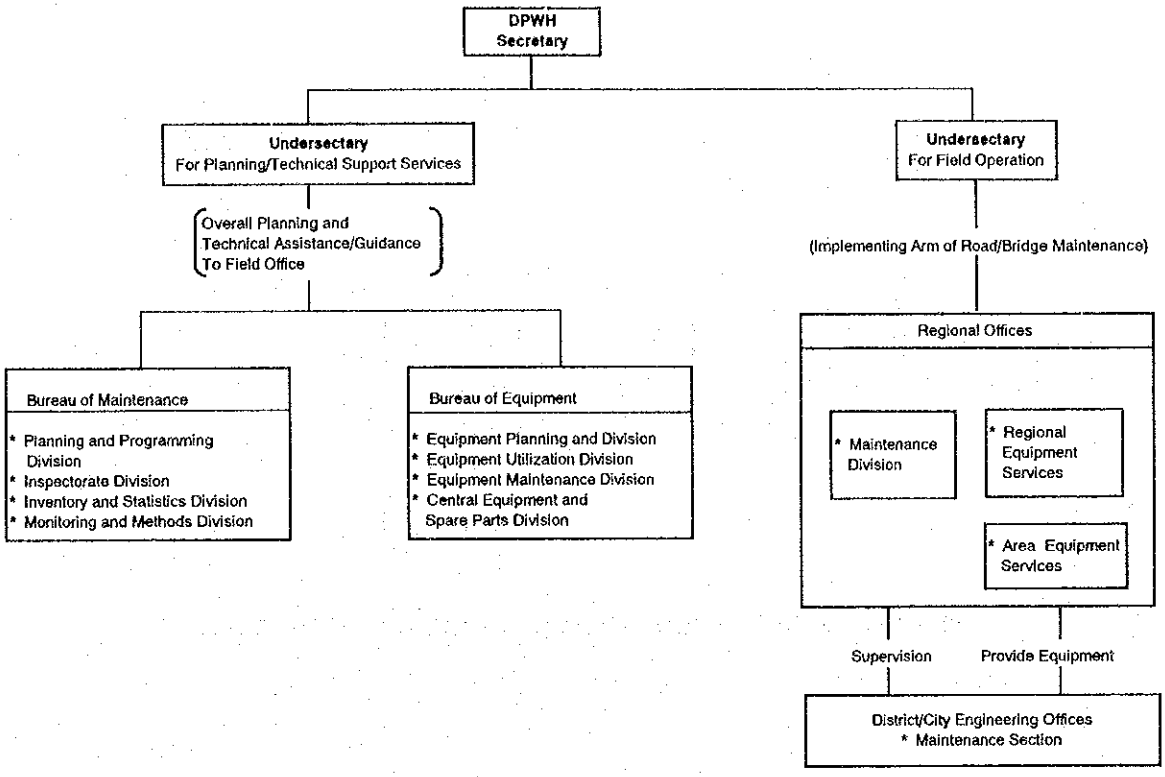


FIGURE 4.2-1 DPWH ORGANIZATION RELATED TO ROAD/BRIDGE MAINTENANCE

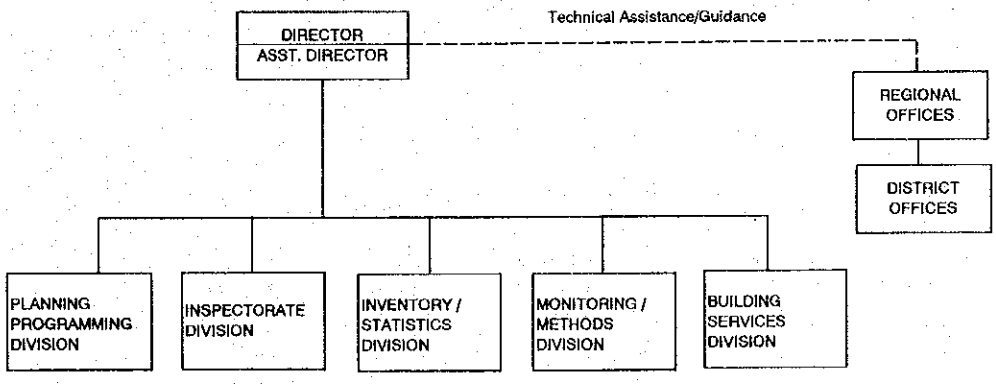


FIGURE 4.2-2 ORGANIZATION CHART OF BUREAU OF MAINTENANCE

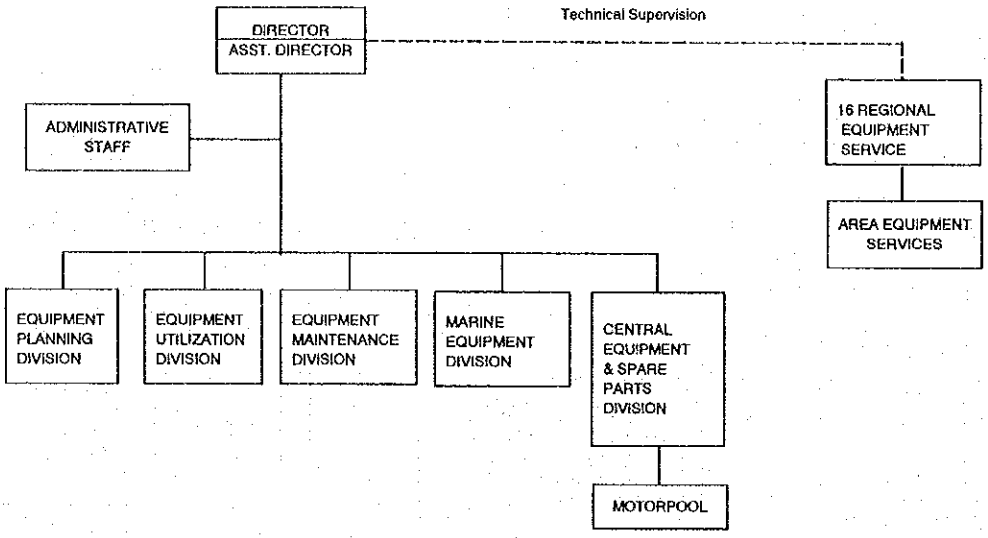


FIGURE 4.2-3 ORGANIZATION CHART OF BUREAU OF EQUIPMENT

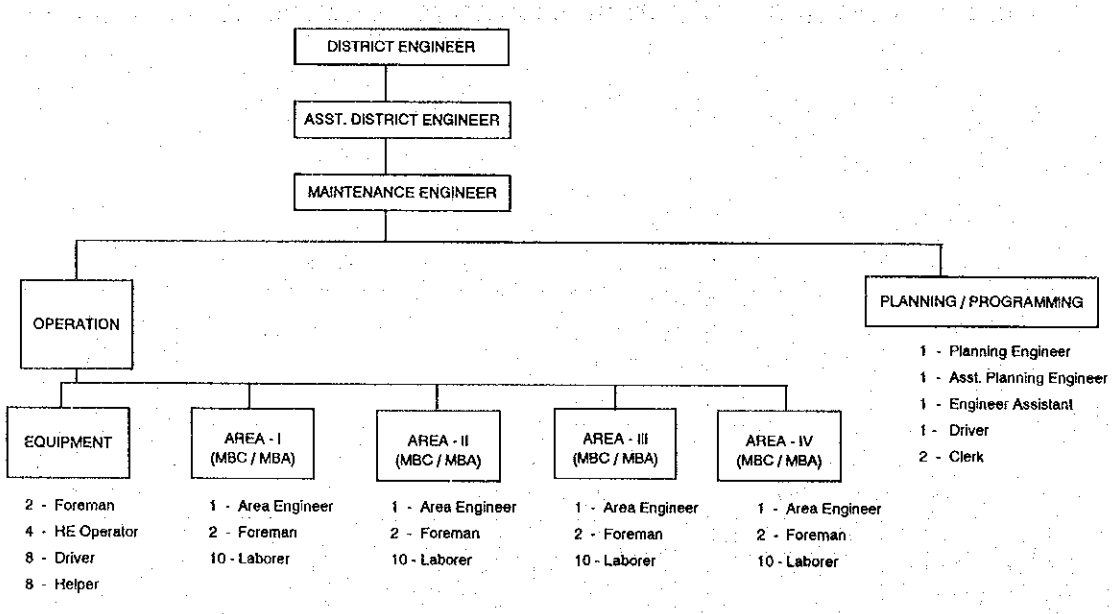


FIGURE 4.2-4 TYPICAL ORGANIZATION CHART OF MAINTENANCE SECTION OF DISTRICT ENGINEERING OFFICE
(EXAMPLE OF AGUSAN DEL SUR FIRST ENGINEERING DISTRICT)

(2) Maintenance Budget

The road maintenance budget and allocation to Regional Offices and DEO/CEO are determined by the Equivalent Maintenance Kilometer (EMK) system. The EMK System is as follows:

Maintenance Budget = Basic Cost x EMK

Basic Cost	:	Cost per one equivalent-maintenance-kilometer for one year
EMK	:	Equivalent-Maintenance-Kilometer to be determined by a physical length times EMK factors. EMK factors are determined for type of pavement, width of roadway and traffic volume.

Basic Cost from 1990 to 1997 is presented in Table 4.2-1.

TABLE 4.2-1 BASIC COST

Year	Basic Cost at Current Price	Basic Cost at 1995 Prices	
1990	P20,500	P33,600	(0.54)
1991	P20,500	P28,331	(0.45)
1992	P28,049	P35,566	(0.57)
1993	P31,517	P37,127	(0.57)
1994	P33,500	P36,180	(0.58)
1995	P62,463	P62,436	(1.00)
1996	P63,351	P58,473	(0.94)
1997	P66,835	P58,748	(0.94)

Note : Inflation rate of 1997 was assumed to be 5%.
Source: Bureau of Maintenance, DPWH

Basic Cost was drastically increased in 1995, however, has not been increased in real term since then.

Maintenance budget is released to the respective DEO/CEO every quarter. Five percent of the total maintenance budget allocated for each region is set aside for the maintenance of roads newly converted to or taken over as national roads for the current year.

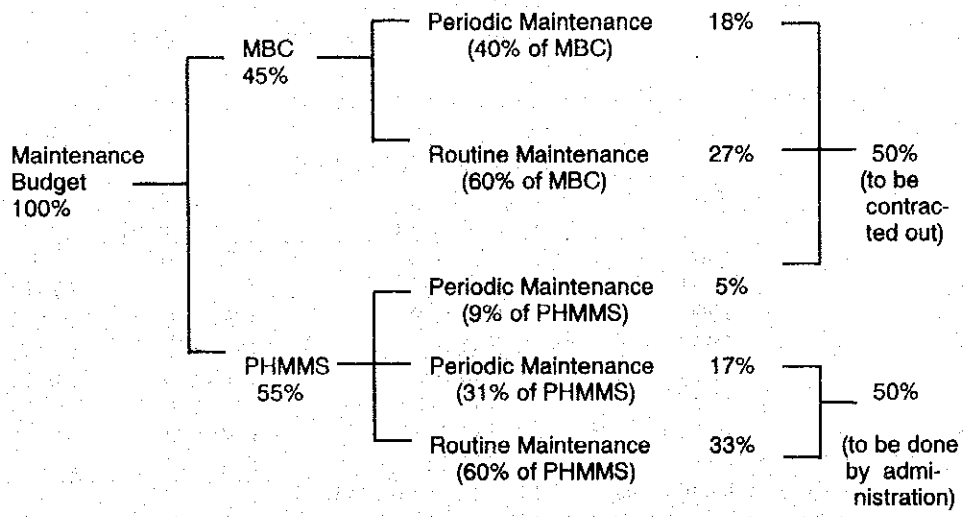
To provide a ready fund for emergencies, another five percent of the budget for every DEO/CEO is retained at the Regional Offices as Immediate Response Fund (IRF). This fund is used for the immediate repair of roads and bridges damaged by natural calamities or for emergency activities.

(3) Maintenance Planning and Programming

Maintenance planning and programming is carried out within the following framework:

- Maintenance budget framework for routine maintenance and periodic maintenance
- Maintenance budget framework for Maintenance under PHMMS and Maintenance by Contract (MBC)

In 1993, budget framework was specified as follows:



Based on the road maintenance inventory data, the annual maintenance work program and performance budget (AMWP/PB) is prepared for the road sections under PHMMS and the annual work program (AWP) is prepared for the road sections under MBC.

(4) Maintenance Procedure

Maintenance Work by Administration (MBA) under PHMMS

The maintenance by administration follows the procedure of PHMMS. Routine maintenance is undertaken by maintenance crews of DEO/CEO, while periodic maintenance is partially contracted out to private contractors.

Maintenance activities are determined through inspection conducted by district/city or regional personnel, and complaints by the public. The District/City Area Engineer is responsible for conducting routine inspections of all the roads in the area at least once in 15 days. Semi-monthly schedule is prepared for each area by the District/City Area Engineers and approved during a scheduled meeting conducted by the District/City Maintenance Engineer.

Maintenance Work under MBC

Under MBC, all routine and periodic maintenance activities selected for MBC sections are contracted out through competitive bidding at the DEO/CEO. The contract amounts usually ranges from one million to two million pesos per contract, and normally lasts for about 9 months until the end of a fiscal year.

Maintenance works are scheduled by each three months. The tri-monthly work schedule describes the activities, the corresponding quantities, the location and the deadline for the activities to be undertaken.

All activities on site and measurements of all completed works are recorded by foremen or Area Engineers at DEO/CEO level. Each week, the accomplishment and the corresponding quantities are summarized and agreed upon between the Contractor and DEO/CEO. Every month, the accomplishment is summarized in the Monthly Summary Sheet. The summary sheet is used by the contractor to substantiate his request for payment and also used for contract monitoring in the Regional and BOM levels.

(5) Maintenance Equipment

Maintenance equipment is provided to DEO/CEO by Regional Equipment Service (RES). RES has a Base Shop and several Area and Mobil Shops. Major equipment are repaired at a Base Shop and minor repairs are done at Area and Mobil Shops. Number of Base Shops and Area Shops in the Study Area is presented in Table 4.2-2.

TABLE 4.2-2 NUMBER OF BASE/AREA SHOPS IN THE STUDY AREA

Region	No. of Base Shop	No. of Area Shops	No. of Mobil Shops
IV-B	1	6	10
V	(1)	1	(8)
VI	1	4	7
VII	1	4	8
VIII	1	5	8
IX	1	6	3
X	1	4	4
XI	1	4	6
XII	1	5	6
XIII	1	4	5
Total	9 (10)	43	57 (65)

SOURCE: BOE
NOTE : Number in ( ) shows that these are not necessarily located in the Study Area.

According to BOE, the latest purchase of equipment was made in 1983 with the financial assistance of IBRD. The condition of most commonly used equipment is presented in Table 4.2-3. Operational/operating equipment accounts for only 30.6%, 18.2% of equipment is under minor/major repair, 23.6% is awaiting minor/major repair and 27.6% is unserviceable.

Status of Mobil Shops is presented in Table 4.2-4. Only one-half are operational/operating. Unserviceable Mobil Shops account for 11%.

TABLE 4.2-3 CONDITION OF MOST COMMONLY USED EQUIPMENT

EQUIPMENT TYPE	DPWH No.	STATUS (As of Nov. 1996)							
		A	B	Cn	Cj	Dn	Dj	E	TOTAL
AIR COMPRESSOR	A1	73	33	8	15	14	52	65	260
PAVEMENT BREAKER	A3	14	2	2	22	10	46	33	129
TRUCK MOUNTED CRANE	F5	26	46	10	15	11	23	32	163
HYDRAULIC EXCAVATOR, WHEEL MOUNTED	F17	6	19	10	11	3	15	5	69
DUMP TRUCK	H3	31	321	77	127	54	176	351	1,137
ROAD MAINTAINER	H11	9	41	17	27	18	33	56	201
BULLDOZER	L1	17	39	29	35	16	70	105	311
FRONT END LOADER	L2	10	111	35	42	16	59	87	360
ROAD GRADER	N1	23	190	48	68	36	91	138	594
VIBRATORY ROLLER COMPACTOR	Z18	28	42	33	10	12	52	32	209
GRASS CUTTER	Z23	16	14	4	15	20	31	98	198
TOTAL		253	858	273	387	210	648	1,002	3,631
		(30.6%)		(18.2%)		(23.6%)		(27.6%)	(100%)

SOURCE: BOE, DPWH

L E G E N D:

A - Operational (Idle "Ready to Run")
B - Operating (On Rental)
Cn - Under Minor Repair
Cj - Under Major Repair
Dn - Awaiting Minor Repair
Dj - Awaiting Major Repair
E - Unserviceable

NOTE:

* Average age of above - stated equipment range from 15 to 20 years.

