

4.8 PREPARATION OF PRESENT OD MATRICES

4.8.1 Methodology

To establish the present OD matrices, OD data are collected through the road-side OD survey at 15 stations on 6 screen lines. Trip matrices for each vehicle category formed directly from expanded information contain only an estimate of the total number of those movements intercepted by the survey. As the collected data are insufficient to establish island-wide OD matrices for the all number of zones, a calibration technique is developed and applied to compensate unknown OD pairs through known traffic volumes.

Sample OD data as number of vehicles are first expanded based on the traffic count data, selected on the screen lines and after applying different fluctuation factors, to formulate expanded OD tables for the known OD pairs. Then, they are combined with unknown OD pairs estimated through a population base gravity model. A calibration procedure is carried out to adjust the resulted OD matrices by comparing their assigned traffic volumes with the actually observed volumes on the road network. A flow chart of the applied procedure to establish vehicular OD matrices is shown in Figure 4.8-1.

In establishing the passenger and commodity OD matrices, and when comparing the OD pattern for passenger and commodity movements, passenger trips in total can be represented in triangle pattern of OD matrices since their final destination is almost the very origin of their trips. On the other hand, and because the production and consumption areas for commodities are mostly different depending on each type of commodities, commodity movement should be represented in the square pattern of OD matrices and for each group of commodities separately. Figure 4.8-2 simplifies the procedure applied on the generated and attracted trips of sample and vehicle matrices to establish the present OD matrices for each commodity group.

In this procedure to establish the present OD matrices, the "all-or-nothing" traffic assignment technique is applied to assign the combined OD matrices of known and unknown OD pairs on the road network so the resulted volumes can be calibrated with the observed volumes. In this assignment technique, the road network is split up into links which are lengths of road between trip generators and important junctions known as nodes. Links and nodes are coded, and the additional information typically needed on the road and traffic conditions are determined through the road inventory data base.

The applied zoning system of Luzon Island is presented in Figure 4.8-3 with the municipalities of each zone as in Appendix 4.5. This zoning system is made on the basis of the existing and proposed road networks and the municipality population distribution. The total number of 634 municipalities in the study area is grouped into 98 zones. The node and link system used in the assignment for the road network is presented in Figure 4.8-4.

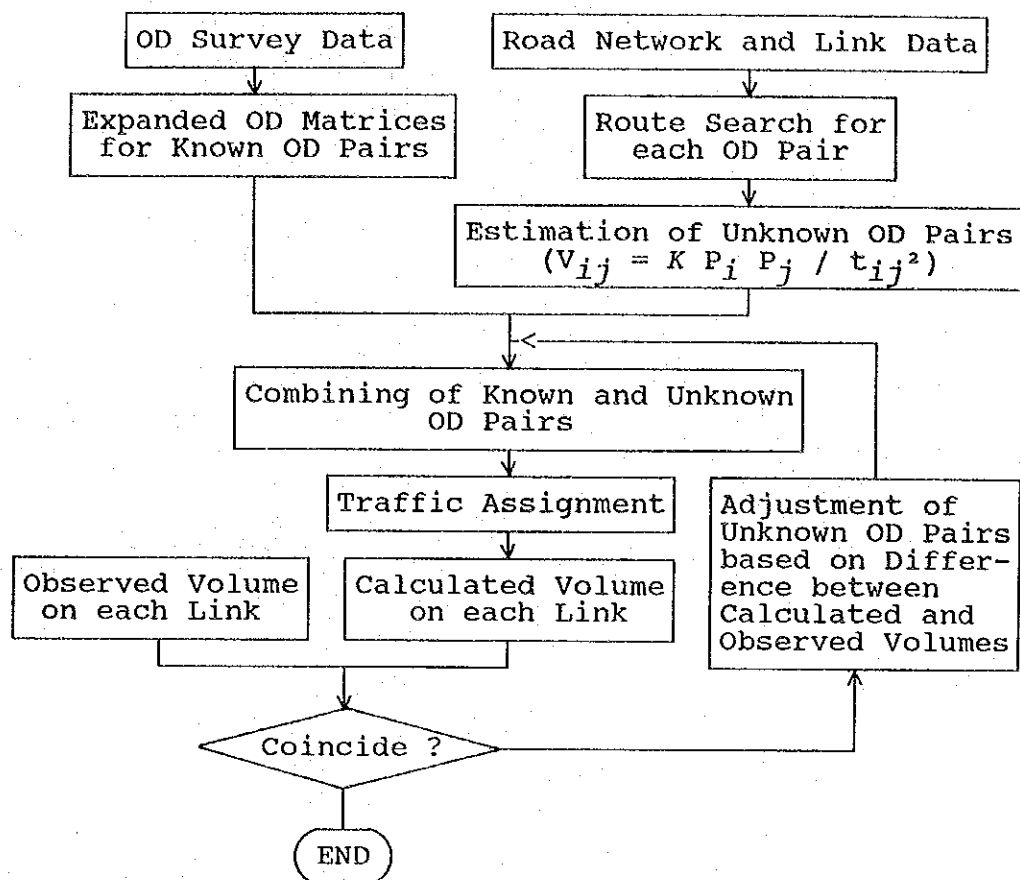


FIGURE 4.8-1 ESTABLISHMENT OF PRESENT OD MATRICES FOR VEHICLES

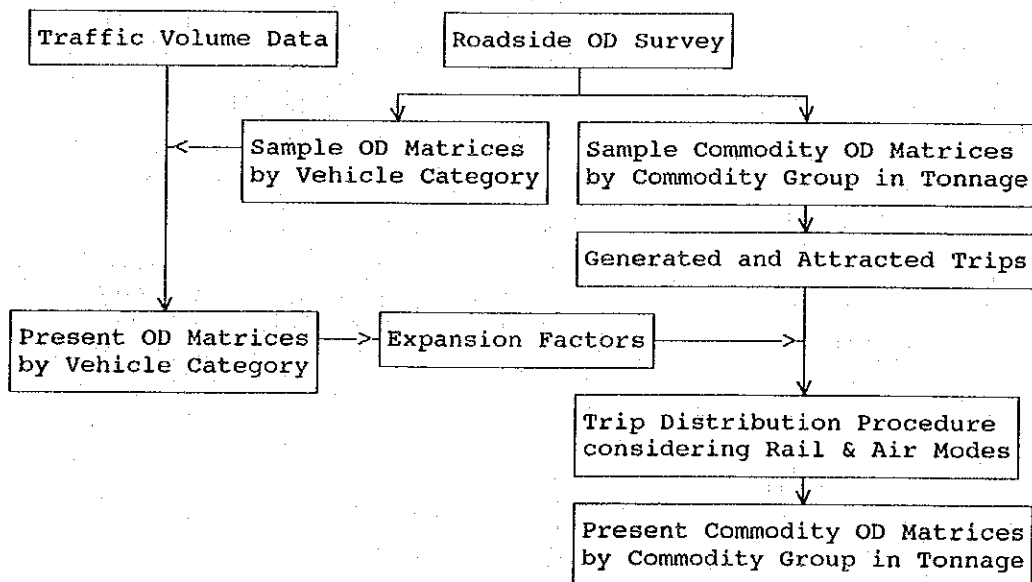


FIGURE 4.8-2 ESTABLISHMENT OF PRESENT OD MATRICES FOR COMMODITIES

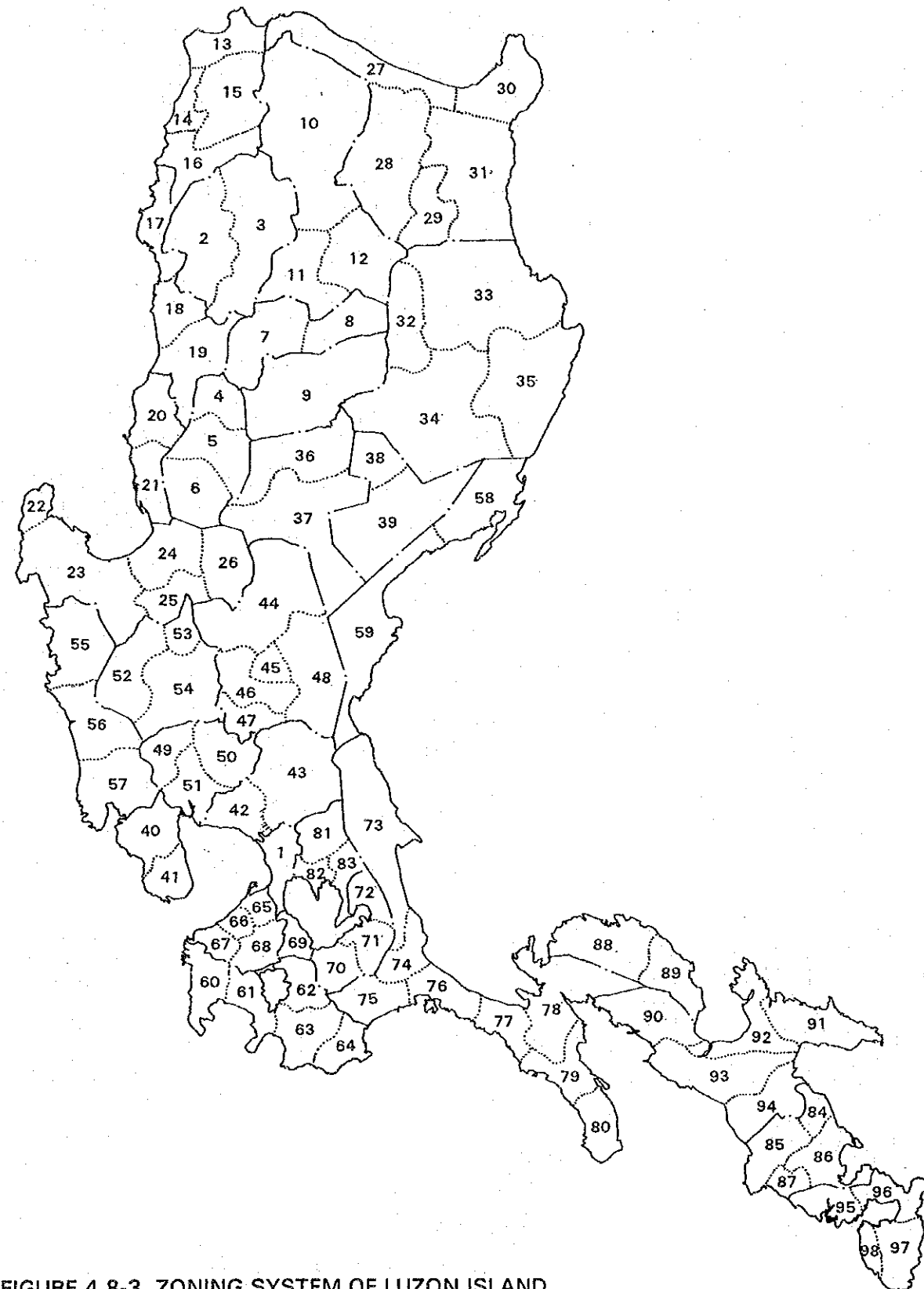


FIGURE 4.8-3 ZONING SYSTEM OF LUZON ISLAND

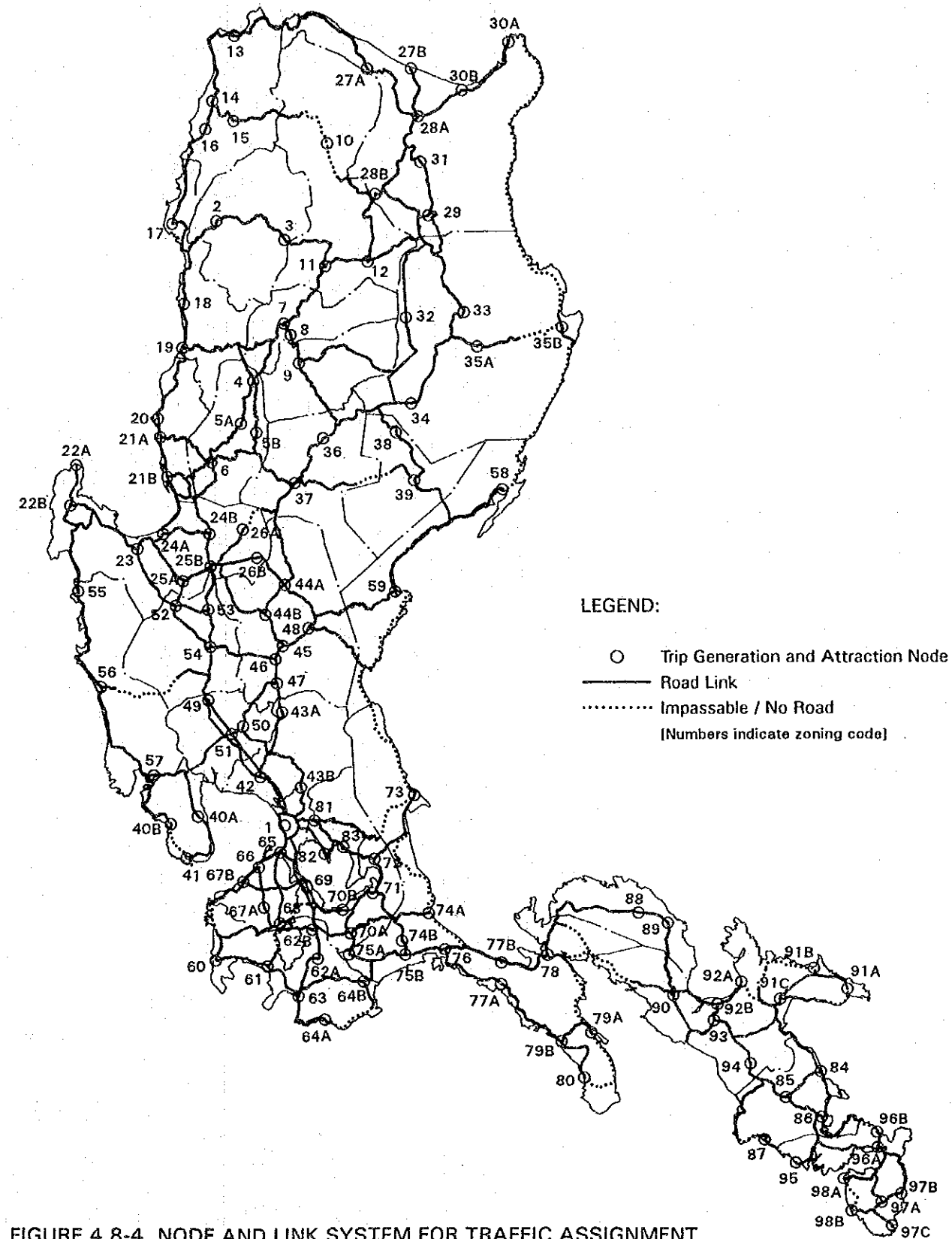


FIGURE 4.8-4 NODE AND LINK SYSTEM FOR TRAFFIC ASSIGNMENT

4.8.2 Present Trip Pattern

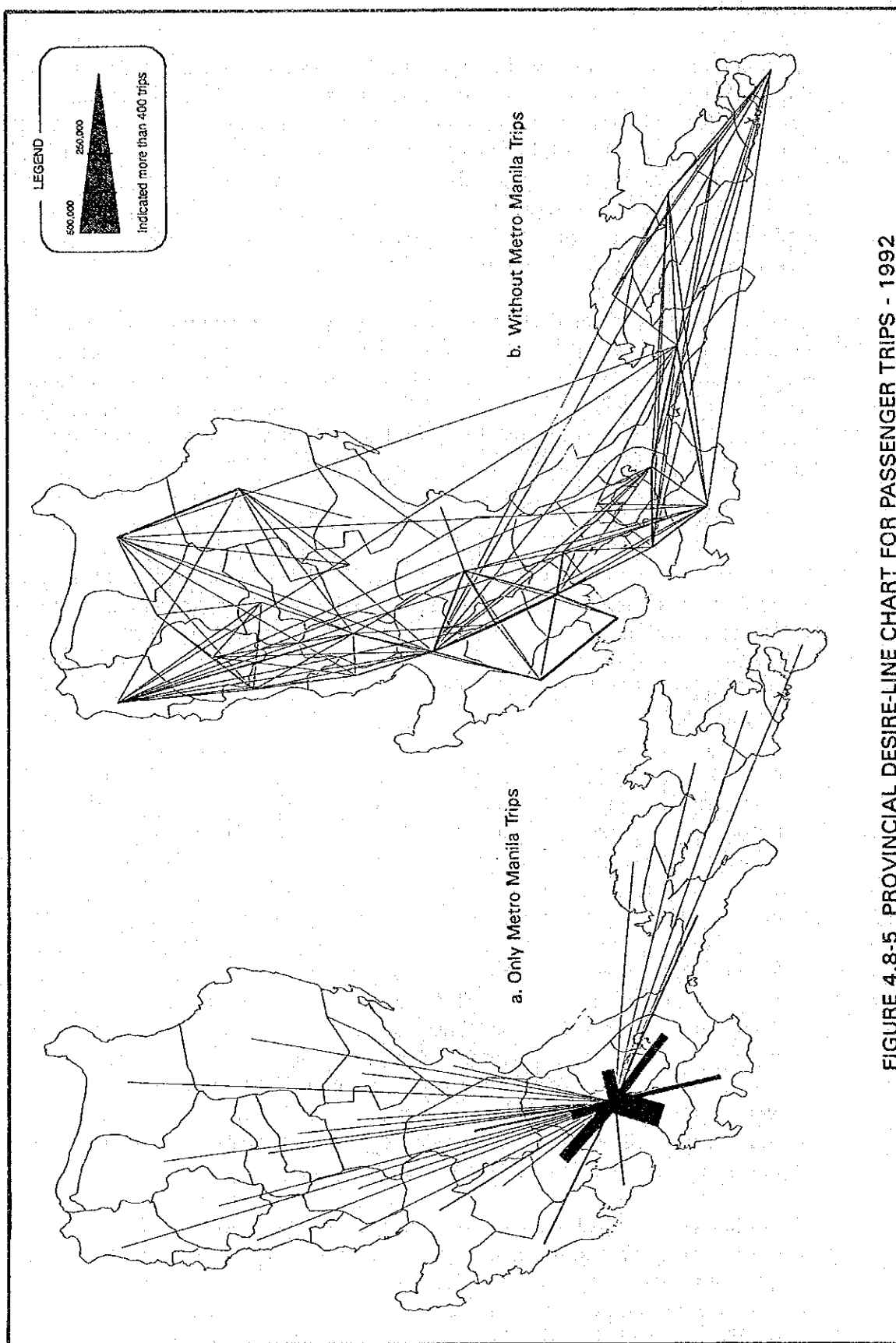
The major purpose of the comprehensive OD studies is to obtain information on existing passenger and cargo movement so that they can be modeled for making future projections on demand in order that strategic plans and policies can be developed. To obtain the total movement pattern of passengers and cargo in Luzon Island, other modes of transport are considered in the OD matrices. OD matrices of only air and rail transport, however, are added to the road passenger and cargo matrices as the intra-island coastwise traffic in Luzon Island does not represent any considerable volume.

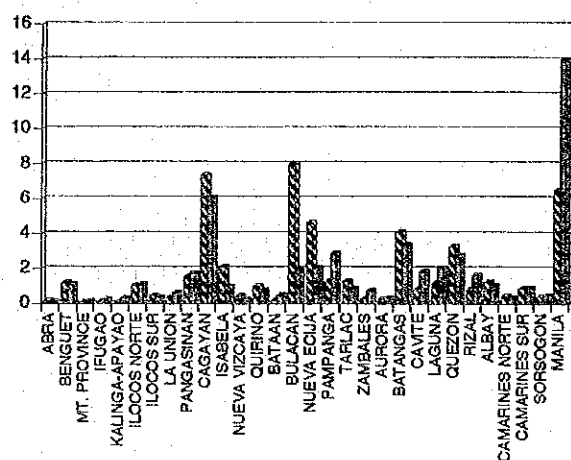
To summarize the resulted OD matrices, a graphical representation is prepared by desire-line charts which show a number of trips routed directly between each zone centroid and all others, without taking any account of the routes taken by drivers. Results of the OD tables are analyzed on three zoning levels. Basically, they are calculated for a total of 98 zones, then grouped on the provincial and regional levels.

1) Provincial Trips

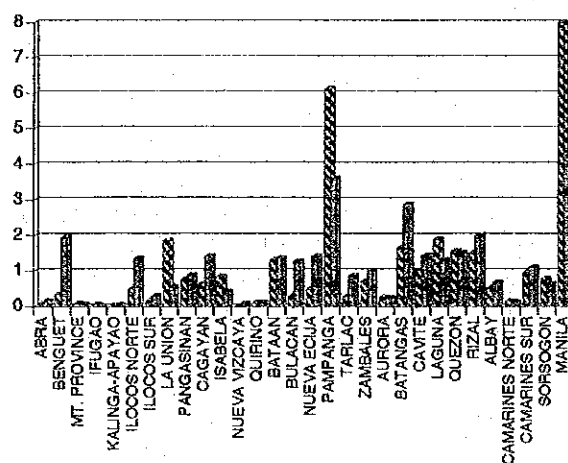
Present provincial OD matrices are presented in Appendix 4.6 for all passengers, commodities and vehicles. Desire-line charts for the inter-province passenger trips are shown in Figure 4.8-5. Generated and attracted commodity trips per group in each province are shown in Figure 4.8-6, while Figure 4.7-7 for vehicle trips per category and Figure 4.8-8 for passenger trips in addition to the trip rate per 1000 persons. High generators of total commodity are Bulacan, Cagayan, Manila, Nueva Ecija and Batangas. Manila is the main attractor for the total commodity trips and is followed by Cagayan, Batangas, Pampanga and Quezon. Trips of agricultural products are generated mainly from Bulacan, Cagayan, Manila, Nueva Ecija and Batangas. The main attraction destination is Manila, followed by Cagayan, Batangas, Pampanga and Quezon. In the manufacturing commodities, Manila has the highest number of both generated and attracted trips, however, generated trips are nearly twice the attracted trips. Next is Pampanga with also higher generation than attraction. Other main generators are Laguna, La Union and Batangas, while attractors are Batangas, Benguet and Rizal. Minerals and mining products including petrols are generated mainly from Batangas, Manila, La Union, Bataan and Pangasinan. The main attractors are Batangas, Pangasinan, Quezon, Manila and Ilocos Norte. The group of construction materials has the main generator of Rizal, then Nueva Ecija, Manila, Laguna Cavite. Manila is the main destination and followed by Tarlac, Cavite, Pampanga and Quezon.

Vehicle trips, for all vehicle categories, have Metro Manila as the highest generator and attractor, and is followed by Pampanga and Cavite. For the passenger trips, highest generators for passenger trips are Manila, Cavite, Pampanga, Laguna and Batangas. Cavite has the highest rate of trips per population and is followed by Bataan, Pampanga and Zambales.