TABLE 4.2-4 STATUS OF MAINTENANCE MOBILE SHOPS

As of February 1997

Status	CESPD	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	IX	X	XI	XII	XIII	TOTAL	(%)
A			1	1	1			2	1		1	2	1	1		1		12	(50.5%)
B	1	3	3	1	3	4	4	1	2	2	3	2		1	3	2	2	37	
Cn				1	1			1			1							4	(10.3%)
Cj								1		3						2		6	
Dn								1	2			1	2				1	7	(27.8%)
Dj			1		2	3	2	2	1		2			1	3	1	2	20	
E								2	2	2	1	3		1				11	(11.3%)
TOTAL	1	3	5	3	7	7	6	10	8	7	8	8	3	4	6	6	5	97	(100%)

SOURCE: Regional Equipment Services, DPWH

LEGEND:

A - Operational (but awaiting assignment)
B - Operating (on rental)
Cn - Under Minor Repair
Cj - Under Major Repair
Dn - Awaiting Minor Repair
Dj - Awaiting Major Repair
E - Unserviceable

4.2.2 Brief History of Maintenance by Contract (MBC)

In 1988 and 1989, DPWH started MBC in Batangas and Bohol provinces as a pilot project under the technical assistance of ADB.

The purposes of introducing MBC were:

a) To attain more cost-effective maintenance

   (DPWH has had a large number of maintenance crews and productivity per maintenance crew has been lowered year by year and the share of personnel expenditures in the maintenance budget have been gradually increased, instead actual expenditures for maintenance works have been gradually decreased.)

b) To contribute to "Small Government" by expediting privatization and at the same time to promote private sector's participation in the Government's projects.

With the successful results of 2-year testing, MBC system was introduced nationwide since 1990. At the beginning, DPWH planned to implement MBC up to 84% of maintenance budget by 1994, but lowered this 84% target to 70% in order to keep 30% of maintenance budget for MBA implementation due to necessity to cope with emergency situation such as natural calamities. In spite of the above DPWH plan, the National Congress cut down the MBC budget share, resulting in the fluctuated MBC budget share as shown in Table 4.2-5. However, DPWH anticipates that the budget share between MBA and MBC will be stabilized at 50:50 for the time being.

TABLE 4.2-5 MBC BUDGET SHARE IN THE MAINTENANCE BUDGET

Year	DPWH PLAN		Approved MBC Share By GAA	Remarks
	Original Plan	Revised Plan		
1990	40%	40%	40%	
1991	51%	50%	50%	
1992	61%	50%	50%	
1993	72%	60%	60%	
1994	84%	70%	30%	Drastic Reduction
1995	84%	70%	50%	
1996	84%	70%	30%	Drastic Reduction
1997	84%	70%	50%	
1998	84%	70%	50%	

Note: GAA – General Appropriations Act

4.2.3 Maintenance Problems

The Study Team conducted hearing survey of DPWH Regional and District Offices by sending questionnaires. Answers were summarized in Appendix 4.2-1. Maintenance problems raised by the DPWH field offices and identified by relevant studies such as the OECF-financed Road Maintenance Sustainability Study (1998) and the Study Team are summarized hereunder.

(1) Maintenance Budget

As shown in Table 4.2-1, the maintenance budget has not increased in the real term since 1995.

About 84% of District Offices complained insufficiency of the maintenance budget. Sufficiency of the budget largely depends on the maintenance level or standard targeted. If the higher maintenance level is targeted, the more budget will be required. The present maintenance level under the present budget can cover only 40% of pavement distresses.

Thus, if the present budget is maintained, pavement condition will be continuously aggravated year by year. If the maintenance level is set to maintain at least present pavement conditions and to prevent further deterioration, the maintenance budget needs to be increased by 1.7 to 2.2 times of the present budget (refer to Section 19.3).

(2) EMK Budget Allocation System

The present EMK budget allocation system does not include the factor of road conditions. The maintenance budget should ideally be allocated according to maintenance needs which largely depend on road conditions. In fact, road conditions vary from District to District Offices, thus the present budget allocation is not equitably made.

(3) Utilization of Limited Maintenance Budget

Some District Offices spent the maintenance budget as follows:

• Unpaved Roads (88 km)	48%
• Paved Roads (100 km)	15%
• Shoulders	8%
• Drainages	6%
• Roadside Features	7%
• Others	17%
Total	100%

As shown above, the present maintenance works are focused on unpaved roads and maintenance of paved roads is rather neglected.

(4) Maintenance Level (or Standards)

Due probably to the limited maintenance budget, the present maintenance level (or standards) is not high enough to cope with existing and increasing pavement distresses. According to the analysis of "Road Maintenance

Sustainability Study", only 34 ~ 40% of PCC pavement distresses and 78 ~ 88% of AC pavement distresses can be repaired under the present maintenance level.

(5) Prioritization of Maintenance Activities

Maintenance needs are high, but budget is limited, therefore, prioritization of maintenance works is quite important. Each maintenance activity is currently specified as "unlimited (First Priority)" or "limited (Second Priority)", or "Variable (Third Priority)". Priority guideline does not consider a road class, traffic volume and type of pavement.

(6) Maintenance By Administration (MBA)

Problems of MBA are as follows:

Equipment:

- Too old equipment with an average age of 19 years.
- Available is only 40-50%, others is under repair or unserviceable.
- High cost of repair/maintenance which in 1996 reached to about 34% of purchase price.

Workforce:

- Low productivity due to old age of staff (33% are more than 51 years old).
- Older generation is adversely influencing younger generation in work discipline.

Reduction of Workforce:

- Reduction of workforce which was one of the objectives for introduction of MBC is not progressing.
- Permanent employees are being reduced, but non-permanent employees are not. One factor is budgetary share of MBA which is not decreasing.

Administration Procedure:

- For material procurement, 18 steps of the procedure must be cleared, preventing timely implementation of maintenance.

(7) Maintenance By Contract (MBC)

- Maintenance oriented contractors are few. Many contractors do not consider MBC as their main line of business.
- Present contract size (average is about 2.3 million. Maximum about 4.5 million) need to be reviewed. The work volume of Quarterly Schedule is good for only I week to 1 month, thus, remaining period is just for idling on the part of the contractor.
- In order to promote maintenance oriented contractors, scope of work of contract need to be reviewed. For example, one contract specifically for pavement markings.

- To provide some more flexibility to MBC, present limit of change order (15% of contract amount) needs to be reviewed.
- Completion of contract procedures is usually delayed as well as payments to contractors.
- District Offices staffing composition is still that of MBA. Management/supervisory staffs for MBC need to be strengthened.

(8) Demarcation of Maintenance Activities into MBA and MBC

Present BOM guideline on demarcation of maintenance activities into MBA and MBC is as follows:

- MBA for "bad/very bad section"
- MBC for "good/fair section"

However, many District Offices are practicing as follows:

- MBA for labor oriented activities
- MBC for equipment oriented activities

Above demarcation is oftenly adopted by the District Offices which suffer insufficient equipment.

To clearly demarcate maintenance activities into MBA and MBC is not practical due to the following factors:

- Present 50:50 budgetary sharing of MBC and MBA
- Road conditions are different from the District to District Offices, accordingly maintenance needs for each maintenance activity are different.
- Number of laborers and equipment condition status, are different from the District to District Offices.

Under such circumstances, the possible way to demarcate maintenance activities will be to determine.

Category A: Maintenance activities to be definitely done by MBA
Category B: Maintenance activities to be definitely done by MBC
Category C: Maintenance activities which can be done either by MBA or MBC

In the future, maintenance activities under Category C should be shifted to Category B.

Demarcation criteria should be as follows:

MBA : Maintenance activities which must be immediately done whenever need arises and minor activities

MBC: Maintenance activities which can be planned ahead

(9) Budgetary Share of MBA and MBC

Abrupt change in budgetary share of MBA and MBC which happened in 1994 and 1996 must be eliminated, particularly abrupt increase of MBA share. Existing work force and equipment in each District Office cannot efficiently cope with the sudden increase of workload.

(10) Existing Workforce

Since the introduction of MBC, permanent employment is decreasing, on the other hand non-permanent employment is gradually increasing, resulting in almost same number of employment as a whole. One reason is that the DPWH plan to reduce budgetary share of MBA to 30% has not been achieved yet and another is that work volume in terms of amount of MBA budget has not been reduced as a result of sharp increase of maintenance budget in 1995

Under the present maintenance budget level with MBA share of 50%, most District Offices have surplus of workforce, provided that the productivity of staff and equipment is the same as specified in the Maintenance Manual. However, if the productivity is 70% of the standards as many District Offices assess, about 40% of District Offices suffer lack of workforce. Thus, key issue is how to maintain productivity of staff and equipment to the level specified in the Maintenance Manual.

CHAPTER 5

TRANSPORT SURVEY

5.1 ROAD TRANSPORT

Two types of road transport surveys; vehicle registrating survey and traffic survey, were carried out to grasp present traffic characteristics in the Study Area for formulation of present OD tables.

The Nationwide Traffic Counting Program (NTCP) of DPWH provides the basic traffic data for this Study. Registered vehicle data of the Land Transportation Office (LTO) are analyzed to study growth trend and composition of the different vehicle categories.

To obtain additional data on the existing traffic movement of passengers and cargo, a roadside OD survey was carried out in major islands in the Study Area. In addition, a traffic count survey was carried out to collect data necessary to expand the OD data obtained by sampling survey and to supplement existing traffic volumes of NTCP.

Traffic volumes of 1997 were initially estimated for the roads covered by traffic surveys and applied to obtain traffic composition in relation to road condition. Present OD tables were established for a total number of 841 zones and analyzed for the movement of passengers and cargoes as well as per vehicle categories to complete information of the existing trip pattern of the road network. Traffic assignment techniques were applied to allocate the present trip matrices to the road network in order to estimate the traffic volumes on the road network.

5.1.1 Registered Vehicles

The Land Transportation Office (LTO) plans, formulates and implements policies, rules and regulations concerning the land transport system of the country. It is also responsible for the registration of motor vehicles, issuance of driver's licenses and permits, enforcement and adjudication of land transportation laws, rules and regulations. Motor vehicle registration is carried out through agencies of LTO in all provinces. There are 74 LTOs which are operating to register vehicles in the Study Area. Vehicles are classified in five (5) groups of private, government, diplomatic, for hire and exempt.

Annual growth in the number of registered vehicles in the Philippines is shown in Figure 5.1-1. All types of vehicles have steadily increased in the past ten (10) years. The average growth rate per year of each vehicle is 10.75% for utility vehicles, 9.70% for trucks / trailers, 8.19% for cars and 7.84% for buses.

Table 5.1-1 presents the number of registered vehicles in the Regions of the Study Area, NCR and the Philippines, while the share in the vehicle composition by Region is illustrated in Figure 5.1-2. Highest share of cars is noticed in NCR and lowest share in Region V. Appreciable number of motorcycles / tricycles are registered in the Study Area compared with NCR and the whole country. This may imply long distance trips for cars are not yet prevalent in the area.

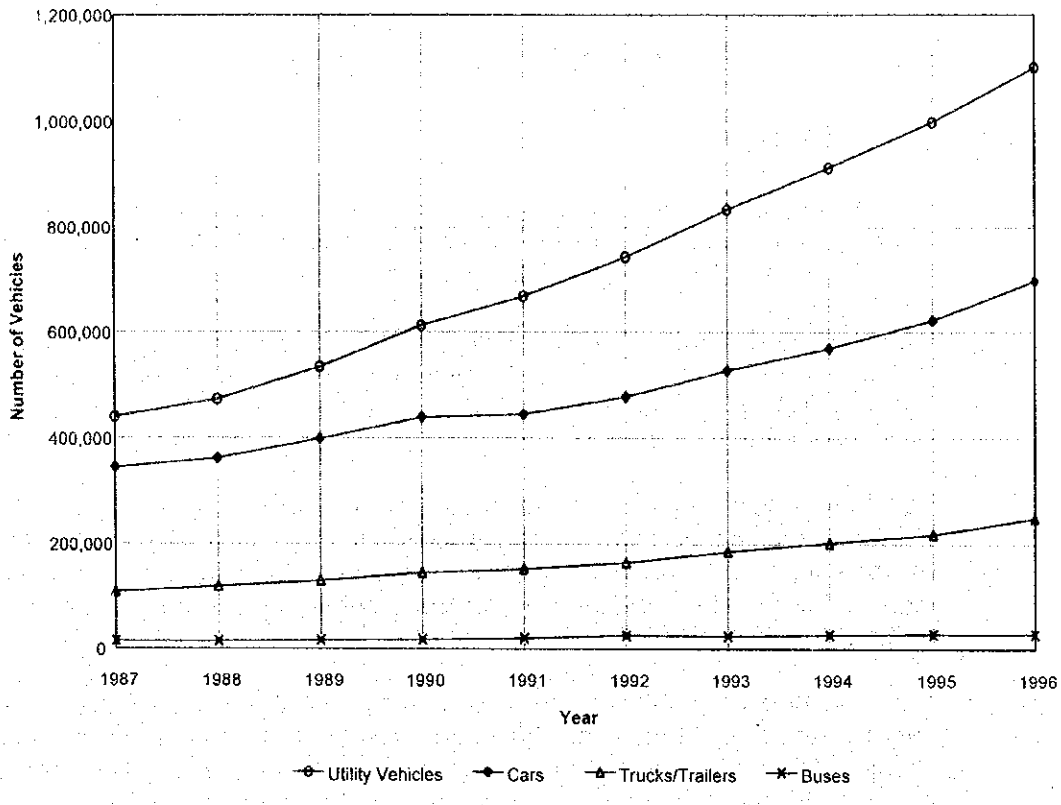


FIGURE 5.1-1 GROWTH OF REGISTERED VEHICLES IN THE PHILIPPINES

5.1.2 Traffic Surveys

Two types of traffic surveys, OD Survey and Traffic Count Survey, were conducted to establish the present OD matrices for the trips of passengers, commodities and vehicles, and to estimate the traffic volumes on the road network of the Study Area. The OD Survey was carried out in major islands of the area, Mindanao, Panay, Leyte, Samar, Cebu and Negros Islands, to survey inter-city trips. The Traffic Count Survey was conducted simultaneously at the same locations of the OD Survey to determine the traffic composition and factors to be used for adjusting OD data collected on sampling base. Additional thirty seven (37) traffic count stations were established in the islands of Mindoro, Catanduanes, Masbate, Bohol, Palawan, Camiguin and Mindanao to augment existing traffic count data.

(1) Collection of Existing Data

Prior to the field survey, traffic count data conducted by DPWH and previous studies were gathered and examined. The DPWH conducts traffic count survey periodically, along national roads in nationwide. This traffic count program is widely known as Nationwide Traffic Count Program (NTCP).