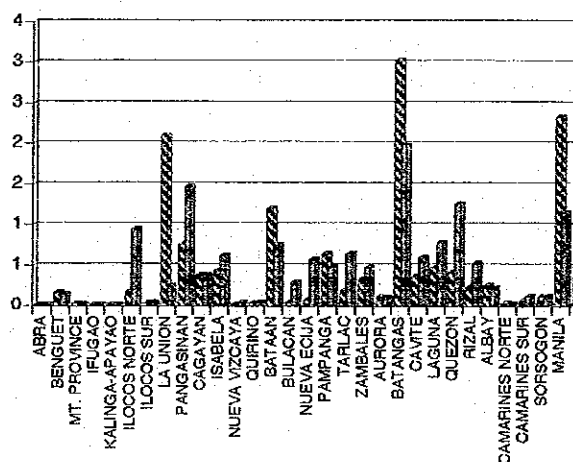




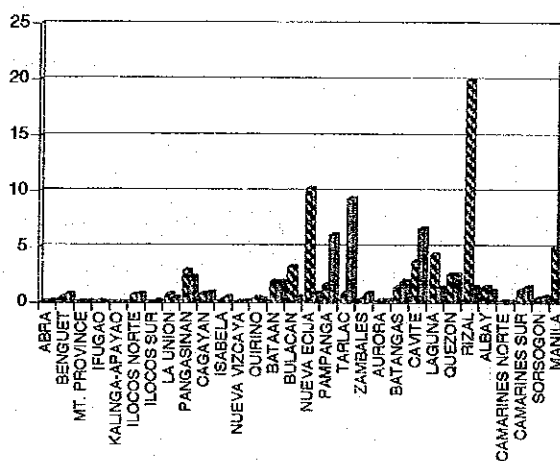
1. Agricultural Products



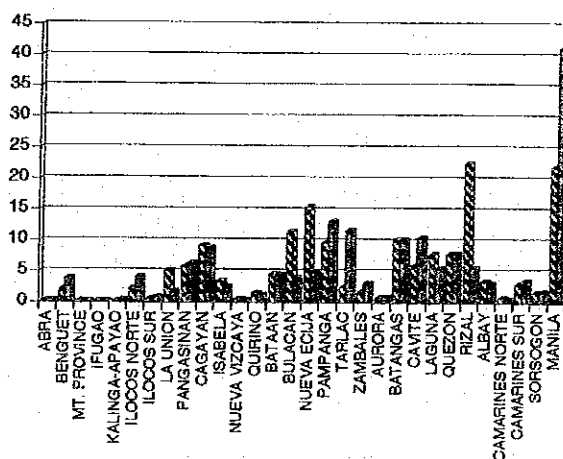
2. Manufacturing Products



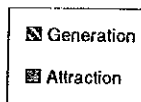
3. Mineral Products



4. Construction Materials

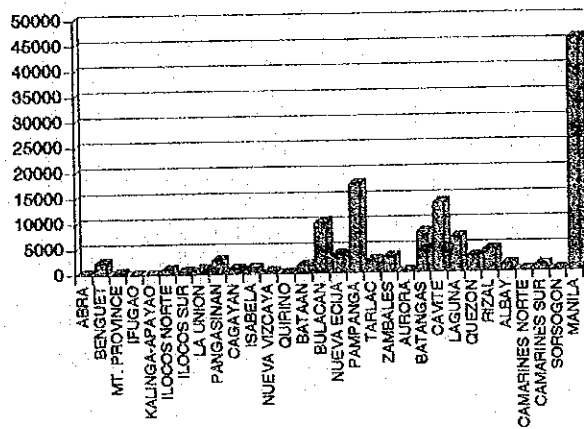


5. Total Commodities

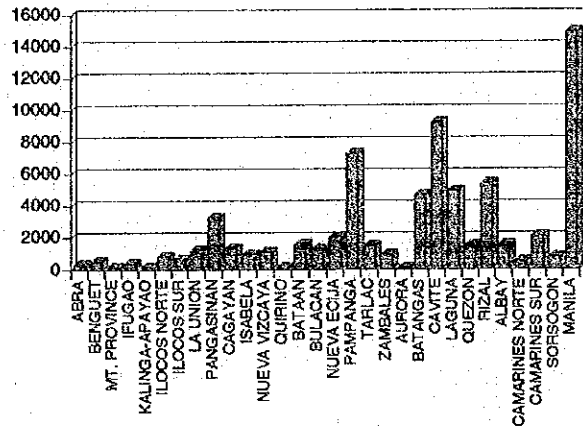


(1000 Tons)

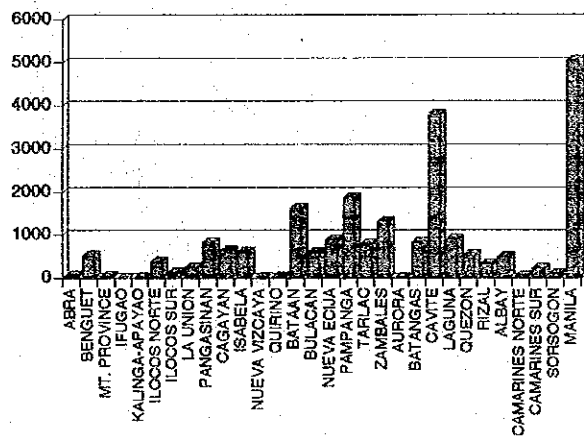
FIGURE 4.8-6 GENERATED AND ATTRACTED PROVINCIAL COMMODITY TRIPS - 1992



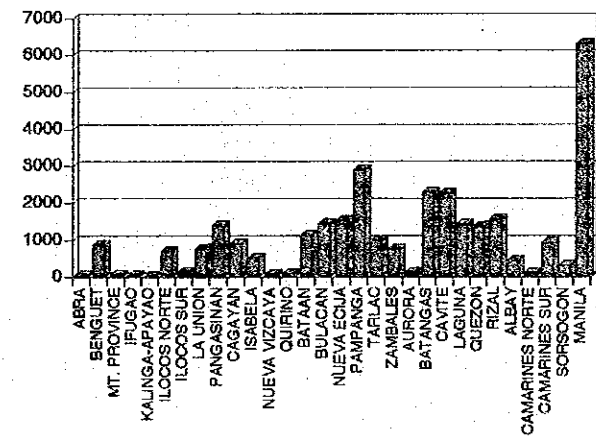
1. Car/Taxi/Jeep/Pick-up



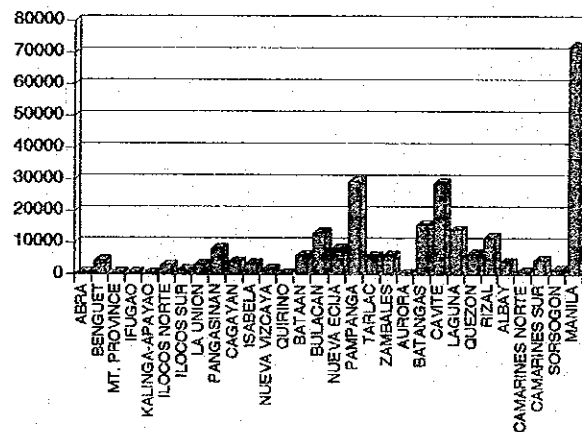
2. Jeepney



3. Bus



4. Truck



5. All Vehicles

(Trip/day)

FIGURE 4.8-7 GENERATED PROVINCIAL VEHICLE TRIPS - 1992

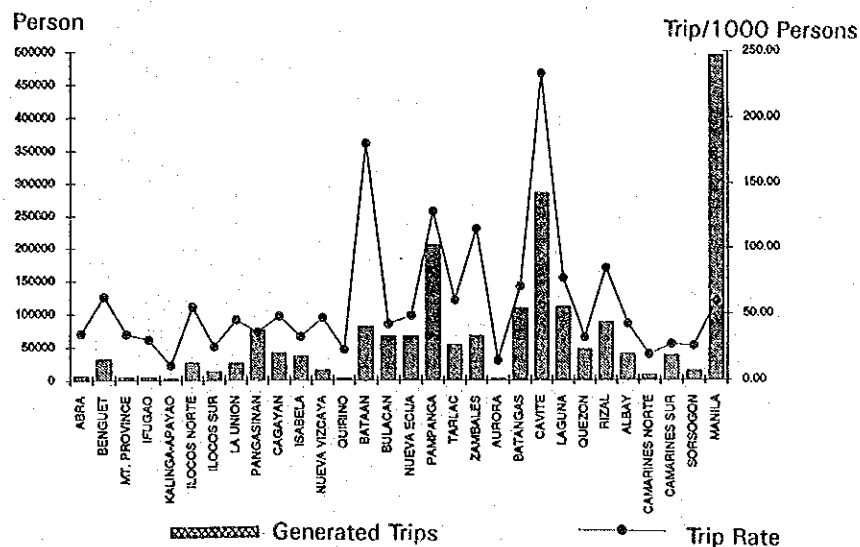


FIGURE 4.8-8 GENERATED PROVINCIAL PASSENGER TRIPS - 1992

2) Regional Trips

Table 4.8-1 gives the regional OD matrices for passenger movement, which include both intra- and inter-region trips, without NCR intra-region trips which are not included in this study. Table 4.8-2 gives the commodity trips, and the trips of vehicles by category are presented in Table 4.8-3. Regional Desire-Line Charts are shown in Figure 4.8-9 for passenger trips, Figure 4.8-10 for commodities and Figure 4.8-11 for vehicles.

In the passenger movement, Region IV-A has the highest number of either generated or attracted trips, and is followed by Region III and NCR, in which only inter-region trips are considered. Lowest number of passenger regional trips is shown between Region V in the south and Region I and CAR in the north. CAR, in general, has the lowest number of either generated or attracted passenger trips. In the intra-region trips only, Region III has the highest number of trips and is followed by Region IV-A. Considering the total movement of commodities, Regions III and IV-A have the highest number of generated trips while CAR has also the lowest trips.

TABLE 4.8-1 PASSENGER REGIONAL OD MATRIX- 1992

(Trip/day)

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|---------|--------|---------|--------|---------|---------|--------|-----------|
| NCR | - | 3,832 | 9,864 | 2,167 | 153,689 | 319,982 | 3,876 | 493,409 |
| CAR | 3,832 | 17,306 | 17,508 | 6,296 | 2,417 | 1,643 | 804 | 49,805 |
| I | 9,864 | 17,508 | 81,552 | 4,408 | 23,333 | 3,379 | 1,588 | 141,633 |
| II | 2,167 | 6,296 | 4,408 | 78,828 | 1,485 | 1,489 | 961 | 95,633 |
| III | 153,689 | 2,417 | 23,333 | 1,485 | 350,289 | 6,343 | 1,493 | 539,050 |
| IV-A | 319,982 | 1,643 | 3,379 | 1,489 | 6,343 | 298,035 | 7,309 | 638,180 |
| V | 3,876 | 804 | 1,588 | 961 | 1,493 | 7,309 | 81,447 | 97,478 |
| TOT. | 493,409 | 49,805 | 141,633 | 95,633 | 539,050 | 638,180 | 97,478 | 2,055,187 |

TABLE 4.8-2 COMMODITY REGIONAL OD MATRIX - 1992

(Ton - Trip/day)

1. Agricultural Products

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|-------|-------|-------|--------|-------|--------|
| NCR | - | 92 | 307 | 187 | 1,899 | 3,988 | 44 | 6,517 |
| CAR | 347 | 781 | 192 | 131 | 105 | 64 | 35 | 1,654 |
| I | 574 | 208 | 1,689 | 134 | 655 | 95 | 52 | 3,407 |
| II | 619 | 638 | 605 | 7,356 | 1,124 | 362 | 238 | 10,942 |
| III | 9,165 | 96 | 856 | 158 | 4,913 | 412 | 78 | 15,677 |
| IV-A | 3,238 | 60 | 158 | 66 | 236 | 6,269 | 464 | 10,491 |
| V | 72 | 36 | 66 | 48 | 73 | 743 | 1,860 | 2,898 |
| TOTAL | 14,015 | 1,912 | 3,873 | 8,079 | 9,005 | 11,933 | 2,770 | 51,586 |

2. Manufacturing Products

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|-------|-------|-------|-------|-------|-------|-------|--------|
| NCR | - | 276 | 533 | 209 | 2,938 | 3,886 | 154 | 7,995 |
| CAR | 20 | 331 | 71 | 60 | 30 | 29 | 18 | 558 |
| I | 56 | 1,360 | 1,472 | 62 | 203 | 53 | 25 | 3,230 |
| II | 46 | 44 | 27 | 1,376 | 45 | 51 | 20 | 1,610 |
| III | 1,721 | 107 | 798 | 224 | 6,070 | 228 | 33 | 9,181 |
| IV-A | 2,332 | 52 | 97 | 40 | 169 | 4,757 | 431 | 7,878 |
| V | 57 | 35 | 55 | 39 | 55 | 318 | 1,854 | 2,412 |
| TOTAL | 4,231 | 2,204 | 3,052 | 2,010 | 9,510 | 9,321 | 2,536 | 32,863 |

3. Mineral Products

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|-------|-----|-------|-------|-------|-------|-----|--------|
| NCR | - | 12 | 52 | 125 | 574 | 1,568 | 0 | 2,331 |
| CAR | 0 | 121 | 57 | 26 | 20 | 12 | 7 | 243 |
| I | 36 | 19 | 2,312 | 105 | 543 | 49 | 20 | 3,083 |
| II | 7 | 24 | 12 | 773 | 36 | 18 | 12 | 882 |
| III | 183 | 13 | 226 | 30 | 1,987 | 38 | 14 | 2,490 |
| IV-A | 925 | 23 | 39 | 26 | 53 | 3,497 | 91 | 4,653 |
| V | 1 | 7 | 13 | 10 | 15 | 75 | 351 | 474 |
| TOTAL | 1,152 | 218 | 2,711 | 1,095 | 3,228 | 5,256 | 496 | 14,156 |

4. Construction Materials

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|-------|-------|--------|--------|-------|--------|
| NCR | - | 65 | 243 | 96 | 1,533 | 2,963 | 120 | 5,019 |
| CAR | 1 | 461 | 96 | 109 | 46 | 49 | 30 | 790 |
| I | 104 | 276 | 2,576 | 52 | 1,185 | 110 | 67 | 4,369 |
| II | 6 | 98 | 37 | 1,209 | 45 | 52 | 36 | 1,483 |
| III | 381 | 58 | 495 | 242 | 16,431 | 523 | 82 | 18,213 |
| IV-A | 21,279 | 92 | 180 | 109 | 340 | 9,996 | 278 | 32,275 |
| V | 7 | 39 | 69 | 52 | 73 | 357 | 2,521 | 3,116 |
| TOTAL | 21,776 | 1,090 | 3,696 | 1,868 | 19,652 | 14,050 | 3,133 | 65,265 |

5. Total Commodities

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|--------|--------|--------|--------|-------|---------|
| NCR | - | 445 | 1,135 | 617 | 6,944 | 12,405 | 337 | 21,884 |
| CAR | 367 | 1,693 | 415 | 325 | 200 | 153 | 90 | 3,244 |
| I | 769 | 1,863 | 8,049 | 353 | 2,586 | 307 | 164 | 14,090 |
| II | 678 | 804 | 681 | 10,715 | 1,250 | 483 | 306 | 14,916 |
| III | 11,449 | 275 | 2,375 | 653 | 29,401 | 1,202 | 207 | 45,561 |
| IV-A | 27,791 | 227 | 474 | 242 | 798 | 24,528 | 1,270 | 55,328 |
| V | 155 | 117 | 203 | 148 | 216 | 1,533 | 6,596 | 8,969 |
| TOTAL | 41,209 | 5,424 | 13,332 | 13,053 | 41,395 | 40,611 | 8,970 | 163,993 |

TABLE 4.8-3 VEHICLE REGIONAL OD MATRIX - 1992

(Trip/day)

1. Car/Taxi/Jeep/Pick-up

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|-------|-------|--------|--------|-------|---------|
| NCR | - | 330 | 649 | 113 | 20,348 | 24,105 | 140 | 45,684 |
| CAR | 330 | 1,508 | 723 | 116 | 181 | 87 | 31 | 2,977 |
| I | 649 | 723 | 2,762 | 90 | 746 | 125 | 58 | 5,154 |
| II | 113 | 116 | 90 | 2,227 | 91 | 62 | 40 | 2,739 |
| III | 20,348 | 181 | 746 | 91 | 16,000 | 659 | 63 | 38,088 |
| IV-A | 24,105 | 87 | 125 | 62 | 659 | 10,262 | 351 | 35,653 |
| V | 140 | 31 | 58 | 40 | 63 | 351 | 2,295 | 2,978 |
| TOTAL | 45,684 | 2,977 | 5,154 | 2,739 | 38,088 | 35,653 | 2,978 | 133,273 |

2. Jeepney

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|-------|-------|--------|--------|-------|--------|
| NCR | - | 4 | 19 | 0 | 2,446 | 12,446 | 4 | 14,919 |
| CAR | 4 | 527 | 459 | 425 | 26 | 24 | 9 | 1,474 |
| I | 19 | 459 | 4,282 | 198 | 861 | 94 | 28 | 5,941 |
| II | 0 | 425 | 198 | 2,839 | 47 | 11 | 5 | 3,526 |
| III | 2,446 | 26 | 861 | 47 | 10,998 | 183 | 19 | 14,580 |
| IV-A | 12,446 | 24 | 94 | 11 | 183 | 12,689 | 320 | 25,766 |
| V | 4 | 9 | 28 | 5 | 19 | 320 | 4,527 | 4,912 |
| TOTAL | 14,919 | 1,474 | 5,941 | 3,526 | 14,580 | 25,766 | 4,912 | 71,118 |

3. Bus

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|-------|-----|-------|-------|-------|-------|-----|--------|
| NCR | - | 78 | 216 | 51 | 1,766 | 2,841 | 96 | 5,048 |
| CAR | 78 | 184 | 280 | 28 | 44 | 31 | 17 | 661 |
| I | 216 | 280 | 652 | 51 | 310 | 53 | 31 | 1,592 |
| II | 51 | 28 | 51 | 1,095 | 19 | 33 | 21 | 1,298 |
| III | 1,766 | 44 | 310 | 19 | 4,871 | 62 | 30 | 7,102 |
| IV-A | 2,841 | 31 | 53 | 33 | 62 | 3,340 | 71 | 6,430 |
| V | 96 | 17 | 31 | 21 | 30 | 71 | 609 | 874 |
| TOTAL | 5,048 | 661 | 1,592 | 1,298 | 7,102 | 6,430 | 874 | 23,005 |

4. Truck

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|-------|-------|-------|-------|-------|-------|-------|--------|
| NCR | - | 83 | 224 | 81 | 2,752 | 3,131 | 53 | 6,323 |
| CAR | 83 | 418 | 412 | 74 | 59 | 36 | 21 | 1,103 |
| I | 224 | 412 | 1,674 | 65 | 537 | 75 | 37 | 3,024 |
| II | 81 | 74 | 65 | 1,234 | 104 | 43 | 27 | 1,629 |
| III | 2,752 | 59 | 537 | 104 | 5,113 | 189 | 40 | 8,793 |
| IV-A | 3,131 | 36 | 75 | 43 | 189 | 5,345 | 239 | 9,057 |
| V | 53 | 21 | 37 | 27 | 40 | 239 | 1,399 | 1,816 |
| TOTAL | 6,323 | 1,103 | 3,024 | 1,629 | 8,793 | 9,057 | 1,816 | 31,744 |

5. Total

| REGION | NCR | CAR | I | II | III | IV-A | V | TOTAL |
|--------|--------|-------|--------|-------|--------|--------|--------|---------|
| NCR | - | 495 | 1,107 | 245 | 27,312 | 42,522 | 292 | 71,974 |
| CAR | 495 | 2,637 | 1,874 | 643 | 310 | 179 | 78 | 6,215 |
| I | 1,107 | 1,874 | 9,370 | 404 | 2,454 | 347 | 154 | 15,711 |
| II | 245 | 643 | 404 | 7,395 | 260 | 149 | 94 | 9,192 |
| III | 27,312 | 310 | 2,454 | 260 | 36,982 | 1,093 | 152 | 68,563 |
| IV-A | 42,522 | 179 | 347 | 149 | 1,093 | 31,636 | 980 | 76,906 |
| V | 292 | 78 | 154 | 94 | 152 | 980 | 8,829 | 10,580 |
| TOTAL | 71,974 | 6,215 | 15,711 | 9,192 | 68,563 | 76,906 | 10,580 | 259,141 |

In the total attracted trips, Regions III, NCR and IV-A are the highest attractors. Intra-region commodity trips show also that Region III has the highest number and is followed by Region IV-A. Trips of commodity groups show that agricultural products are generated mainly from Region III, with NCR as the main attractor region. Region II has the highest number of intra-region trips. Manufacturing products are generated from Region III, then from NCR and Region IV-A, and are attracted to Regions III and IV-A with most intra-region trips are in Region III. Mineral products including petrol have most intra-region trips in Regions IV-A and I as also the main trip generators. Construction materials have the most inter-region trips from Region IV-A to NCR while other regions have relatively high intra-region trips.

Regional generated and attracted trips for both passengers and commodities are shown in Figure 4.8-12 for passenger trips and in Figure 4.8-13 for commodities. In the passenger movement, as the generated and attracted trips are equal, the figure shows only the generated trips and the daily trip rate for 1000 persons in population.

Regional trips by vehicle category, as presented in Figure 4.8-14, show high volumes of car and bus trips are in Region III, while most trips of Jeepney and trucks are in Region IV-A. For the trips of all vehicles, intra-region trips are considerably higher than inter-region trips, which are concentrated mainly between NCR and each of Region III and IV-A.

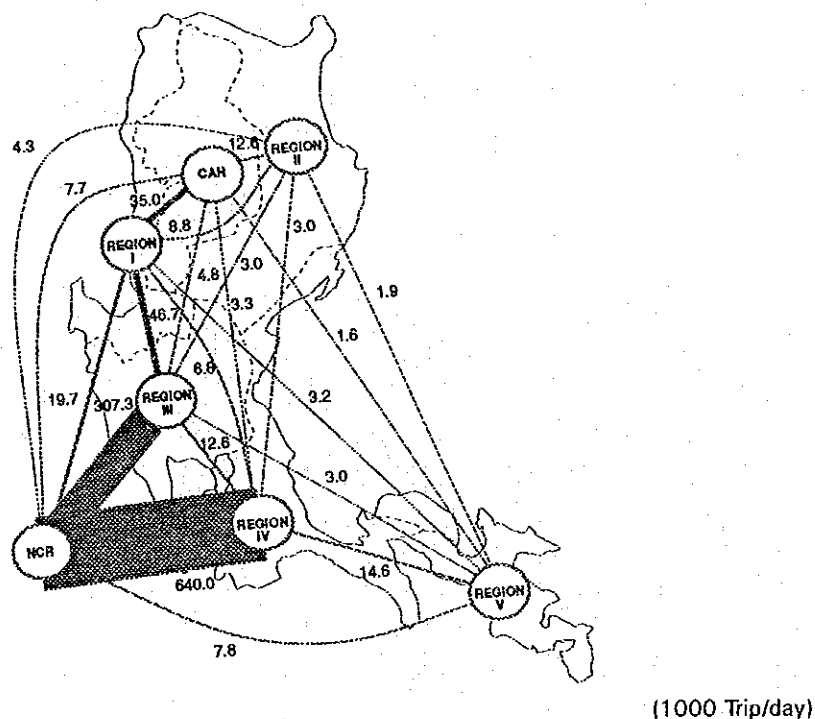
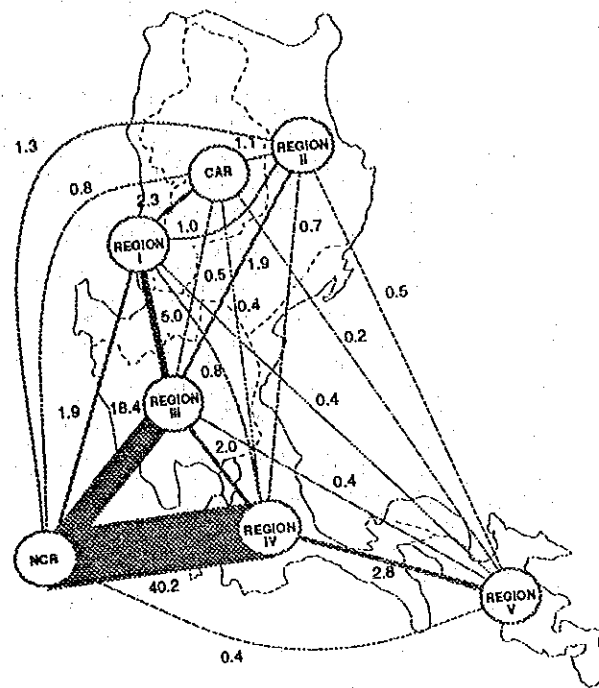
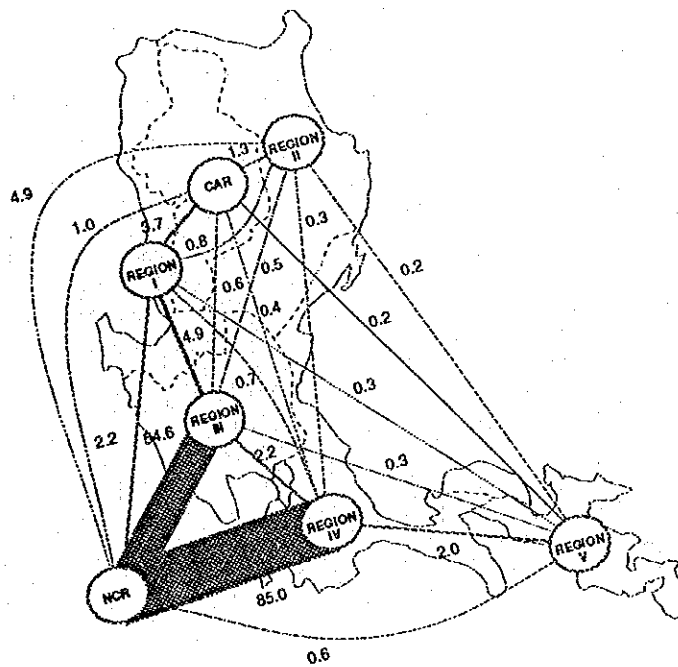