TABLE 5.1-1 NUMBER OF REGISTERED VEHICLES - 1996

Region	CARS	UV	TRUCKS	BUSES	MT/TC	TRAILERS	TOTAL
IV	43,233	172,496	17,637	3,672	105,180	1,264	343,482
V	5,515	20,380	5,201	1,245	37,388	146	69,875
VI	20,838	51,096	19,874	1,478	53,753	986	148,025
VII	35,320	56,844	25,381	1,675	89,861	1,830	210,911
VIII	2,160	13,770	4,436	948	26,967	217	48,498
IX	2,570	15,758	4,440	817	37,367	144	61,096
X	7,944	20,657	6,396	1,482	26,687	335	63,501
XI	17,364	35,380	13,923	1,590	65,571	1,068	134,896
XII	4,045	14,062	3,406	445	23,268	176	45,402
XIII	2,872	7,682	2,421	245	12,381	83	25,684
Sub-total	141,861	408,125	103,115	13,597	478,423	6,249	1,151,370
NCR	490,613	462,981	74,004	8,768	131,768	17,707	1,185,841
Philippines	699,305	1,101,077	220,388	29,330	821,599	29,515	2,901,214

* Data in ARMM is not available

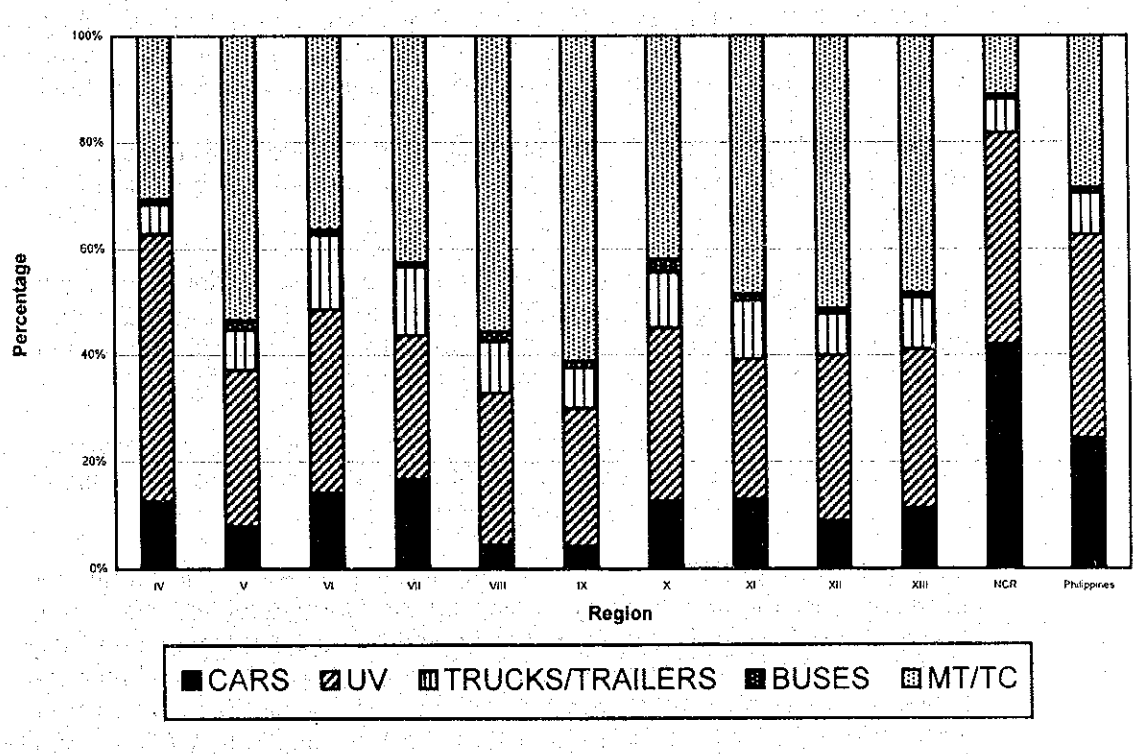


FIGURE 5.1-2 VEHICLE COMPOSITION BY REGION

The traffic count stations of NTCP are classified into the following three (3) types:

- Coverage Station

  Traffic counts are undertaken for two (2) consecutive weekdays, over a 12-hour period from 6:00 A.M. to 6:00 P.M., two times during the year. Coverage stations under the present NTCP set-up are operationalized only once in five (5) years.

- Control Station

  Traffic counts are undertaken for seven (7) consecutive days, over a 12-hour daylight period for six (6) days and a 24-hour period for one day (usually Wednesday), for four times a year or one count operation for each quarter.

  Stations are located mainly on the first class arterial national road network of provincial boundaries and selected screen lines. Each control station is related to a superior seasonal station and to a number of nearby coverage stations within the same region and district.

- Seasonal Station

  Traffic are counted for seven (7) consecutive days, over a 12-hour daylight period for six (6) days and a 24-hour period for one day (usually Wednesday), for twelve times a year or one count operation for each month.

  Stations are located mainly on first class arterial national road network at regional boundaries, and on second class arterial national roads at provincial boundaries.

  The output of seasonal stations is used as a basis to derive seasonal factors by vehicle type to be applied by the control and coverage stations to obtain the AADT, and it can be used also to produce daily and hourly factors for application in updating procedures for coverage stations.

  NTCP covers 55 seasonal stations, 114 control stations and 701 coverage stations in the whole country. In the Study Area, there are 25 seasonal stations, 65 control stations and 356 coverage stations.

  Data collected by NTCP were utilized in different stages in this Study, and supplemented through two (2) traffic surveys undertaken in this Study. The average daily traffic (ADT) was estimated by applying Hourly and Daily Factors (HF & DF) obtained from control stations of NTCP. To estimate the annual average daily traffic (AADT), a Seasonal Factor (SF) derived from data collected at a nearby seasonal station was applied to ADT. ADT values presented by NTCP are classified into six (6) groups of vehicle categories, which are: car, jeepney, mini-bus, big-bus, rigid truck and articulated truck.

As there were many road sections with different values of traffic volume and composition, sites of all stations were accurately plotted on road map and traffic data of the stations close to municipalities and cities were screened to eliminate intra-zonal traffic. Next, all the data were plotted and evaluated on a traffic flow map to allocate the most appropriate volumes on the links of the road network.

After examining the data consistency of NTCP data, traffic count data of 11 seasonal stations, 30 control stations and 139 coverage stations were utilized as control traffic volume for the establishment of present OD matrices.

In addition to NTCP traffic count data, traffic data of the following studies were utilized in this Study:

- Road Investment Development and Engineering Study (RIDES), DPWH, 1996
- Feasibility Study on Pan-Philippine Highway Rehabilitation Project (Mindanao Section), JICA, 1995
- Feasibility Study on Agusan – Surigao Link Road Project, DPWH, 1995
- Feasibility Study on General Santos City Circumferential Road Construction Project, DPWH, 1995
- Post-Evaluation Report of 4th ADB Road Improvement Project, ADB, 1995

(2) Roadside OD Survey

Purpose

The roadside OD Survey was conducted in order to prepare the present OD tables and forecast of the future OD tables, and estimate the future traffic volumes on the road network.

Zoning

The municipality / city name was used to identify origin and destination of trips during OD survey, hence, OD data were collected on the administrative base in which each city / municipality was considered as one zone. Municipalities not connected to survey roads were merged with adjacent municipality connected to the survey roads. Municipalities outside Study Area were merged into provincial / regional base to reflect traffic movement in and outside Study Area.

The total number of OD Zones is 841 excluding zones outside Study Area.

Location of Survey Stations

The criteria in selecting the location of survey stations was set mainly to collect data representing the movement of vehicles between zones in the island and for the main arterial roads especially those handling traffic from major cities. Total 40 stations were set up to cover traffic movement of the selected islands.

Figure 5.1-3 shows the location of traffic survey stations while profile of each survey station is presented in Appendix 5.1-1.

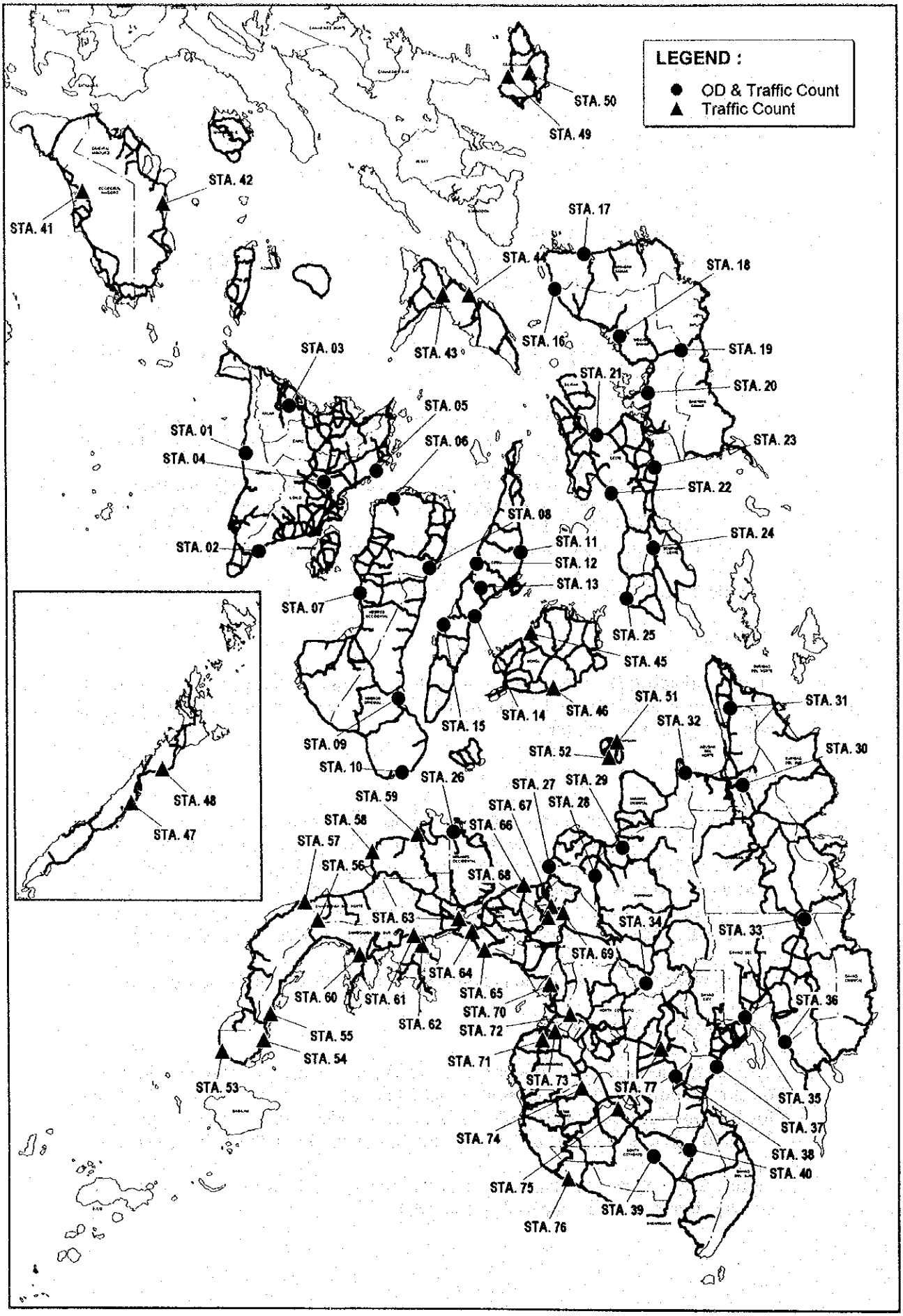


FIGURE 5.1-3 **TRAFFIC SURVEY STATIONS**

Survey Items

Passengers of buses and jeepneys, and drivers of the following ten (10) types of vehicles were interviewed during the OD survey:

- Car/Taxi/Jeep
- Jeepney
- Pick-up/Van
- Mini Bus < 30 seats
- Large Bus < 30 seats
- Truck 2-Axle
- Truck 3-Axle
- Truck 4- or more Axle
- Motor Tricycle
- Motorcycle

Information collected in each survey station were:

- Vehicle Type
- Type of Fuel
- Origin (Province and City / Municipality)
- Destination (Province and City / Municipality)
- Trip Purpose
- Number of Passengers
- Seat Capacity
- Commodity Type
- Commodity Weight
- Net Load Capacity

Passengers of buses and jeepneys were asked about their origin, destination and trip purpose.

Procedure

Survey forms for recording data in the field were prepared based on the forms used by DPWH. Forms were designed in a simple pattern to be easily understood and filled, and with coding areas to ease data processing. The survey forms used in the OD survey is shown in Appendix 5.1-2.

The survey period at each station continued in the two directions of traffic for two-day twelve-hours (07:00 – 19:00) on weekdays. Survey teams used portable traffic signs and cones for the traffic control and safety purposes.

The target number of samples which was calculated for each survey station according to the ADT (1996) and the following simplified formula was used for high sampling rates with low ADT and low rates with high ADT. The formula is derived from the methodology of the Department of Transport in the United Kingdom and provides ± 5% accuracy rate.

$$\text{Target Sample Rate} = \text{ADT} / (0.0003\ \text{ADT} + 1)$$

Based on the above formula, the target sample rate for the survey stations can be generalized as follows:

ADT Range	Target Sample Rate
- 1,500	75%
1,501 - 5,000	45%
5,001 - 20,000	20%
20,001 -	10%

(3) Traffic Count Survey

Purpose

The purpose of this survey was to supplement and update the traffic volume data and to determine the distribution of vehicle categories in the traffic flow, so that expansion factors can be estimated.

Location

Traffic count survey was conducted simultaneously with the OD survey at same stations. Additional 37 traffic count stations were selected in the islands of Mindoro, Masbate, Palawan, Bohol, Catanduanes, Camiguin, and Western Mindanao. Location of the survey station are presented in Figure 5.1-3.

Procedure

The adopted survey form is shown in Appendix 5.1-3.

The survey period at each station for this survey was two-day twelve-hours (07:00 – 19:00) on weekdays. The survey was conducted to collect traffic composition data in both directions by the following vehicle types:

- Car/Taxi/Jeep
- Jeepney
- Pick-up/Van
- Mini Bus < 30 seats
- Large Bus < 30 seats
- Truck 2-Axle
- Truck 3-Axle
- Truck 4- or more Axle
- Motor Tricycle
- Motorcycle

(4) Sample Size

Figure 5.1-4 presents the number of collected OD samples versus targeted samples estimated based on the daily traffic volumes. The sample size was generally higher than target number of samples except in several stations. This may be attributed to deletion of some inconsistent data such as internal trips and simple recording errors from original data during compilation of field data.

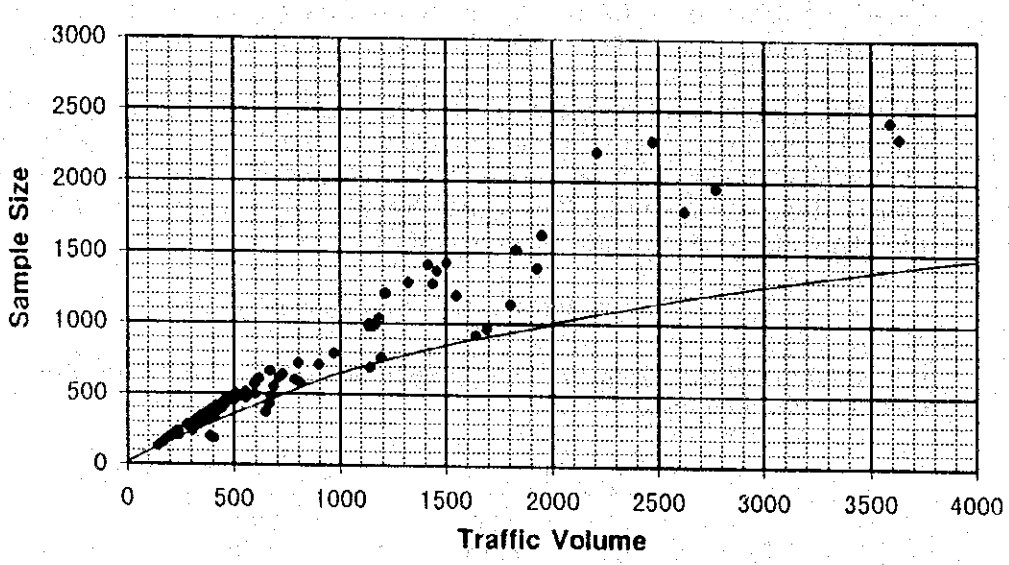


FIGURE 5.1-4 ACTUAL AND TARGET SAMPLE SIZE

(5) Check of Traffic Survey Results

It is essential to check the validity of traffic surveys and their expansion from sample survey data to represent the daily traffic volumes. All the data collected in the field were first manually checked and scrutinized for errors, omissions and ambiguous classifications during the coding procedure. Coding system of the National Statistics Office is used for municipalities and provinces as origins and destinations. Next, data were subject to systematical checks which were applied through the data processing stage to verify the accuracy of coding and the consistency of trip data. The applied systematical checks include the coding range check, and capacity limits check.