FIGURE 4.8-9 REGIONAL PASSENGER TRIPS DESIRE-LINE CHART - 1992



(1000 Ton - Trip/day)

FIGURE 4.8-10 REGIONAL COMMODITY TRIPS DESIRE-LINE CHART - 1992



(1000 Trip/day)

FIGURE 4.8-11 REGIONAL VEHICLE TRIPS DESIRE-LINE CHART - 1992

3) Commodity Trips from/to Metro Manila

As most of the economic activities in Luzon Island are concentrated in Metro Manila, it is important to investigate the commodity trip pattern of Metro Manila separately in relation to all other provinces in the island. Figure 4.8-15 shows the commodity flow between Metro Manila and other provinces.

Commodity trips from Metro Manila are mainly directed to four destinations which are: Rizal, Pampanga, Laguna and Cavite, and followed by Batangas and Bulacan. Generally, provinces in Region III have more attracted commodity trips from Metro Manila than other provinces. On the other hand, commodities to Metro Manila are coming mainly from the surrounding provinces of Rizal, Bulacan, Laguna and Pampanga.

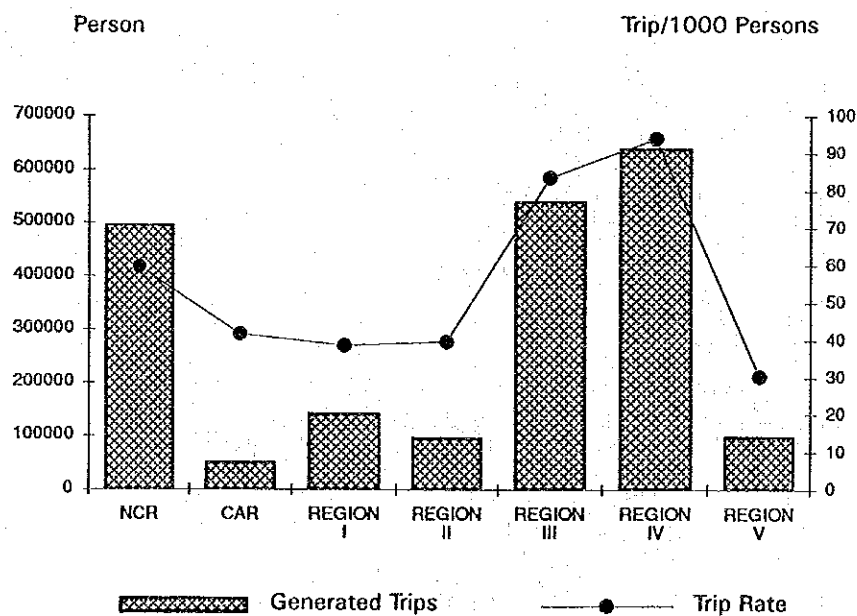
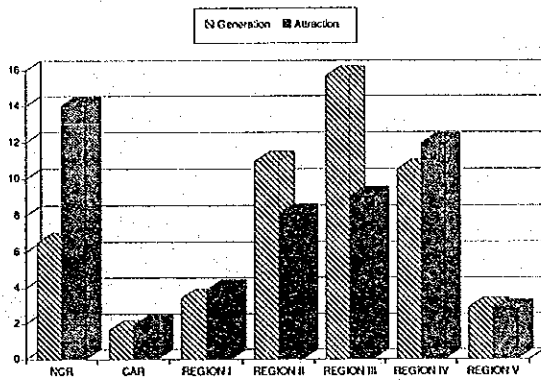
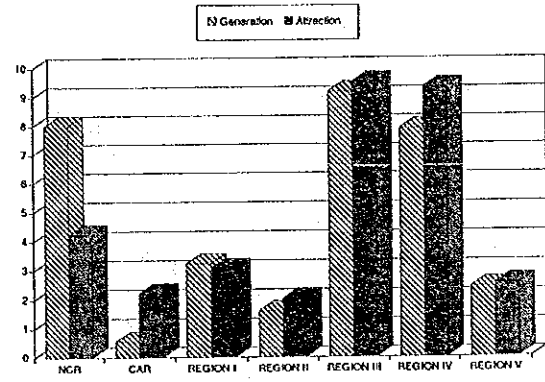


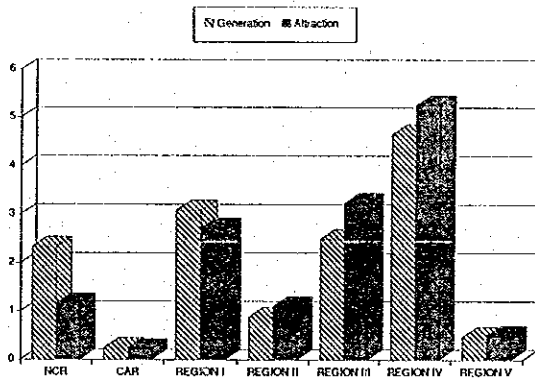
FIGURE 4.8-12 GENERATED REGIONAL PASSENGER TRIPS - 1992



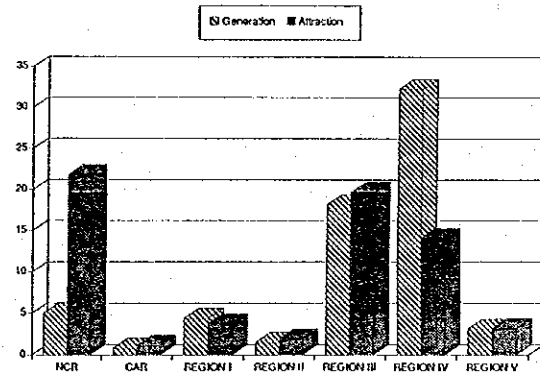
1. Agricultural Products



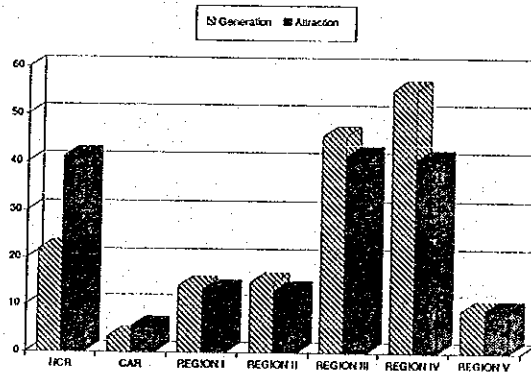
2. Manufacturing Products



3. Mineral Products



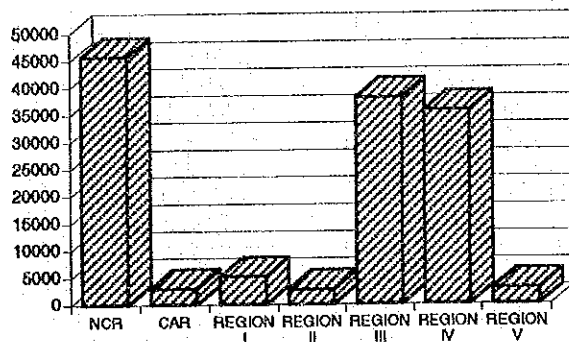
4. Construction Materials



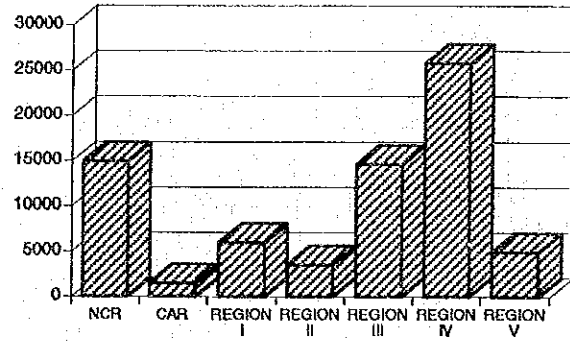
5. Total Commodities

(1000 Tons)

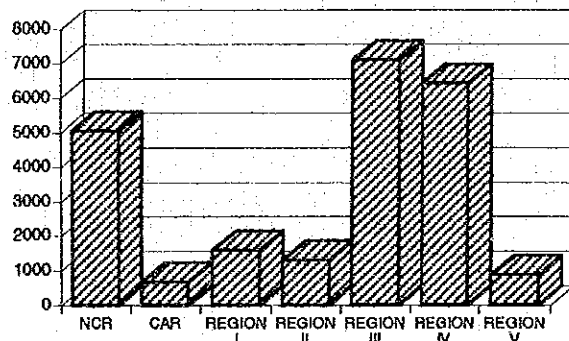
FIGURE 4.8-13 GENERATED AND ATTRACTED REGIONAL COMMODITY TRIPS - 1992



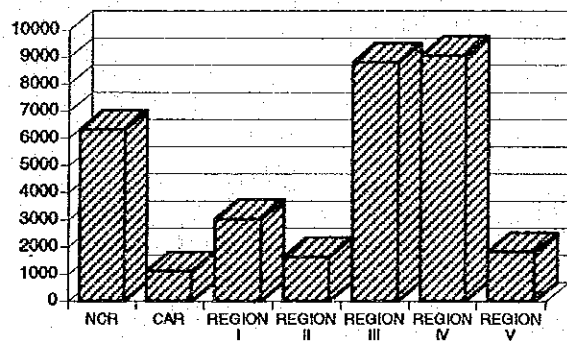
1. Car/Taxi/Jeep/Pick-up



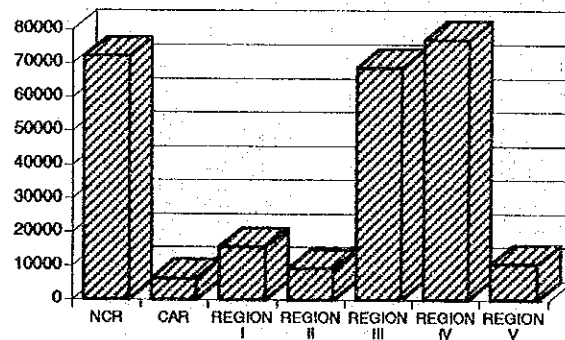
2. Jeepney



3. Bus



4. Truck



5. All Vehicles

(Trip/day)