5.1.3 Preparation of Present OD Matrices

(1) Methodology

Zoning

Zoning was set in accordance with city/municipality division, with the following adjustments:

- Consolidate the municipalities having the same access point to the study road network,
- Subdivide the municipalities spreading over two or more nodes,
- Consolidate all cities/municipalities of a province outside the Study Area.

Number of zones is shown in Table 5.1-2.

TABLE 5.1-2 NUMBER OF ZONES

Island	Number of Cities/Municipalities	Number of Zones
Mindoro	24	24
Palawan	13	13
Romblon	13	16
Marinduque	6	6
Masbate	15	15
Catanduanes	11	11
Panay	95	95
Guimaras	5	8
Negros	57	55
Cebu	46	48
Bohol	47	47
Siquijor	6	6
Samar/Leyte/Biliran	129	124
Camiguin	5	5
Mindanao	367	368
Total	839	841

Kind of OD Matrices

The following 15 kinds of OD matrices were prepared:

1.	Vehicle	1-1	Car/taxi/jeep/pick-up/van
		1-2	Jeepney
		1-3	Bus
		1-4	Truck
2.	Passenger	2-1	Private vehicle passenger
		2-2	Jeepney passenger
		2-3	Bus passenger
3.	Commodity	3-1	Agricultural products by car/pick-up/van
		3-2	Manufactured products by car/pick-up/van
		3-3	Mineral products by car/pick-up/van
		3-4	Construction materials by car/pick-up/van
		3-5	Agricultural products by truck
		3-6	Manufactured products by truck
		3-7	Mineral products by truck
		3-8	Construction materials by truck

Note: Passenger and commodity OD matrices were prepared only for the islands where the roadside OD surveys were conducted.

Coverage of Roadside OD Survey

Although the Roadside OD Survey stations were located so as to collect data of as many OD pairs as possible, the Survey did not cover all OD pairs but only those that pass the Survey stations, as shown in Table 5.1-3.

TABLE 5.1-3 COVERAGE OF ROADSIDE OD SURVEY

Island	Total Number of OD Pairs *	Number of OD Pairs covered by the Survey	Number of Remaining OD Pairs
Mindoro	552 (100%)	-	552 (100%)
Palawan	156 (100%)	-	156 (100%)
Romblon	240 (100%)	-	240 (100%)
Marinduque	30 (100%)	-	30 (100%)
Masbate	210 (100%)	-	210 (100%)
Panay	8,930 (100%)	5,854 (66%)	3,076 (34%)
Guimaras	56 (100%)	-	56 (100%)
Negros	2,970 (100%)	2,072 (70%)	898 (30%)
Cebu	2,256 (100%)	1,592 (71%)	664 (29%)
Bohol	2,162 (100%)	-	2,162 (100%)
Siquijor	30 (100%)	-	30 (100%)
Samar/Leyte/Biliran	15,252 (100%)	13,164 (86%)	2,088 (14%)
Mindanao	135,056 (100%)	92,376 (68%)	42,680 (32%)
Total	167,900 (100%)	115,058 (69%)	52,842 (31%)

* excluding intra-zonal traffic

Procedures for Preparation of Present OD Matrices

OD volumes of the OD pairs passing the Survey stations (KNOWN OD) were obtained from the Survey data, while those not passing any Survey station (UNKNOWN OD) were estimated by the following means:

Vehicle OD Matrices

The procedure is shown in Figure 5.1-5.

1. KNOWN OD was obtained from the Roadside OD Survey data.
2. The OD Trip Model of gravity type was developed by multiple regression analysis using KNOWN OD as objective variable and populations of origin and destination zones and travel time as explanatory variables.
3. Initial volumes of UNKNOWN ODs were calculated applying the above model.
4. OD volumes were assigned to the road network to get the traffic volume on each link.
5. Traffic volume data on as many links of the network as possible were obtained from various sources. These volumes were used as CONTROL VOLUME.
6. The assigned volumes calculated in **4** above were compared with CONTROL VOLUME. If different, UNKNOWN ODs were adjusted and the link volumes based on the adjusted OD were re-calculated (back to **4** above). This **4** – **6** step was iterated until the assigned volume coincides with CONTROL VOLUME.

In the islands where the Roadside OD Survey was not conducted, the analysis started from **3**, by using the OD Trip Model developed in the other islands.

Private Vehicle Passenger OD Matrices

The procedure is shown in Figure 5.1-6.

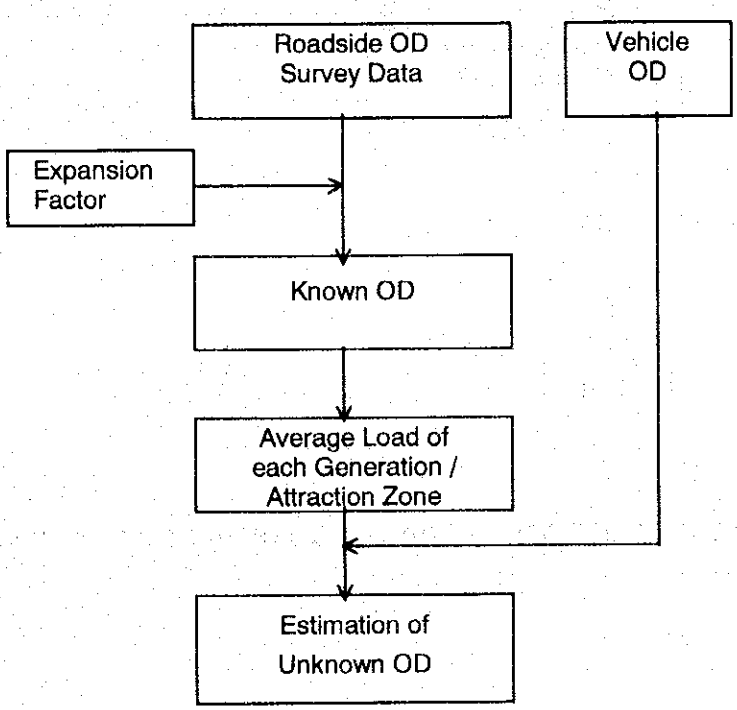


FIGURE 5.1-6 PROCEDURE FOR PREPARATION OF PRIVATE CAR PASSENGER OD AND COMMODITY OD MATRICES

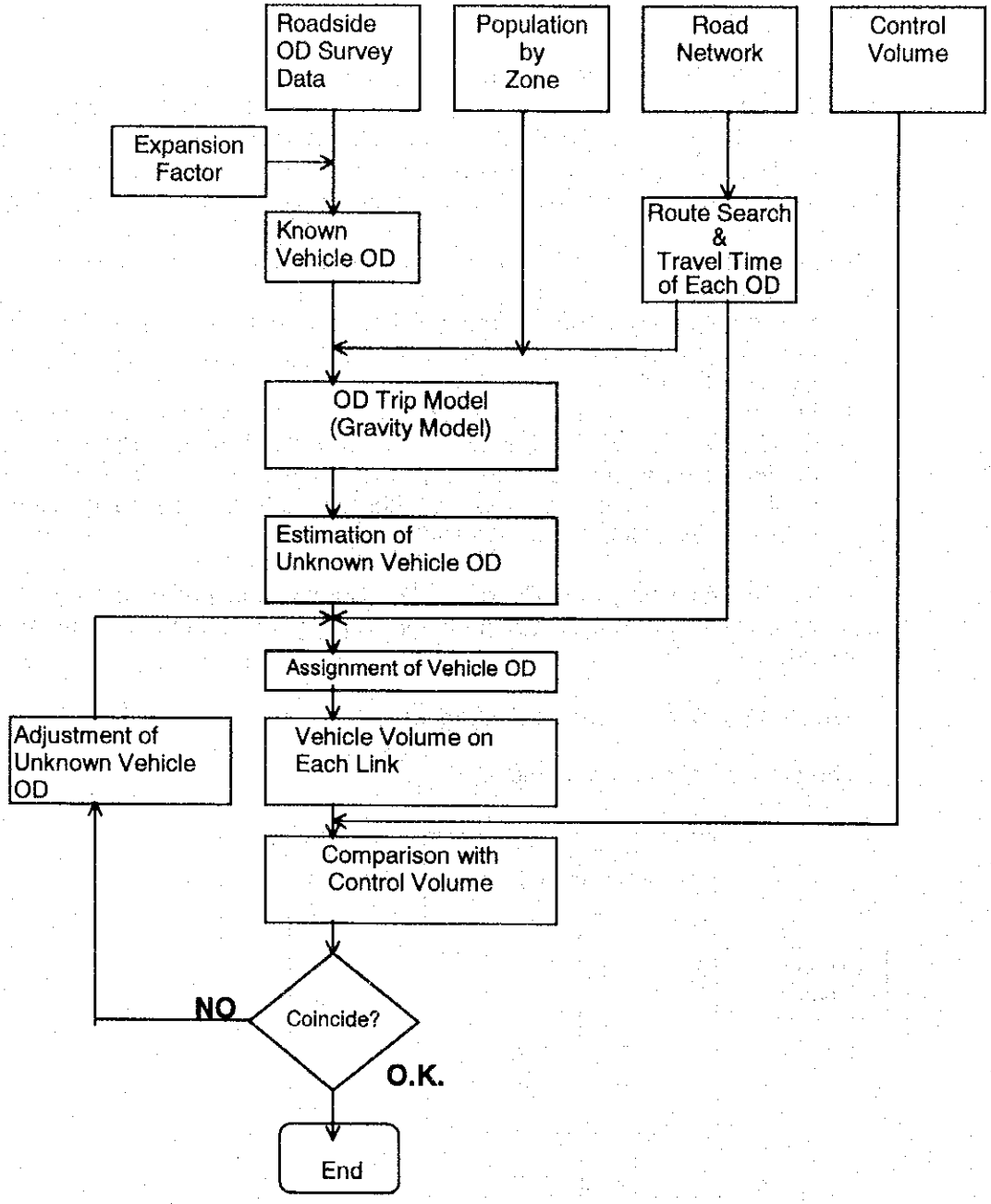


FIGURE 5.1-5 PROCEDURE FOR PREPARATION OF VEHICLE OD MATRICES

1. KNOWN OD was obtained from the survey results.
2. Based on the KNOWN OD, average number of passengers was obtained for each origin/destination.
3. UNKNOWN OD was estimated by multiplying the vehicle OD (previously obtained) by the average number of passengers of corresponding origin/destination. When the average number of passengers of the corresponding origin/destination was not available (i.e., no KNOWN OD has the same origin/destination), average value of the island was applied.

Jeepney / Bus Passenger OD Matrices

The procedure is shown in Figure 5.1-7. The method for preparing the jeepney/bus passenger OD matrices is similar to that for the vehicle OD matrices.

Jeepney/bus volume on every link has been estimated. Multiplying the volume by the average number of passengers obtained from the Survey results, the number of passengers on each link was estimated and used as CONTROL VOLUME.

Commodity OD Matrices

The method shown in Figure 5.1-6 is the same as that for the private vehicle passenger OD matrices, except that the average load was used instead of average number of passengers.

Analysis of Roadside OD Survey Data

The survey data were expanded to obtain the annual average daily volume. The expansion includes **1** sample data to 12 hours total volume, **2** 12 hours volume to 24 hours volume, **3** 24 hours volume on the specific day to annual average daily volume. **1** was done based on the Traffic Count Survey results carried out simultaneously with the Roadside OD Survey. **2** and **3** depended on the hourly variation and daily and seasonal variations of traffic respectively, which were derived from the Nationwide Traffic Counting Program (NTCP) data.

OD Trip Model

OD Trip model is expressed by the following form:

$$Xij = \alpha Pi\ Pj\ tij^{-\gamma}$$

where, X_{ij} : *OD volume from zone i to zone j*
P_i, P_j : *population of zone i and j*
t_{ij} : *travel time from zone i to zone j*
α, γ : *parameters obtained by the multiple regression analysis based on the KNOWN OD*

The parameters α and γ were calculated individually by island and by kind of OD.

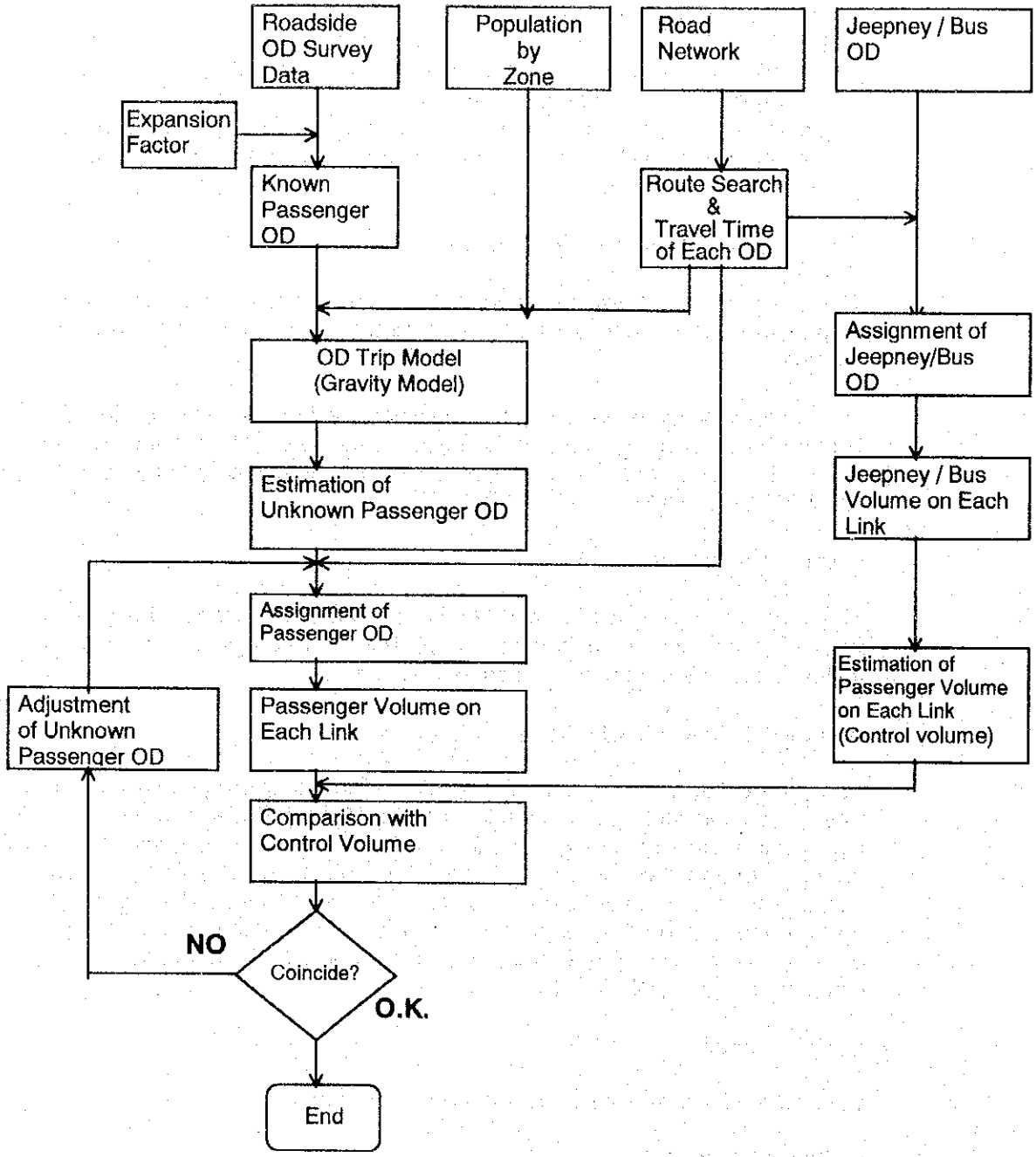


FIGURE 5.1-7 PROCEDURE FOR PREPARATION OF JEEPNEY/ BUS PASSENGER OD MATRICES

(2) Trip Characteristics

This Study dealt with only inter-city/municipality traffic. The local traffic within a city/municipality was not included.

Traffic Volume

Traffic volume was estimated by assigning the present OD matrices to the existing road network. The existing road network is shown in Appendix 9.3-1. Traffic volume is given in Appendix 9.3-2 and graphically shown in Figure 5.1-7.

Heavy traffic sections with more than 5,000 vehicles per day are as follows:

- Oton-Iloilo City-Zarraga (Iloilo)
- Enrique B. Magalona-Bacolod City-Bago City-Pontevedra (Negros. Occidental)
- Compostela-Cebu City-San Fernando (Cebu)
- Mandaue City-Lapu-lapu City (Cebu)
- Tacloban City and vicinity (Leyte)
- Cagayan de Oro City and vicinity (Misamis Oriental)
- Tagum-Davao City-Digos (Davao del Norte / Davao del Sur)
- Gen. Santos City-Polomolok (South Cotabato)
- Butuan City-Remedios T. Romualdez (Agusan del Norte)

Vehicle Trip

Table 5.1-4 presents total number of vehicle trips and total vehicle-km (cumulative running distance) by vehicle type for each island.

Vehicle type composition and average trip length in the whole Study Area are as follows:

	Composition in terms of number of trips	Composition in terms of vehicle-km	Average Trip Length
Car	44.4%	42.3%	35.7 km
Jeepney	29.9%	24.4%	30.6 km
Bus	5.5%	10.5%	71.5 km
Truck	20.1%	22.8%	42.5 km

Average trip length of jeepney is the shortest and that of bus is the longest. The latter is about 2.3 times as much as the former.

Passenger Trip

Table 5.1-5 presents total number of passenger trips and total trip-km by type of vehicle for the islands where the Roadside OD Surveys were conducted.

Vehicle type distribution and average trip length of the said islands are as follows:

	Vehicle Type Distribution	Average Trip Length
Car	17.8%	38.7 km
Jeepney	55.6%	27.0 km
Bus	26.5%	57.5 km