FIGURE 4.8-14 GENERATED REGIONAL VEHICLE TRIPS - 1992

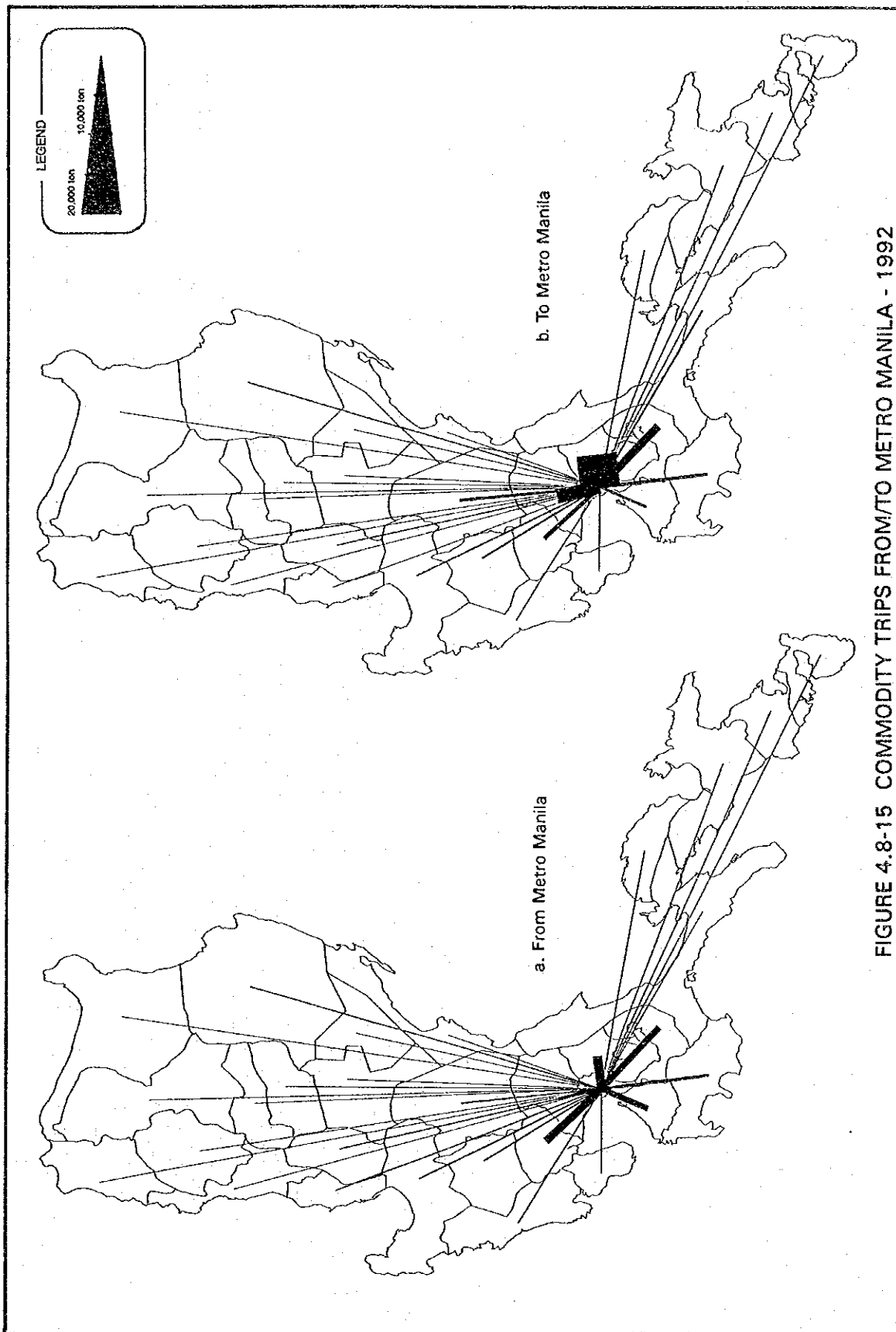


FIGURE 4.8-15 COMMODITY TRIPS FROM/TO METRO MANILA - 1992

CHAPTER 5

RAIL, SEA AND AIR TRANSPORT

5.1 INTRODUCTION

For an archipelago like the Philippines, the country needs an efficient and adequate transport and communication network system to promote its economic progress. Statistical data on infrastructure and operations of this sector provides information necessary in the planning procedure. Present condition of rail, sea and air transports is investigated in this chapter to evaluate the available capacity and volume of passenger and freight traffic of alternate modes of transport in relation to the road transport.

Based on the Medium-Term Philippine Development Plan (1987-1992), the objectives for the transport sector are to support nationwide efforts to stimulate agricultural production and increase rural income by orienting transport infrastructure towards rural areas, and also to reduce inter-regional socioeconomic gaps and strengthen inter-regional linkage by providing more efficient movement of products from excess production areas to deficit market areas.

The estimation of the share of different transport modes in the total movement of goods and passengers is not accurate because of the lack of recorded information. However, in 1980 and 1987, the National Transportation Planning Project (NTPP) estimated mode shares in the whole country, which are presented in Table 5.1-1, by using fuel utilization as recorded by the energy agencies.

This estimation shows the high share of the road transport which may include intra-urban trips while other modes are only used for inter-urban trips. The sea mode of transport is in the second place and is increasing gradually while the air transport has constant share and the rail transport is losing its potential. Considering the intra-island traffic as the study area is Luzon Island only, the road is assumed to continue as the most dominant mode of transport for both passenger and cargo movements.

TABLE 5.1-1 MODE SHARES

(%)

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

5.2 RAIL TRANSPORT

The railway operation started in the Philippines about one hundred years ago. During this period, mainly two long distance lines were operated to the north and south of Metro Manila. Figure 5.2-1 shows the rail network in the country. The Main Line North is extended with a length of 266 kilometers till San Fernando in the province of La Union, while the Main Line South is extended to Legaspi in Albay province with a length of 479 kilometers. As of 1942, the total length of the two main lines and branch lines was about 1,140 kilometers.

Through the years, considerable damage to the system was brought out and the physical neglect accumulated heavily. The critical track sections were getting longer, availability of rolling stock was rapidly declining, and maintenance facilities and equipment were inadequate and obsolete. The Main Line North is temporarily closed at present for long distant train operations owing to the fact that its condition could not warrant safe train operations due to the damage and deteriorated condition of the tracks.

The Philippine National Railways (PNR) operates at present three types of rail services: passenger services for the long distance trains running between Manila and Bicol Region, freight and express services for the transport of cargo, and commuter services which shuttle between Manila and Malolos in the province of Bulacan in the north and Calamba and Carmona in the province of Cavite in the south.

The statistical component of the railway transport does not show at present significant share in comparison with other modes of transport in Luzon Island. The Main Line South is the only operated long distance railway line with regular service of three daily passenger trains between Metro Manila and Albay Province. Two trains are operated till Naga City while the third train continues till Polangui City at a distance of 412 kilometers from Metro Manila, with more than 50 stations. For the freight service, there are on the average two trains running daily between Manila and Naga.

The rail passenger and cargo trend for long distance operation through the years 1950 and 1990 is clarified in Figure 5.2-2. After a high peak of more than 9.4 million passengers and 1.4 million tons of cargo in 1960, the trend is declining gradually to less than one million passengers and 49,000 tons of cargo in 1990. Data of rail passengers and cargo of 1991 shows more declining; the number of passengers reached a lower level of 630,453 passengers while the cargo tonnage was only 21,782 tons, as shown in Table 5.2-1. The table presents the passenger and cargo movement at major railway stations which are considered as those with a number of passengers exceeds 3,000 in 1991, while minor stations are grouped with the nearest major stations.

As the available rail passenger data of 1991 are not classified according to their origin and destination, a generation-attraction and trip distribution procedure is