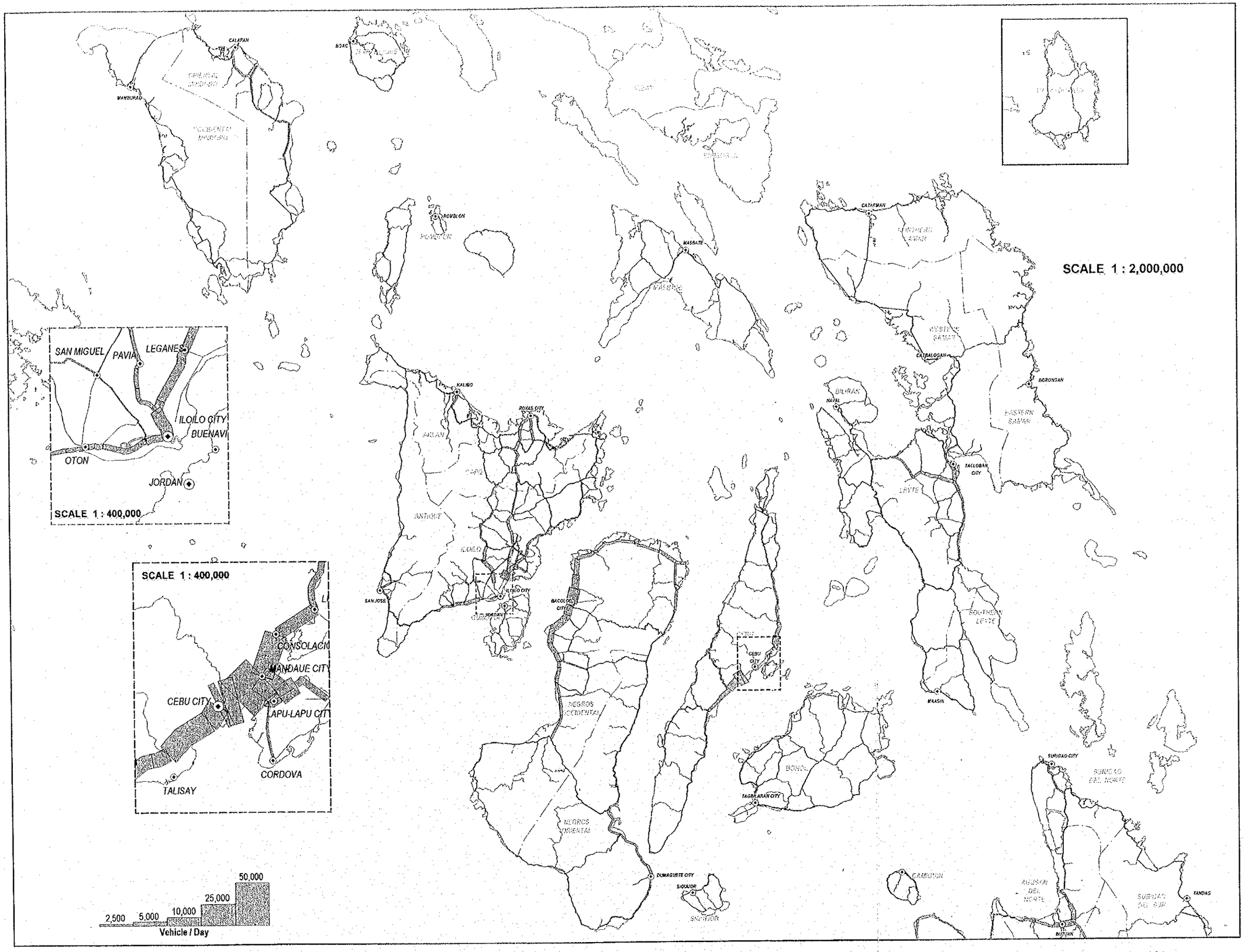


FIGURE 5.1-8(1) PRESENT TRAFFIC VOLUME

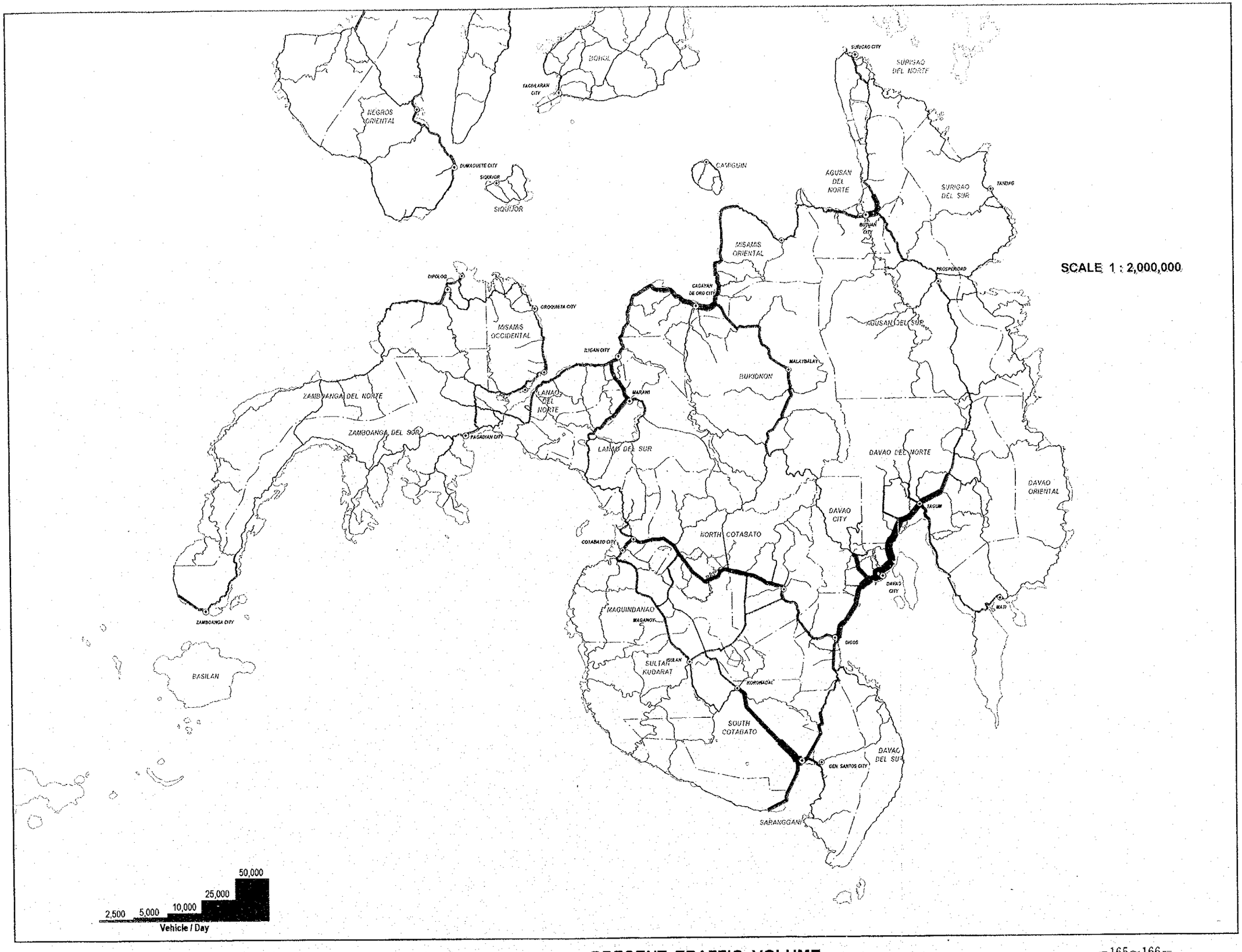


FIGURE 5.1-8(2) PRESENT TRAFFIC VOLUME

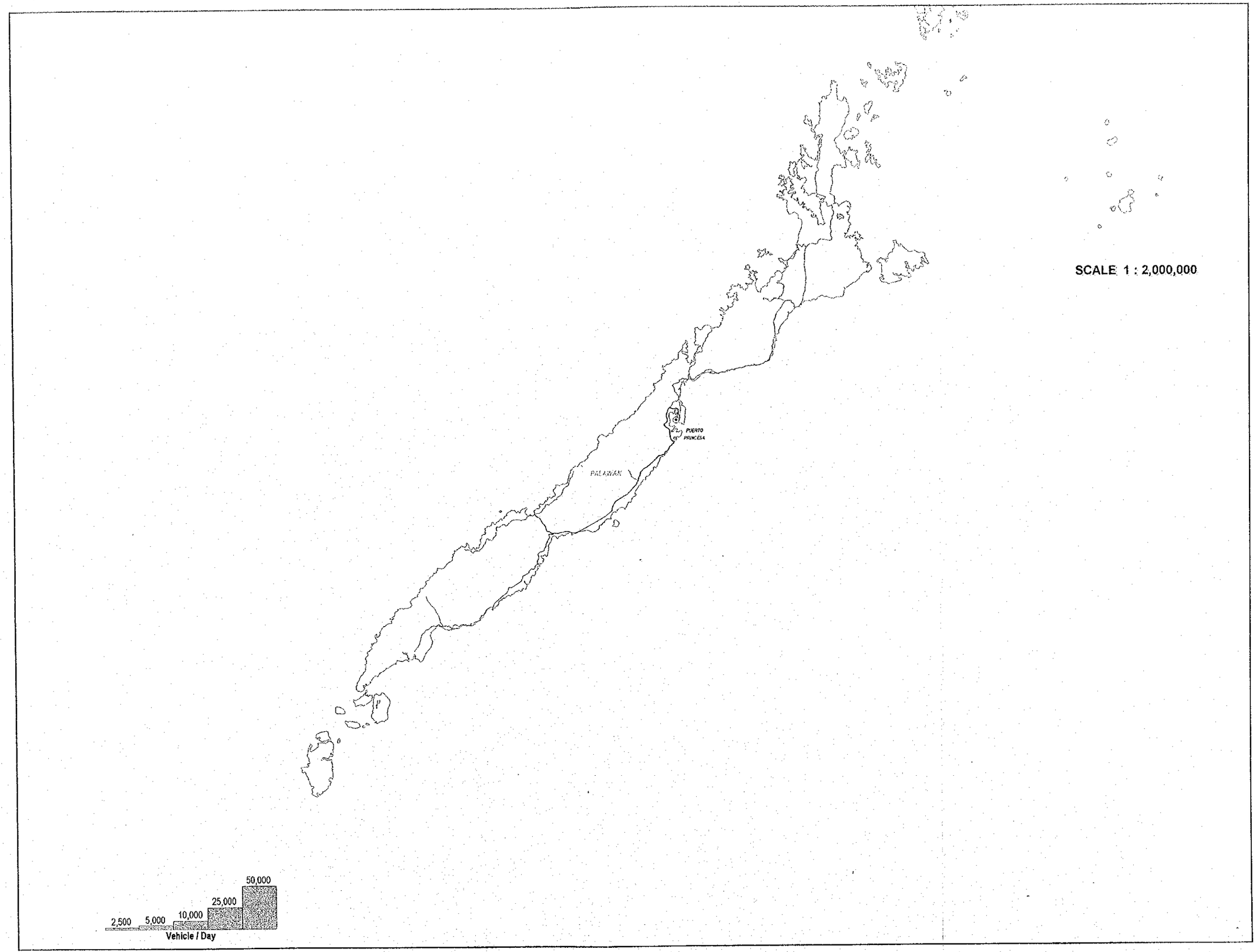


FIGURE 5.1-8(3) PRESENT TRAFFIC VOLUME

TABLE 5.1-4 NUMBER OF VEHICLE TRIPS AND AVERAGE TRIP LENGTH

Island	Total Number of Trips					Total Vehicle - Km					Average Trip Length (Km)				
	Car	Jeepney	Bus	Truck	Total	Car	Jeepney	Bus	Truck	Total	Car	Jeepney	Bus	Truck	Total
Mindoro	2,821	3,184	609	898	7,512	109,644	124,692	30,124	41,439	305,899	38.9	39.2	49.4	46.1	40.7
	(37.5%)	(42.4%)	(8.1%)	(12.0%)	(100.0%)	(35.8%)	(40.8%)	(9.8%)	(13.5%)	(100.0%)					
Palawan	450	352	134	392	1,328	47,666	29,334	19,783	34,671	131,454	106.0	83.3	147.9	88.3	99.0
	(33.9%)	(26.5%)	(10.1%)	(29.5%)	(100.0%)	(36.3%)	(22.3%)	(15.0%)	(26.4%)	(100.0%)					
Romblon	247	493	10	269	1,019	6,454	10,961	280	5,865	23,560	26.1	22.2	29.1	21.8	23.1
	(24.2%)	(48.4%)	(1.0%)	(26.4%)	(100.0%)	(27.4%)	(46.5%)	(1.2%)	(24.9%)	(100.0%)					
Marinduque	271	666	19	175	1,131	7,213	16,202	503	4,789	28,707	26.6	24.3	26.6	27.3	25.4
	(23.9%)	(58.9%)	(1.7%)	(15.5%)	(100.0%)	(25.1%)	(56.4%)	(1.8%)	(16.7%)	(100.0%)					
Masbate	577	745	38	281	1,641	27,321	32,118	2,541	13,598	75,578	47.4	43.1	67.5	48.4	46.1
	(35.2%)	(45.4%)	(2.3%)	(17.1%)	(100.0%)	(36.1%)	(42.5%)	(3.4%)	(18.0%)	(100.0%)					
Catanduanes	370	338	79	280	1,067	9,412	7,112	4,310	6,810	27,644	25.4	21.0	54.3	24.3	25.9
	(34.7%)	(31.7%)	(7.4%)	(26.2%)	(100.0%)	(34.0%)	(25.7%)	(15.6%)	(24.6%)	(100.0%)					
Panay	14,030	25,727	2,140	6,976	48,873	610,973	634,691	129,159	288,213	1,663,036	43.5	24.7	60.4	41.3	34.0
	(28.7%)	(52.6%)	(4.4%)	(14.3%)	(100.0%)	(36.7%)	(38.2%)	(7.8%)	(17.3%)	(100.0%)					
Guimaras	571	874	0	260	1,705	11,399	16,609	0	5,171	33,179	20.0	19.0	-	19.9	19.5
	(33.5%)	(51.2%)	(0.0%)	(15.3%)	(100.0%)	(34.4%)	(50.1%)	(0.0%)	(15.6%)	(100.0%)					
Negros	20,631	13,217	2,761	15,406	52,015	619,909	335,248	141,376	457,711	1,554,244	30.0	25.4	51.2	29.7	29.9
	(39.7%)	(25.4%)	(5.3%)	(29.6%)	(100.0%)	(39.9%)	(21.6%)	(9.1%)	(29.4%)	(100.0%)					
Cebu	65,539	25,944	2,859	17,131	111,473	907,496	347,170	122,942	279,425	1,657,033	13.8	13.4	43.0	16.3	14.9
	(58.8%)	(23.3%)	(2.6%)	(15.4%)	(100.0%)	(54.8%)	(21.0%)	(7.4%)	(16.9%)	(100.0%)					
Bohol	2,302	1,563	985	1,175	6,025	83,935	44,712	47,415	48,492	224,554	36.5	28.6	48.1	41.3	37.3
	(38.2%)	(25.9%)	(16.3%)	(19.5%)	(100.0%)	(37.4%)	(19.9%)	(21.1%)	(21.6%)	(100.0%)					
Siquijor	687	153	0	307	1,147	13,135	2,723	0	5,672	21,530	19.1	17.8	-	18.5	18.8
	(59.9%)	(13.3%)	(0.0%)	(26.8%)	(100.0%)	(61.0%)	(12.6%)	(0.0%)	(26.3%)	(100.0%)					
Samar / Leyte / Biliran	6,777	5,851	2,246	4,856	19,730	386,594	245,830	168,473	255,138	1,056,036	57.0	42.0	75.0	52.5	53.5
	(34.3%)	(29.7%)	(11.4%)	(24.6%)	(100.0%)	(36.6%)	(23.3%)	(16.0%)	(24.2%)	(100.0%)					
Camiguin	573	1,312	1	212	2,098	11,246	23,676	18	3,790	38,730	19.6	18.0	16.9	17.9	18.5
	(27.3%)	(62.5%)	(0.0%)	(10.1%)	(100.0%)	(29.0%)	(61.1%)	(0.0%)	(9.8%)	(100.0%)					
Mindanao *	50,062	31,240	8,686	26,505	116,493	3,073,220	1,542,142	802,618	1,742,525	7,160,505	61.4	49.4	92.4	65.7	61.5
	(43.0%)	(26.8%)	(7.5%)	(22.8%)	(100.0%)	(42.9%)	(21.5%)	(11.2%)	(24.3%)	(100.0%)					
TOTAL	165,908	111,659	20,567	75,123	373,257	5,925,617	3,413,220	1,469,542	3,193,309	14,001,688	35.7	30.6	71.5	42.5	37.5
	(44.4%)	(29.9%)	(5.5%)	(20.1%)	(100.0%)	(42.3%)	(24.4%)	(10.5%)	(22.8%)	(100.0%)					

* only for Study Area

TABLE 5.1-5 NUMBER OF PASSENGER TRIPS AND AVERAGE TRIP LENGTH

Island	Total Number of Trips				Total Trip - Km				Average Trip Length (Km)			
	Car	Jeepney	Bus	Total	Car	Jeepney	Bus	Total	Car	Jeepney	Bus	Total
Panay	67,544	346,949	74,511	489,004	3,085,348	8,073,313	3,763,844	14,922,505	45.7	23.3	50.5	30.5
	(13.8%)	(71.0%)	(15.2%)	(100.0%)	(20.7%)	(54.1%)	(25.2%)	(100.0%)				
Negros	60,360	214,203	105,849	380,412	1,792,159	4,478,786	4,233,505	10,504,450	29.7	20.9	40.0	27.6
	(15.9%)	(56.3%)	(27.8%)	(100.0%)	(17.1%)	(42.6%)	(40.3%)	(100.0%)				
Cebu	188,966	461,558	128,369	778,893	2,644,975	5,962,500	4,572,979	13,180,454	14.0	12.9	35.6	16.9
	(24.3%)	(59.3%)	(16.5%)	(100.0%)	(20.1%)	(45.2%)	(34.7%)	(100.0%)				
Samar / Leyte /	21,615	85,518	72,293	179,426	1,224,365	3,271,559	4,582,428	9,078,352	56.6	38.3	63.4	50.6
Biliran	(12.0%)	(47.7%)	(40.3%)	(100.0%)	(13.5%)	(36.0%)	(50.5%)	(100.0%)				
Mindanao	179,977	509,444	389,840	1,079,261	11,297,356	21,892,442	27,154,638	60,344,436	62.8	43.0	69.7	55.9
	(16.7%)	(47.2%)	(36.1%)	(100.0%)	(18.7%)	(36.3%)	(45.0%)	(100.0%)				
TOTAL	518,462	1,617,672	770,862	2,906,996	20,044,203	43,678,600	44,307,394	108,030,197	38.7	27.0	57.5	37.2
	(17.8%)	(55.6%)	(26.5%)	(100.0%)	(18.6%)	(40.4%)	(41.0%)	(100.0%)				

Inter-Municipal Trip rate (average number of trips per person per day) is given in Table 5.1-6. Average rate is 0.102. The highest rate is found in Cebu Island being 0.274 and the lowest in Samar/Leyte/Biliran Islands being 0.053.

Table 5.1-7 shows the average number of passengers per vehicle in each island. Overall average is as follows:

Car (including driver)	:	3.3 persons/vehicle
Jeepney (excluding driver)	:	15.9 persons/vehicle
Bus (excluding driver/conductor)	:	41.2 persons/vehicle

Commodity Movement

Table 5.1-8 presents commodity movement by type of commodity and vehicle type distribution. Agricultural products account for 41.4%, construction materials 25.0%, manufactured products 24.1% and mineral products 9.4%. Agricultural products were significant in Panay and Negros Islands accounting for 55-58%, and construction materials were significant in Cebu Island accounting for about 50%. Regarding vehicle type distribution, about 95% of commodity was carried by trucks.

Table 5.1-9 shows the average load including empty trucks. Average load of truck is 3.36 ton per vehicle.

TABLE 5.1-6 INTER-MUNICIPAL TRIP RATE

Island	Total Number of Passenger Trips	Population	Trip Rate (trip/person)
Panay	489,004	3,314,430	0.148
Negros	380,412	3,588,496	0.106
Cebu	778,893	2,840,451	0.274
Samar / Leyte / Biliran	179,426	3,355,487	0.053
Mindanao	1,079,261	15,471,377	0.070
TOTAL	2,906,996	28,570,241	0.102

ABLE 5.1-7 AVERAGE NUMBER OF PASSENGERS (person/vehicle)

Island	Car	Jeepney	Bus	Average
Panay	4.8	13.5	34.8	11.7
Negros	2.9	16.2	38.3	10.4
Cebu	2.9	17.8	44.9	8.3
Samar / Leyte / Biliran	3.2	14.6	32.2	12.1
Mindanao	3.6	16.3	44.9	12.0
Average	3.3	15.9	41.2	10.5

TABLE 5.1-8 COMMODITY MOVEMENT AND VEHICLE TYPE DISTRIBUTION (ton)

Island	Agricultural Products	Manufactured Products	Mineral Products	Construction Materials	Total	Vehicle Type Distribution	
						Car	Truck
Panay	16,670	6,166	3,231	3,895	29,962	1,948	28,013
	(55.6%)	(20.6%)	(10.8%)	(13.0%)	(100.0%)	(6.5%)	(93.5%)
Negros	37,620	16,209	4,136	6,547	64,512	2,629	61,882
	(58.3%)	(25.1%)	(6.4%)	(10.1%)	(100.0%)	(4.1%)	(95.9%)
Cebu	10,946	12,843	5,523	29,177	58,489	4,548	53,941
	(18.7%)	(22.0%)	(9.4%)	(49.9%)	(100.0%)	(7.8%)	(92.2%)
Samar / Leyte / Biliran	3,505	3,486	1,298	4,902	13,191	668	12,523
	(26.6%)	(26.4%)	(9.8%)	(37.2%)	(100.0%)	(5.1%)	(94.9%)
Mindanao	34,998	21,800	9,483	18,221	84,502	2,716	81,786
	(41.4%)	(25.8%)	(11.2%)	(21.6%)	(100.0%)	(3.2%)	(96.8%)
TOTAL	103,739	60,504	23,671	62,742	250,656	12,509	238,145
	(41.4%)	(24.1%)	(9.4%)	(25.0%)	(100.0%)	(5.0%)	(95.0%)

TABLE 5.1-9 AVERAGE LOAD (ton/vehicle)

Island	Car	Truck	Average
Panay	0.14	4.02	1.43
Negros	0.13	4.02	1.79
Cebu	0.07	3.15	0.71
Samar / Leyte / Biliran	0.10	2.58	1.13
Mindanao	0.05	3.09	1.10
Average	0.08	3.36	1.10

5.2 SEA TRANSPORT

The Study Area is composed of numerous islands, therefore, the sea and air transport is playing major roles in transporting passengers and cargos between islands. Efficient and effective inter-linkage between the road transport and the sea/air transport is quite important.

5.2.1 Port Classification

There are about 1,250 ports in the Philippines, 123 public ports under the Philippine Port Authority (PPA), 7 under the Cebu Port Authority (CPA), 179 fishing ports under the Philippine Fisheries Development Authority (PFDA), about 720 municipal ports under the municipal governments and about 220 private ports. PPA and CPA classify the ports into base ports, terminal ports and other government-owned ports. The location map of base and terminal ports is presented in Figure 5.2-1.

5.2.2 Cargo and Passenger Traffic

PPA and CPA summarize cargo and passenger traffic by port under their jurisdiction every year. Data on cargo and passenger traffic by port management office in 1995 are summarized in Table 5.2-1.

About 72.4 million tons of domestic cargos a year were transported by the sea transport. Foreign cargos were amounted to about 58.6 million tons a year, of which about 71% (or 41.8 million tons) were import cargos. About 41.9 million passengers were transported by the sea transport.

Based on the above statistics, cargo ODs with breakdown of commodity types and sea passenger ODs were roughly estimated by the JICA Study Team. Regional passenger and cargo distributions were presented in Appendix 5.2-1 and 2, and illustrated in Figures 5.2-2 and -3 respectively.

5.2.3 Major Shipping and Ro-Ro Service Routes in the Study Area

Major shipping routes in the Study Area are presented in Figure 5.2-4, which covers all base ports and some important terminal ports.

Figure 5.2-5 shows the Ro-Ro service links studied under the JICA-Assisted Nationwide Roll-on Roll-off Transport System Development Study (1992) and their priorities. Among the Ro-Ro service links shown in the figure, the existing ones are as follows:

- Batangas City - Calapan (Oriental Mindoro)
- Batangas City - Abra de Ilog (Occidental Mindoro)
- Escalante (Negros Oriental) - Tuburan (Cebu)
- San Carlos City (Negros Oriental) - Toledo City (Cebu)
- Dumaguete City (Negros Oriental) - Santander (Cebu)
- Dumaguete City (Negros Oriental) - Larena (Siquijor)
- Cebu City (Cebu) - Tagbilaran (Bohol)
- Matnog (Sorsogon) - Allen (Northern Samar)
- Matnog (Sorsogon) - San Isidro (Northern Samar)
- Liloan (Soutern Leyte) - Lipata (Surigao del Norte)
- Tangub (Misamis Occidental) - Tubod (Lanao del Norte)

One or two Ro-Ro vessels with carrying capacity of less than 20 vehicles are operating in each link and make at most 3 round trips per day, therefore, vehicle carrying capacity per day is still very low.

Although there are other links with Ro-Ro vessels such as Cebu-Nasipit, Cebu-Cagayan de Oro, etc., trip frequency of these routes are mostly 3 or 2 times a week or less.