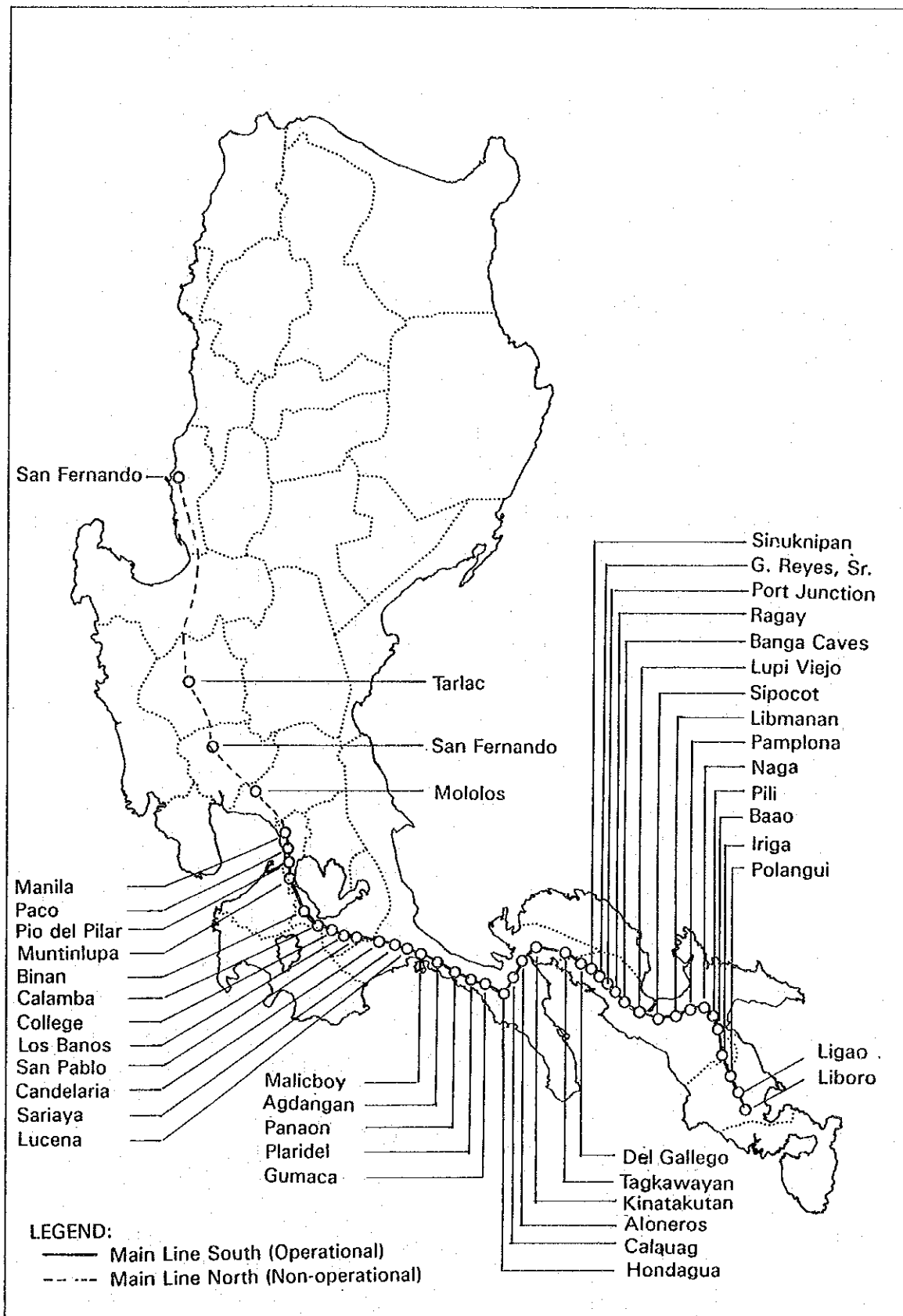


FIGURE 5.2-1 RAIL NETWORK IN LUZON ISLAND

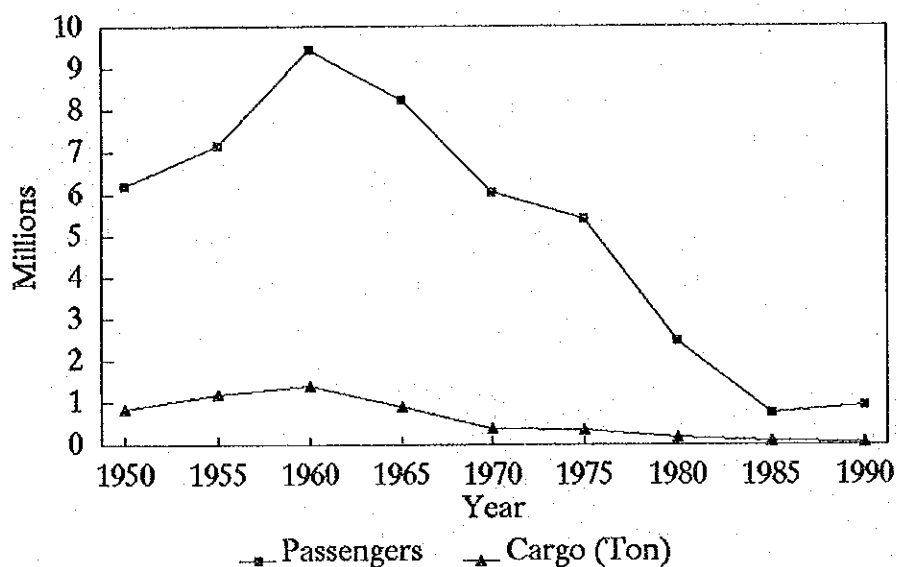


FIGURE 5.2-2 RAIL PASSENGERS AND CARGO, 1950 - 1990

Source: Philippine Statistical Yearbook, 1991

TABLE 5.2-1 RAIL PASSENGERS AND CARGO MOVEMENT - 1991

| PROVINCE | STATION | NUMBER OF PASSENGERS | FREIGHT IN TONS |
|---------------|-------------|----------------------|-----------------|
| NCR | Manila | 94,721 | 1,777 |
| | Paco | 80,434 | 2,630 |
| Laguna | Binan | 27,551 | 76 |
| | Calamba | 21,741 | 31 |
| | College | 4,211 | 7 |
| Quezon | San Pablo | 16,913 | 127 |
| | Candelaria | 5,106 | 35 |
| | Lucena | 19,034 | 789 |
| | Gumaca | 9,331 | 54 |
| | Calauag | 4,356 | 35 |
| Camarines Sur | Tagkawayan | 27,161 | 2,108 |
| | Del Gallego | 13,137 | 1,985 |
| | Godofredo R | 9,126 | 2,390 |
| | Ragay | 45,299 | 4,735 |
| | Banga Caves | 3,799 | 70 |
| | Sipocot | 23,701 | 182 |
| | Libmanan | 25,856 | 167 |
| | Pamplona | 4,144 | 1 |
| | Naga | 140,699 | 3,492 |
| | Pili | 8,047 | 218 |
| Alabay | Iriga | 20,032 | 497 |
| | Polangui | 26,054 | 376 |
| TOTAL | | 630,453 | 21,782 |

Source: Philippine National Railways, Budget and Planning Division.

applied by utilizing Frater Method to conclude this relationship for passengers movement between major stations. Estimated OD matrix for rail passengers between railway stations is presented in Appendix 5.1 and the OD data is grouped on provincial base as presented in Table 5.2-2.

TABLE 5.2-2 RAIL PASSENGERS OD MOVEMENT - 1991

| | | D E S T I N A T I O N | | | | | |
|---|---------------|-----------------------|--------|--------|---------------|-------|--------|
| | | NCR | LAGUNA | QUEZON | CAMARINES SUR | ALBAY | TOTAL |
| O | NCR | 28658 | 20584 | 18918 | 99338 | 7664 | 175162 |
| R | LAGUNA | 20584 | 5044 | 6729 | 35336 | 2726 | 70416 |
| I | QUEZON | 18918 | 6729 | 4356 | 32477 | 2506 | 64986 |
| G | CAMARINES SUR | 99338 | 35336 | 32477 | 113528 | 13157 | 293836 |
| I | ALBAY | 7664 | 2726 | 2506 | 13157 | - | 26053 |
| N | TOTAL | 175162 | 70419 | 64986 | 293836 | 26053 | 630453 |

Rail cargo data of the Main Line South in 1990 are classified per the origin and destination for each commodity type in which the main commodities transported by rail are rice, corn and oil seeds including copra, and then the two groups of other agricultural and non-agricultural products. Appendices 5.2 to 5.6 include the OD matrices of the five commodity types between railway stations and the provincial OD movements are presented in Appendices 5.7 to 5.11 respectively. Table 5.2-3 presents the OD matrix of the total cargo transported by rail, and it should be noticed that the total cargo transported by the Main Line South is approximately 90% of the railway cargo since there are still about 10% of the cargo transported by rail for short distances north of Manila.

TABLE 5.2-3 RAIL CARGO OD MOVEMENT - 1990

| | | D E S T I N A T I O N | | | | | (Kg) |
|---|-------------|-----------------------|---------|----------|-------------|---------|----------|
| | | NCR | LAGUNA | QUEZON | CAMARINES S | ALBAY | TOTAL |
| O | NCR | 2170 | 1047 | 333865 | 5085511 | 908140 | 6330733 |
| R | LAGUNA | 6670 | 430 | 66690 | 405948 | 201014 | 680752 |
| I | QUEZON | 6179982 | 1163211 | 2193951 | 1304034 | 41896 | 10883074 |
| G | CAMARINES S | 5548142 | 1270446 | 13490588 | 3738437 | 17412 | 24065025 |
| I | ALBAY | 791582 | 191963 | 104278 | 178056 | - | 1265879 |
| N | TOTAL | 12528546 | 2627097 | 16189372 | 10711986 | 1168462 | 43225463 |

5.3 SEA TRANSPORT

The Philippines by virtue of its geographical nature will continue to depend to a very large extent on the coastwise transport as one of the main transport systems. The water transport has the second share after the road transport with a high percentage of 35% in 1980 and 47% in 1987 for the cargo movement, while passengers share was only 7% and 9% for the two years respectively. In this regard, national efforts are directed towards the development of the water transport system of the country.

The port network of the country comprises 5 major Port District Offices (PDOs) as each of these offices covers a number of Port Management Offices (PMOs) which are the Philippine Ports Authority's (PPA) administrative and operational arms in every port district of the country. In total, there are nineteen PMOs each of which maintains a base, terminal, municipal and private ports under its territorial jurisdiction. Ports in the Philippines have the following classification and definitions:

- Base Port: A port which is the center of administrative and other operational powers within the Port Management Office.
- Terminal Port: A port under the administration of the base port which serves as the extension of the base port in the regulation of ports in the country.
- Municipal Port: A public port owned and maintained by the municipal government.
- Private Port: A port owned and operated by private entity. It may be commercial or non-commercial as may be allowed by PPA.

National ports are owned by the government, while municipal ports are operated by the municipality with contractors and maintenance appropriated by the national government. Private ports and piers are spreaded all over the country especially in places where there are factories or commercial establishments.

The total amount of cargo handled by all ports in the Philippines during 1990 was recorded at about 83.5 million metric tons in which domestic cargo accounted 55% and 45% as foreign cargo. Inward cargo posted at about 59% and outward share was 41%.

In Luzon Island, the two PDOs of Manila and Luzon supervise all the ports through the five PMOs of Manila South Harbor, Manila North Harbor, San Fernando, Batangas and Legaspi, with 5 base ports, 11 terminal ports, 16 municipal ports and over 50 private ports. Figure 5.3-1 shows the location of major ports in the island.

PMOs of Batangas and North Harbor handle the biggest amount of bulk cargo in the form of petroleum products with 27% and 25.5% of the total bulk cargo of the country, respectively, while the PMO South Harbor is handling mainly break-bulk cargo (12%) and containerized cargo (17%).

Comparing with the share of coastwise traffic in 1980, the share in 1987 shows significant increase either for the cargo or passenger movement in the whole country. The intra-island coastwise traffic in Luzon Island, however, does not seem to represent any considerable volume since there are no regular shipping routes connecting ports in the island together. With the expected growth in the socioeconomic activities, the more time-saving road transport is the more preferable mode of transport specially for passengers. Table 5.3-1 gives the quantity of domestic and foreign cargo handled as inward and outward through the major

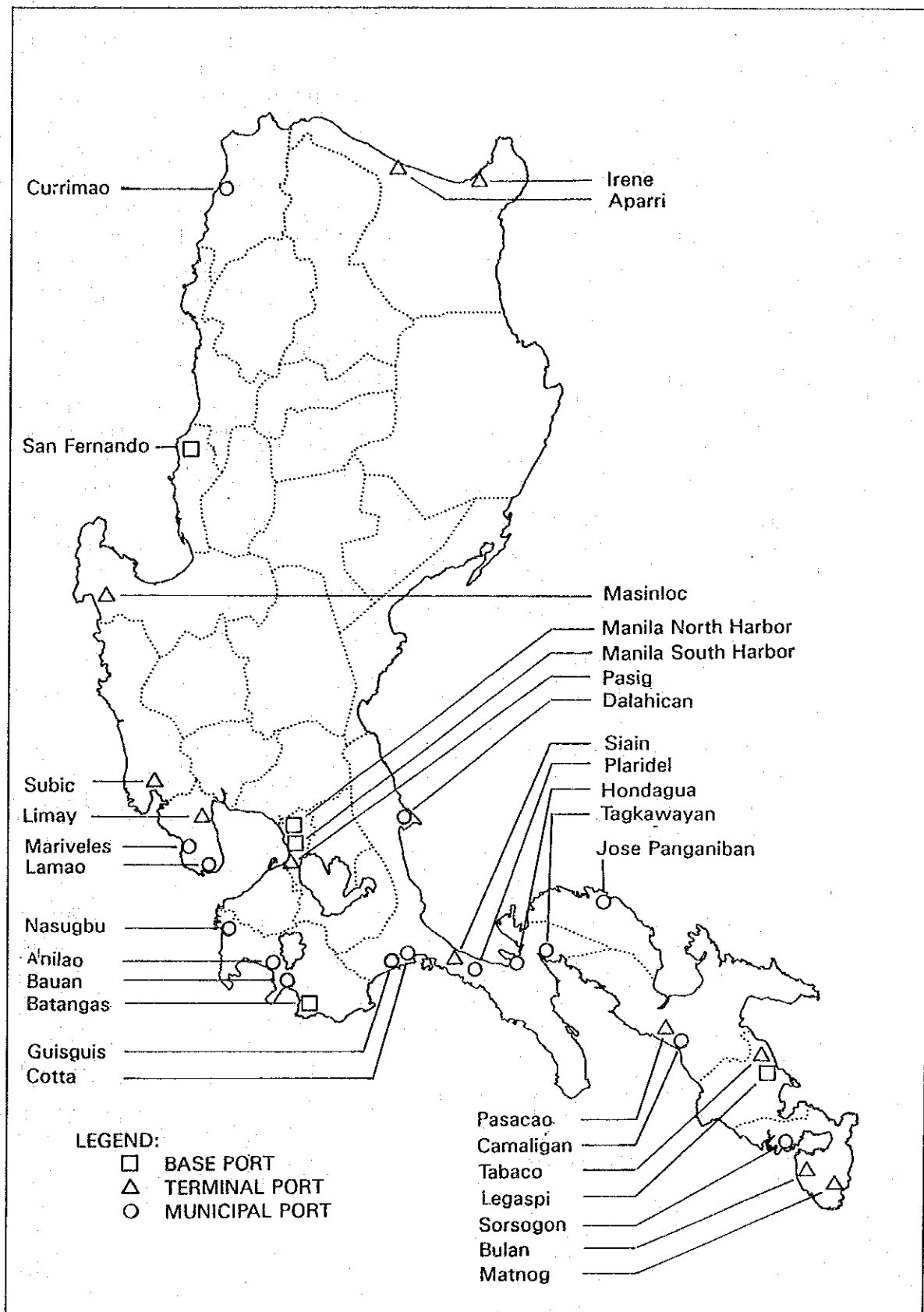


FIGURE 5.3-1 MAJOR PORTS IN LUZON ISLAND

ports in Luzon Island during 1990. As for the coastwise passenger traffic, available data is only for the PMO which handle passenger transport as presented in Table 5.3-2 and it is completely for inter-island traffic since there is no coastwise data recorded currently as intra-island passenger traffic for ports in Luzon Island.