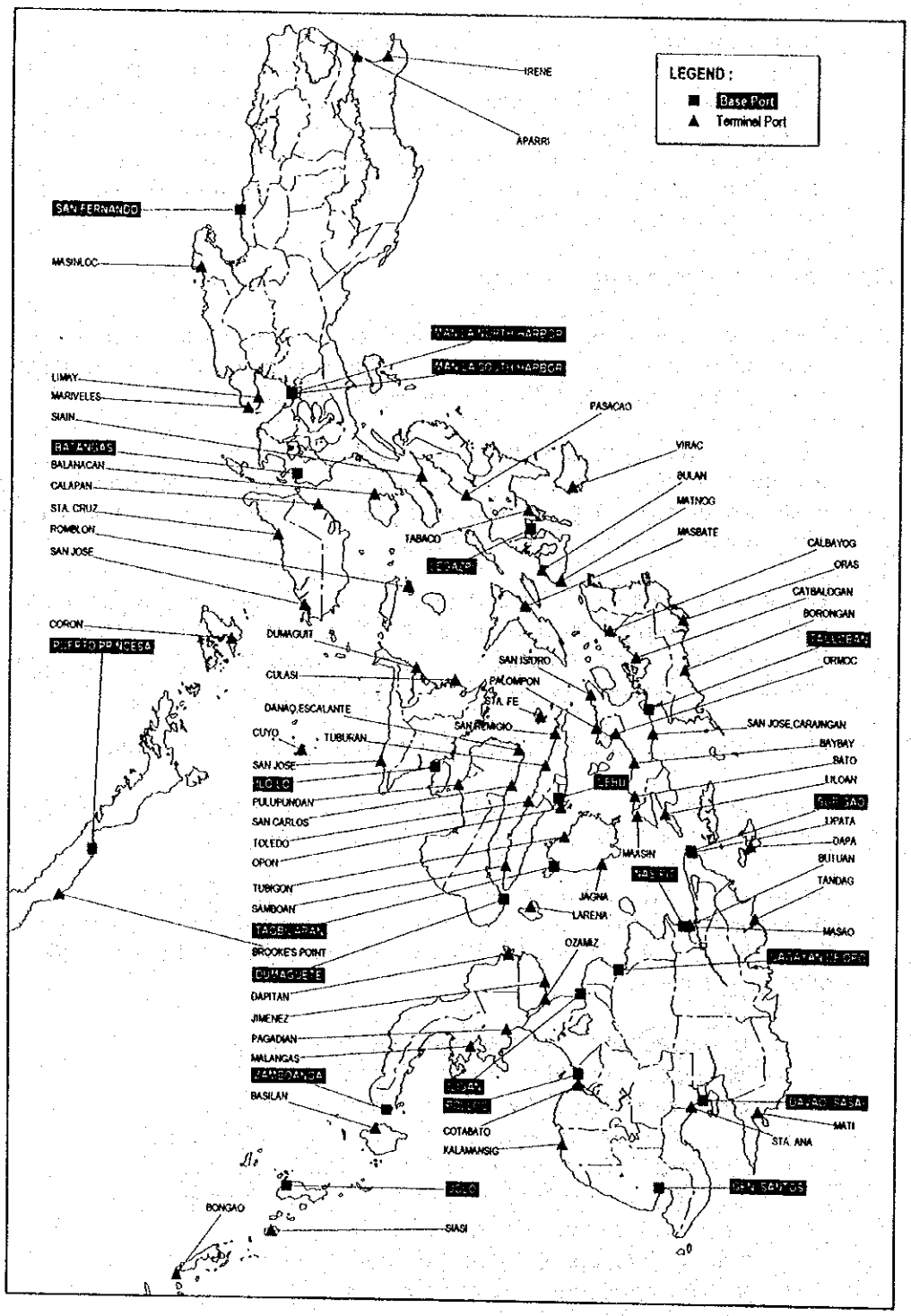


FIGURE 5.2-1 BASE AND TERMINAL PORT IN THE PHILIPPINES

TABLE 5.2-1 CARGO AND PASSENGER STATISTICS BY PORT MANAGEMENT OFFICE: 1995

PORT MANAGEMENT OFFICE	CARGO THROUGHPUT (in metric tons)				PASSENGER TRAFFIC	
	DOMESTIC		FOREIGN			
	INWARD	OUTWARD	IMPORT	EXPORT	DISEMBARKED	EMBARKED
A. Philippine Port Authority (PPA)						
1. Batangas	2,657,428	5,128,191	10,527,196	1,686,770	2,110,503	2,050,406
2. Cagayan de Oro	2,710,600	1,695,428	5,706,109	5,788,906	1,071,601	1,047,626
3. Davao	1,762,735	1,118,856	858,828	1,576,129	255,369	248,542
4. Dumaguete	854,723	620,853	25,582	219,616	968,133	996,112
5. General Santos	624,583	740,219	173,411	481,216	60,321	82,981
6. Iligan	1,257,478	1,752,556	1,607,613	586,862	2,330,419	2,389,227
7. Iloilo	3,855,621	2,281,167	640,159	180,319	2,244,331	2,266,538
8. Jolo	97,661	114,506	0	0	590,848	566,810
9. Legaspi	1,568,186	885,335	55,949	175,632	817,919	820,719
10. Manila - N. Harbor	7,332,419	12,035,762	6,371,375	759,269	2,148,738	2,118,222
11. Manila - S. Harbor	5,123,575	171,153	8,472,999	377,947	7,871	7,820
- M.I.C.T.	30,423	0	3,636,291	1,975,795	0	0
12. Nasipit	537,787	513,528	113,862	14,680	312,407	303,576
13. Polloc	342,062	442,930	120,694	31,326	203,743	201,511
14. Puerto Princesa	262,723	150,142	9,322	678,678	97,533	85,678
15. San Fernando	1,026,100	184,277	798,667	138,744	0	0
16. Surigao	492,142	1,120,362	326,558	451,291	526,887	571,684
17. Tacloban	1,837,255	2,011,469	1,815,488	1,089,906	1,453,430	1,381,300
18. Tagbilaran	543,151	1,166,034	0	115,259	1,040,263	1,027,550
19. Zamboanga	1,330,130	627,853	66,955	295,622	1,610,654	1,649,362
Sub-total for PPA	34,246,782	32,760,621	41,327,058	16,623,967	17,850,970	17,815,664
B. Cebu Port Authority (CPA)	2,942,136	2,439,952	458,074	188,345	3,242,289	2,964,565
TOTAL	**37,188,918**	**35,200,573**	**41,785,132**	**16,812,312**	**21,093,259**	**20,780,229**

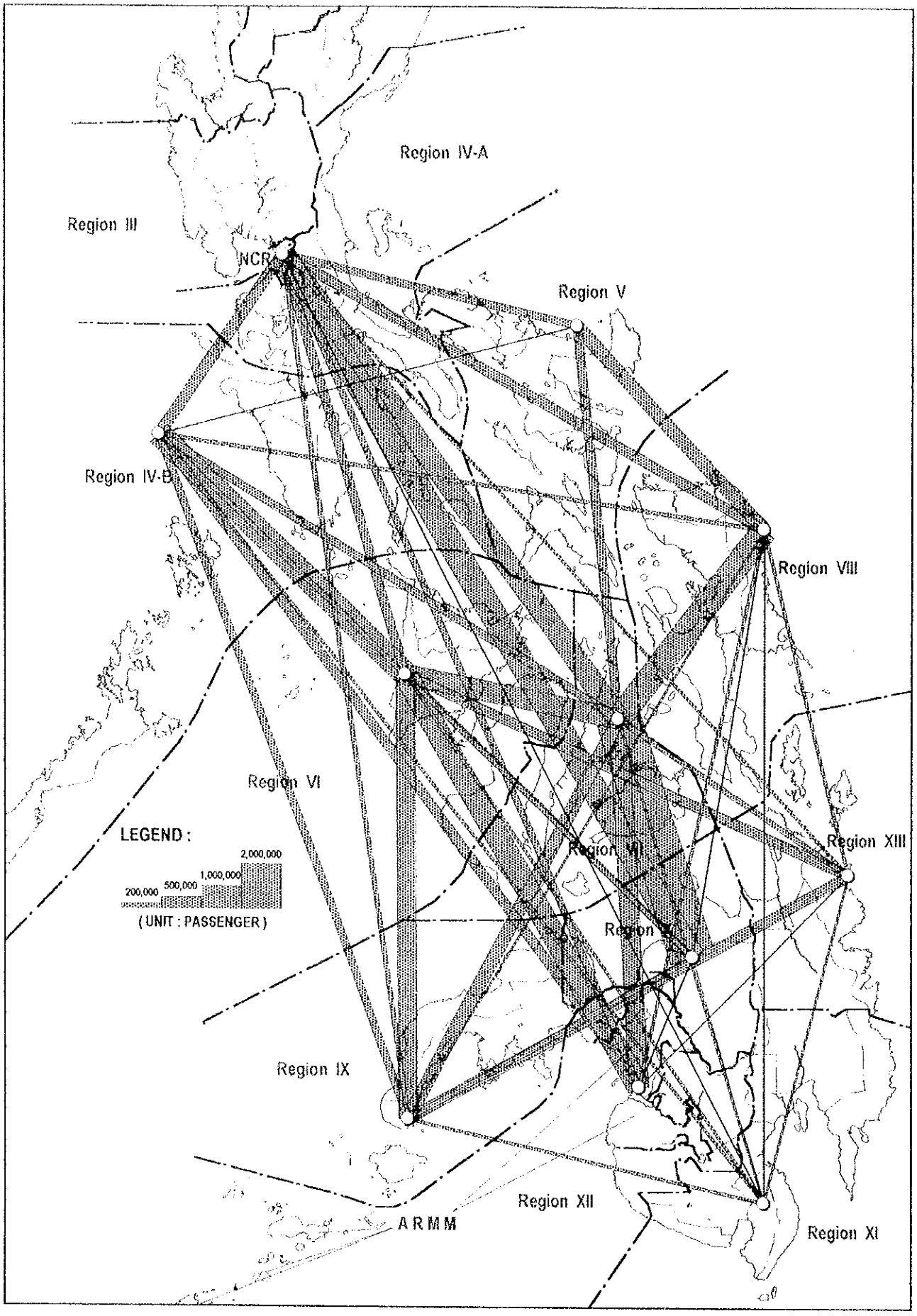


FIGURE 5.2-2 INTER-REGIONAL SEA PASSENGER MOVEMENT

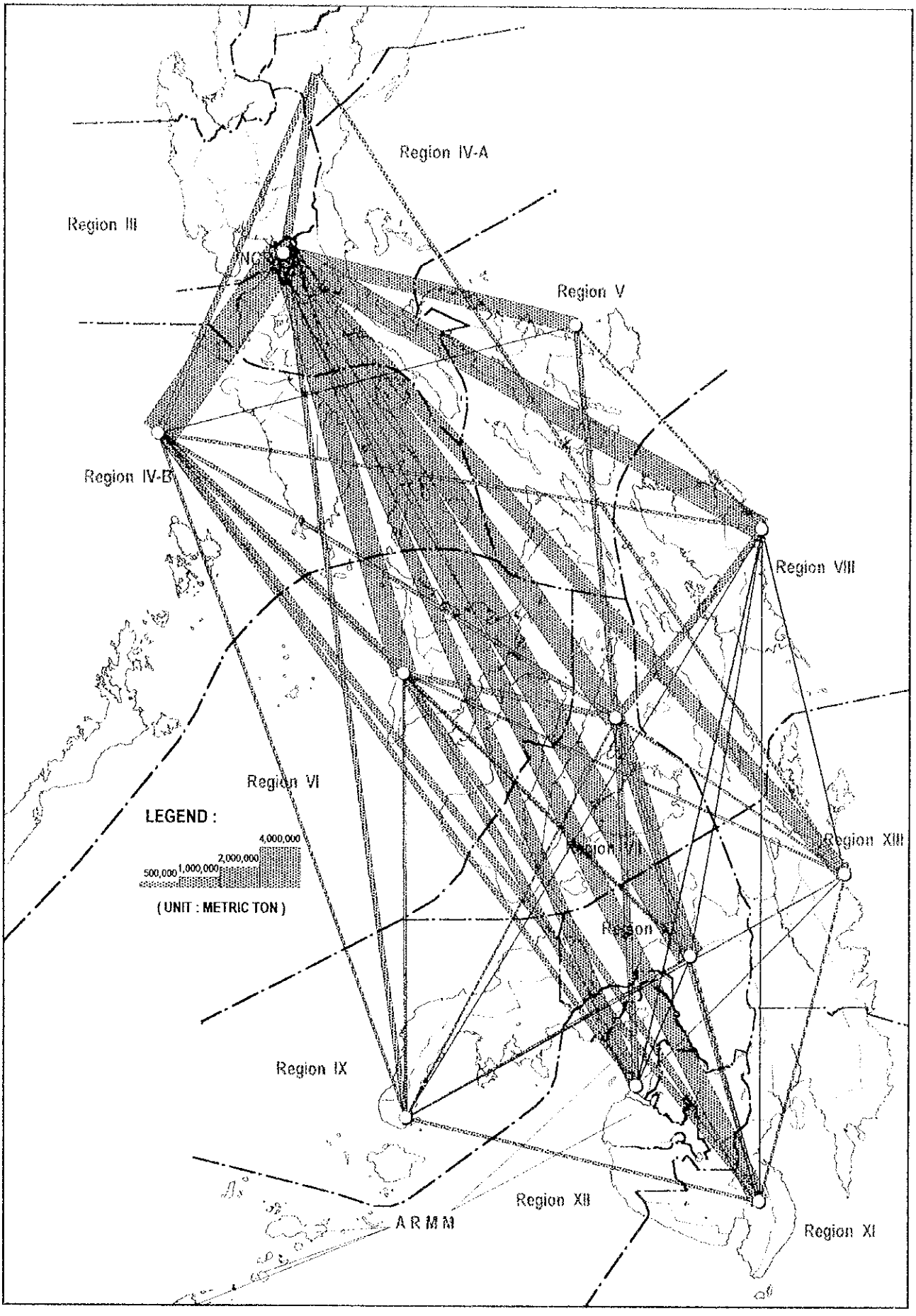
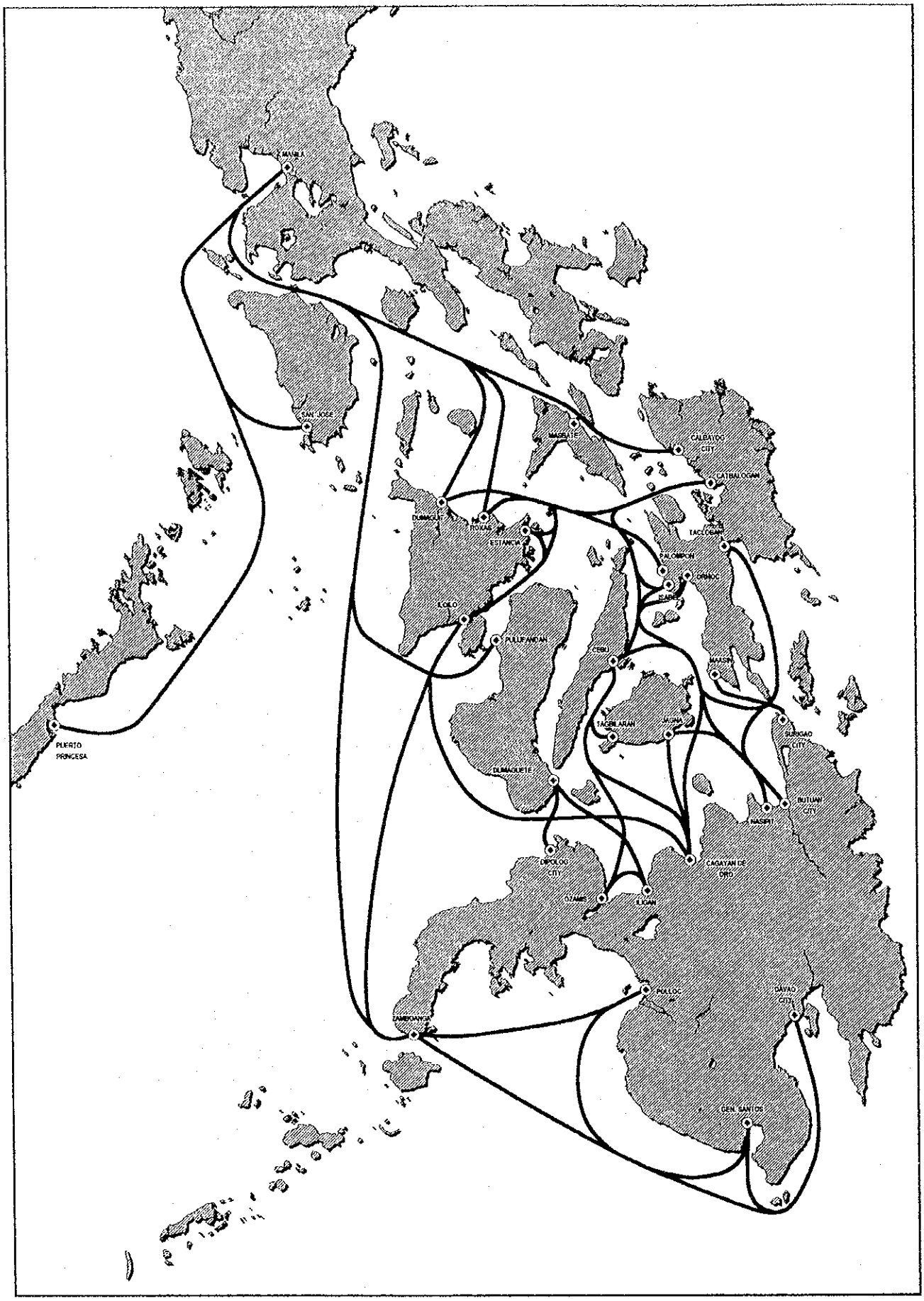
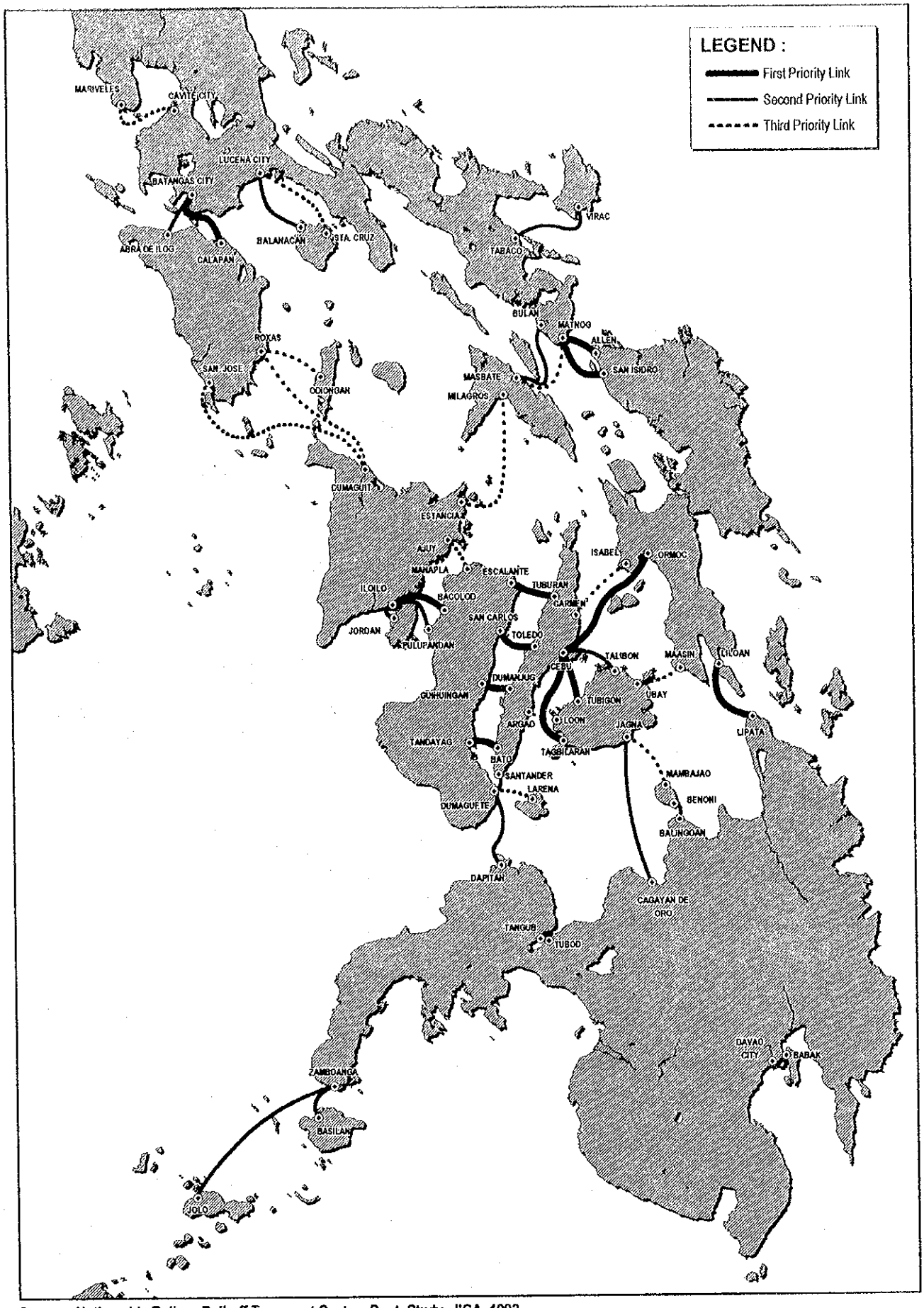


FIGURE 5.2-3 INTER-REGIONAL COMMODITY MOVEMENT



Source : Domestic Ship-owners Association

FIGURE 5.2-4 MAJOR SHIPPING ROUTE IN THE STUDY AREA



Source : Nationwide Roll-on Roll-off Transport System Devt. Study, JICA, 1992

FIGURE 5.2-5 RO - RO SERVICE LINKS

5.3 AIR TRANSPORT

5.3.1 Airport Classification

Airports in the Philippines are classified into five categories and number of airports for each category is as follows:

Airport Classification	No. of Airports
Regular International Airport	4
Alternate International Airport	4
Trunkline Airport	12
Secondary Airport	37
Feeder Airport	34

Location map of airports in the Philippines is presented in Figure 5.3-1.

There are three proposed new airport in the Study Area as follows:

- New Iloilo Airport
- New Bacolod Airport
- New Laguindingan Airport to replace Cagayan de Oro Airport

5.3.2 Air Passengers Traffic and their Movement

Domestic air passenger OD between airports in 1996 is presented in Appendix 5.3-1 and graphically shown in Figure 5.3-2. Total number of air passengers was 10.2 million, of which about 42% (or 4.3 million) were boarded/landed at Manila Airport, 20% (or 2.0 million) at Cebu Airport, and 8% (or 0.8 million) at Davao Airport.

5.3.3 Air Cargo Traffic

Cargos transported by the air transport amounted only 55,000 tons in 1994, which is still very small in magnitude and negligible for this Study.

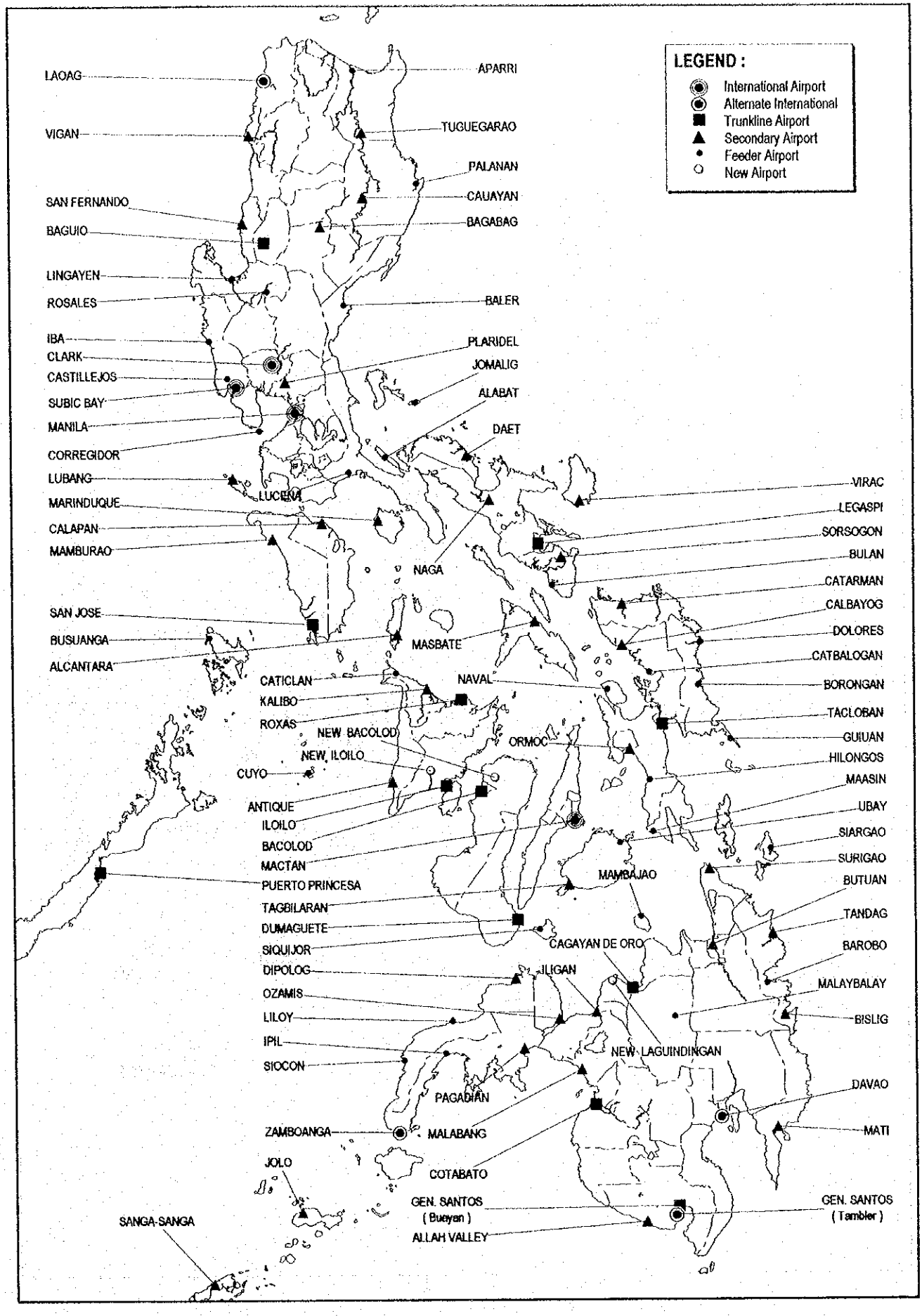


FIGURE 5.3-1 AIRPORTS IN THE PHILIPPINES

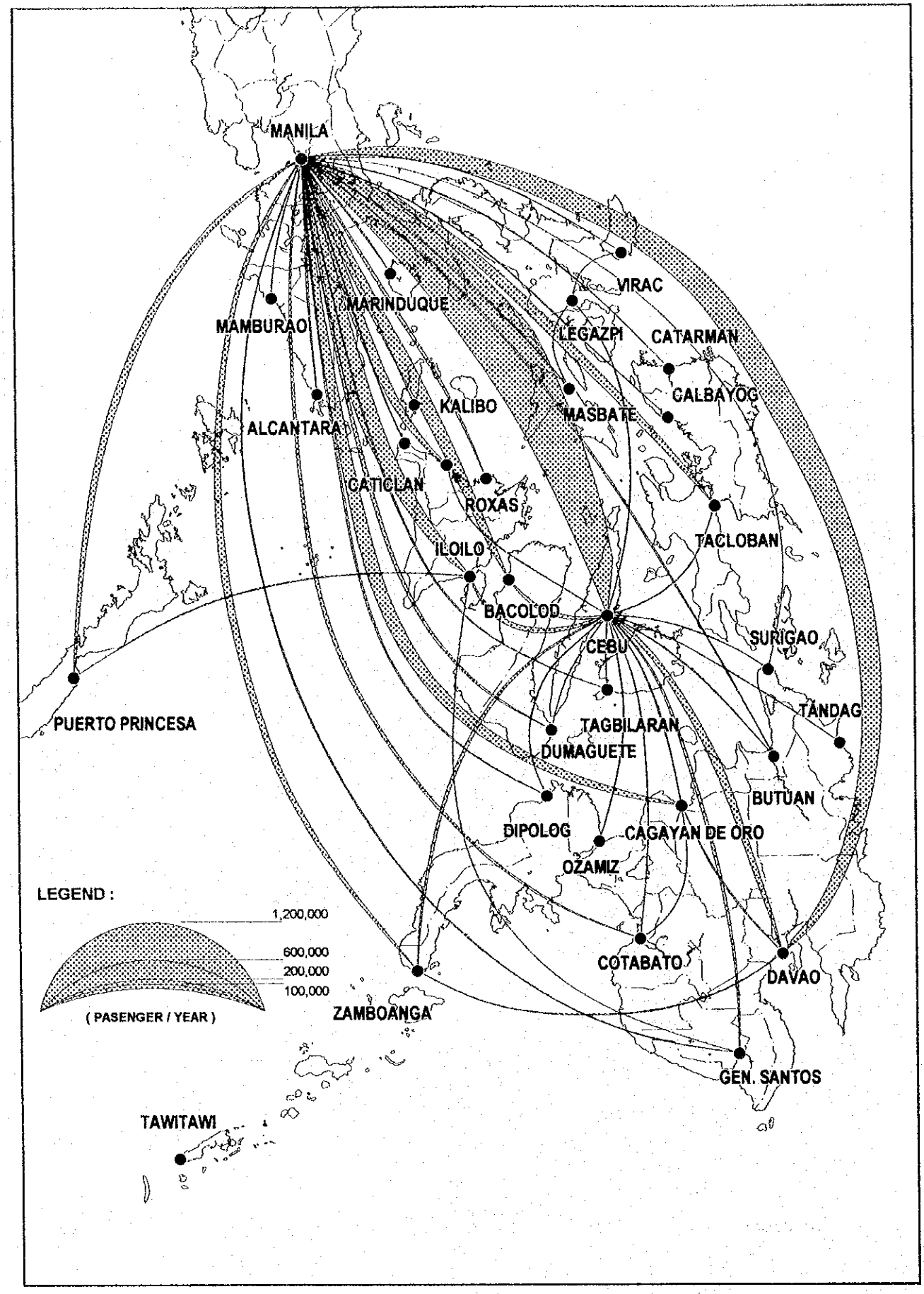


FIGURE 5.3-2 AIR PASSENGER MOVEMENT

5.4 RAIL TRANSPORT

There is no railway operating in the Study Area. There is a proposal to develop a Mindanao Railway System as shown in Figure 5.4-1, but is still a planning stage. Funding sources for the proposed project, implementation schedule, etc. are still unknown at this stage.

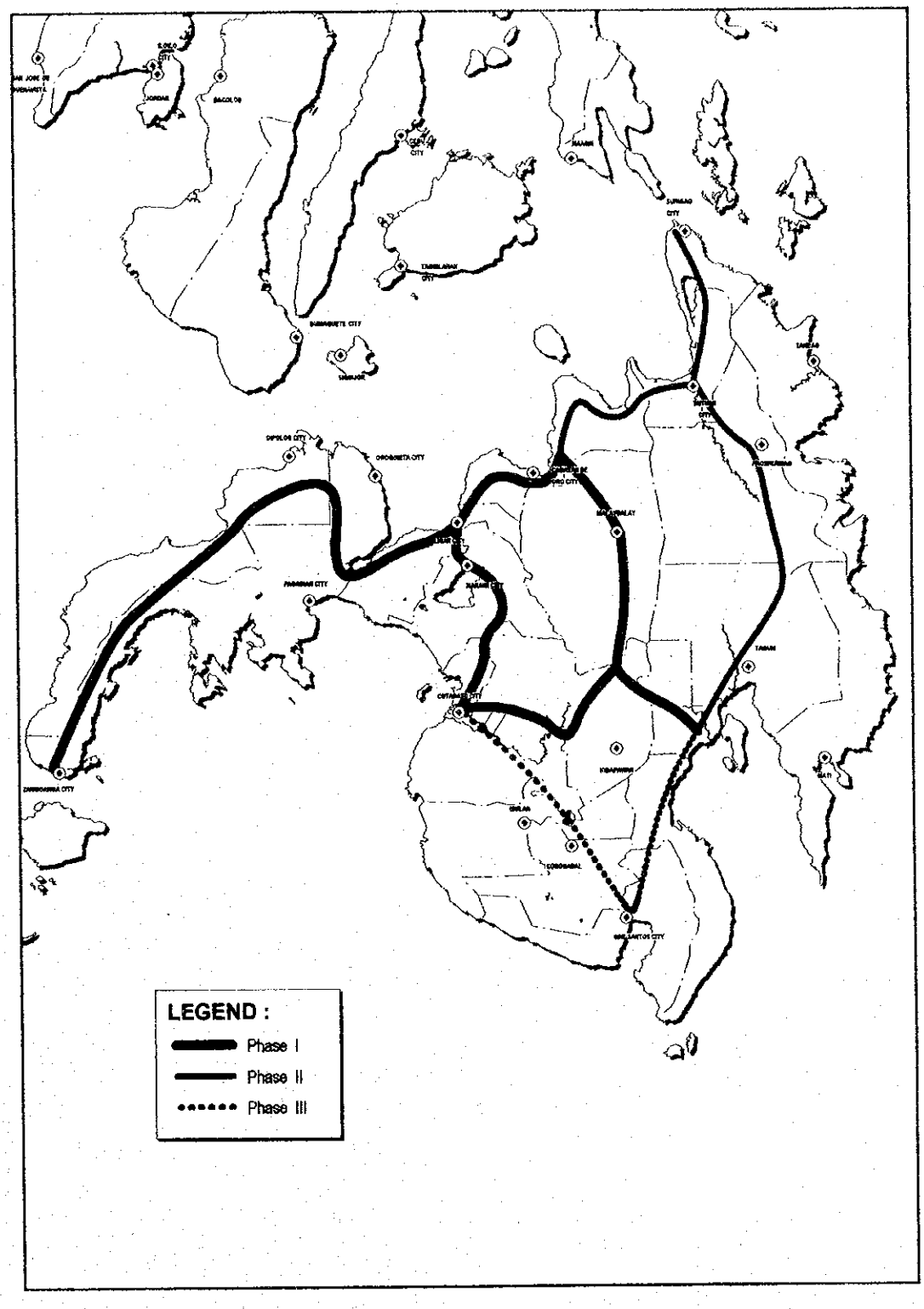


FIGURE 5.4-1 PROPOSED MINDANAO RAILWAY SYSTEM (LONG TERM VIEW)