Cargo data of the year 1990 shows some intra-island movement on irregular basis between some ports in Luzon Island for the total cargo without commodity classification. Shipments from the northern part at Irene to Manila represent the highest figure in the intra-island cargo OD matrix presented in Table 5.3-3. Most of these cargo shipments have Manila North Harbor as their origin or destination.

Classified data for the different commodities transported by sea include only the total quantities as inward or outward cargo at the different ports without information on the origin and destination. To estimate the OD pattern of the main commodities between the major ports of Luzon Island, a generation-attraction and trip distribution procedure based on Frater Method is applied. Intra-island trips are those of the routings only defined in Table 5.3-3. All other ports for inter-island trips in the country are considered as one group called "others". The main commodities of rice, corn, copra, other agricultural products and non-agricultural products are considered here in this estimation. Results of the estimation for the five groups of commodities are included in Appendices 5.12 to 5.16, respectively.

TABLE 5.3-1 CARGO MOVEMENT AT LUZON ISLAND PORTS - 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 North | 1165659 | | 368983 | | 1534642 |
| Manila South | 1448 | 2220688 | | 75707 | 2297843 |
| 2. Terminal Ports | | | | | |
| Siaian | 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 |
| 3. Other Governmental Ports | | | | | |
| Bauan | 38223 | | 16154 | | 54377 |
| Cotta | 34128 | | 12731 | | 46859 |
| Dalahican | 25111 | | 6595 | | 31706 |
| Tagkawayan | 1182 | | | | 1182 |
| Camaligan | 1714 | | 1291 | | 3005 |
| Sorsogon | 19149 | | | | 19149 |
| Currimao | 902 | | 426 | | 1328 |

Source: Annual Statistical Report, Philippine Ports Authority, 1990.

TABLE 5.3-2 COASTWISE DOMESTIC PASSENGER TRAFFIC

| PMO | Year | Disembarked | Embarked | Total |
|------------|------|-------------|------------|------------|
| Manila | 1986 | 777,429 | 548,034 | 1,320,463 |
| | 1987 | 1,116,406 | 986,655 | 2,103,061 |
| | 1988 | 1,479,569 | 1,125,994 | 2,605,563 |
| | 1990 | 905,410 | 728,008 | 1,633,418 |
| Batangas | 1986 | 793,949 | 637,914 | 1,431,863 |
| | 1987 | 812,254 | 739,325 | 1,551,579 |
| | 1988 | 1,107,072 | 980,831 | 2,087,903 |
| | 1990 | 1,451,668 | 1,215,978 | 2,667,646 |
| Legaspi | 1986 | 259,112 | 239,578 | 498,690 |
| | 1987 | 265,624 | 245,526 | 511,150 |
| | 1988 | 502,230 | 489,526 | 991,756 |
| | 1990 | 499,831 | 532,189 | 1,032,020 |
| Philippine | 1986 | 8,102,427 | 7,452,586 | 15,565,013 |
| | 1987 | 9,166,267 | 8,801,154 | 17,967,421 |
| | 1988 | 12,197,487 | 11,384,254 | 23,581,741 |
| | 1990 | 14,204,604 | 13,744,274 | 27,948,878 |

Source: 1986-1988 Philippine Yearbook, 1989.

1990 Annual Statistical Report, Philippine Ports Authority, 1990.

TABLE 5.3-3 INTRA-ISLAND COASTWISE CARGO OD MATRIX - 1990

| D E S T I N A T I O N | | | | | | | | | | (TON) |
|-----------------------|----------|---------|--------|-------|-------|---------|-------|----------|-------|-------|
| | MANILA N | LEGASPI | TABACO | BAUAN | IRENE | PASACAO | BULAN | BATANGAS | COTTA | TOTAL |
| O MANILA N | | 5885 | | | 2525 | | 340 | 879 | | 9629 |
| R LEGASPI | 3302 | | 2751 | | | | | | | 6053 |
| I TABACO | 10 | 3168 | | | | | | | | 3178 |
| G BAUAN | 1136 | | | | | | | | | 1136 |
| I IRENE | 32994 | | | | | | | | | 32994 |
| N PASACAO | | 329 | | | | | | | | 329 |
| BULAN | 474 | | | | | | | | | 474 |
| BATANGAS | 18 | | | | | | | | 34 | 52 |
| COTTA | 81 | | | | | | | | | 81 |
| TOTAL | 38015 | 9382 | 2751 | | 2525 | | 340 | 879 | 34 | 53926 |

Source: Trade Division, National Statistics Office.

5.4 AIR TRANSPORT

Domestic air transportation in the Philippines has been operated since 1941 by the Philippines Airlines (PAL) which has scheduled flights to major airports in the country. To improve the efficiency of airline services and enhance tourism potentials, the Government lifted the particular monopoly of PAL over domestic scheduled services. Other airlines, however, operate mainly inter-island scheduled flights which are not considered in this study. All PAL routes in the island are

originated from Manila to reach presently the destinations of Laoag, Baguio, Daet, Tuguegarao, Legaspi and Naga. Other airports in the island do not have scheduled flights on regular basis.

There are mainly five major classifications of national airports in the Philippines; which are: international, alternate international, trunkline, secondary and feeder airports. The regular international airport is used for the operation of aircrafts engaged in international air navigation. The alternate international airport is used, on the other hand, to serve the irregular international air commerce. A trunkline airport serves a principal commercial center of the country. Secondary airports serve towns and cities with regular traffic densities. Feeder airports serve towns and rural communities with limited air traffic potential.

As of 1990, the total number of registered airports in the country was 173 airports, broken-down into 87 national airports and 86 private airports. Luzon Island has 22 national airports classified as 2 international, 1 trunkline, 10 secondary and 9 feeder airports. Figure 5.4-1 shows the locations of the different airports in Luzon Island according to their classification.

The number of total domestic air passengers arriving and departing in the Philippine has increased steadily for the past 25 years with an average annual growth rate of about 2%. Air passenger movement in Luzon Island has higher average of about 4% over the same period. The trend of the number of passengers movement at both of the airports of Luzon and the Philippine is clarified in Figure 5.4-2. The sudden drops in the number of passengers due to the increase of air fares for several times do not seem to highly affect the trend of Luzon Island comparing with the trend of the whole country. The growth trend is expected to continue with steady increase in the future due to the geographical situation of the country and the steady growth in the socioeconomic activities as well as the relatively low elasticity of demand versus air fare. Appendix 5.17 presents the number of passengers movement at the airports of Luzon Island. The growth trend of the cargo movement in the Philippine does not show any increase during the years 1980 - 1986, however, the movement at Luzon Island airports has an average growth rate of about 2.8% as shown in Figure 5.4-3. The cargo handled by each of Luzon airports is presented in Appendix 5.18.

Excluding Manila airport which has the highest share in the number of domestic commercial and general aviation aircraft operations as it is directly connected to most of the airports all over the country, the trend of the number of aircraft operations in other Luzon Island airports is decreasing gradually even with the annual increase in demand. This could be a result of the modernization of aircraft fleet, increase in fuel prices and the development of roads. Figures 5.4-4 and 5.4-5 show the trend of the commercial and general aviation aircraft operations at Manila and other Luzon airports between 1972 and 1986. The annual numbers of operations for the same period of both commercial and general aviation aircrafts are presented in Appendices 5.19 and 5.20 respectively.

Passenger and cargo data of PAL operations on the regular routes through Luzon

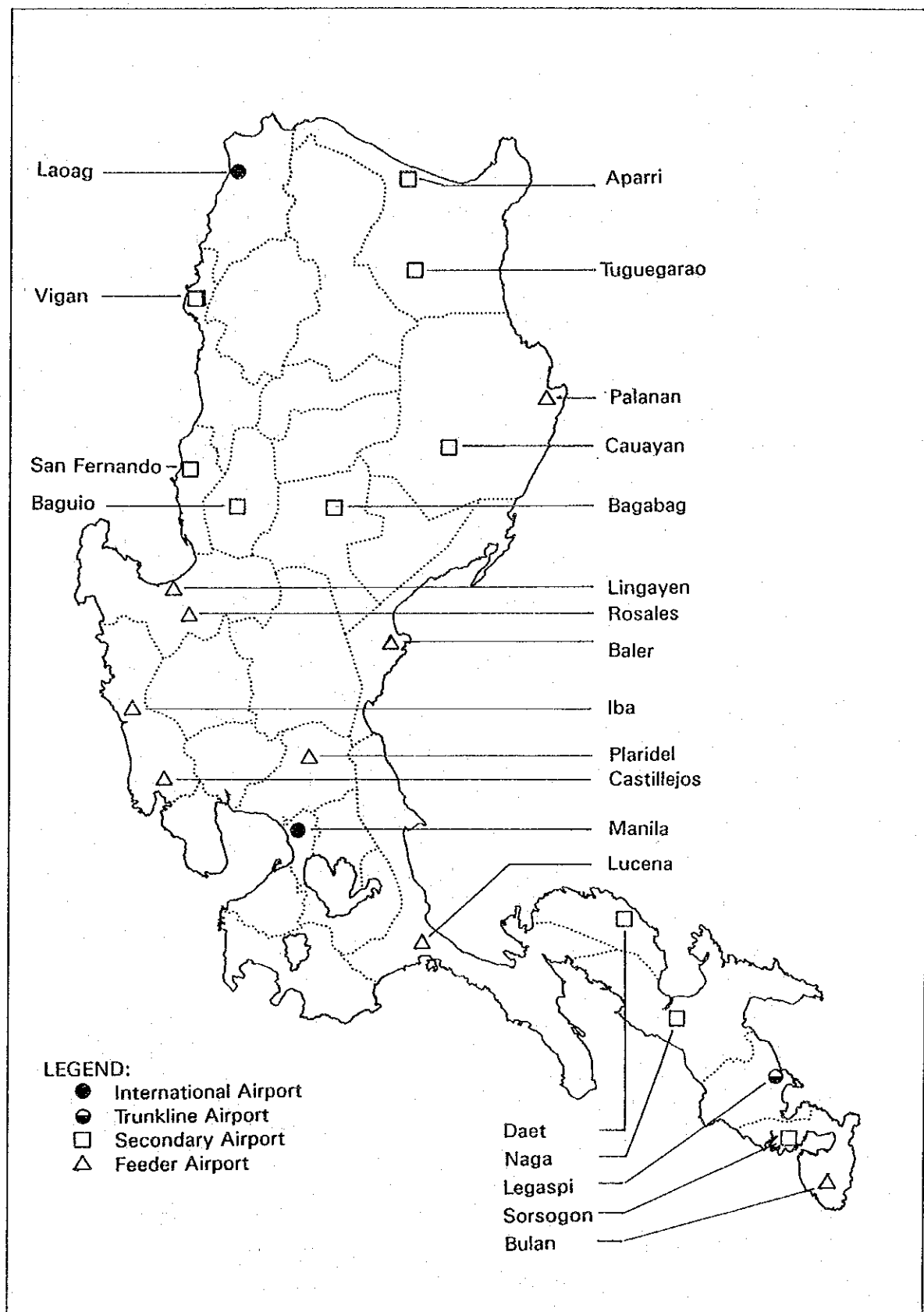


FIGURE 5.4-1 AIRPORTS IN LUZON ISLAND

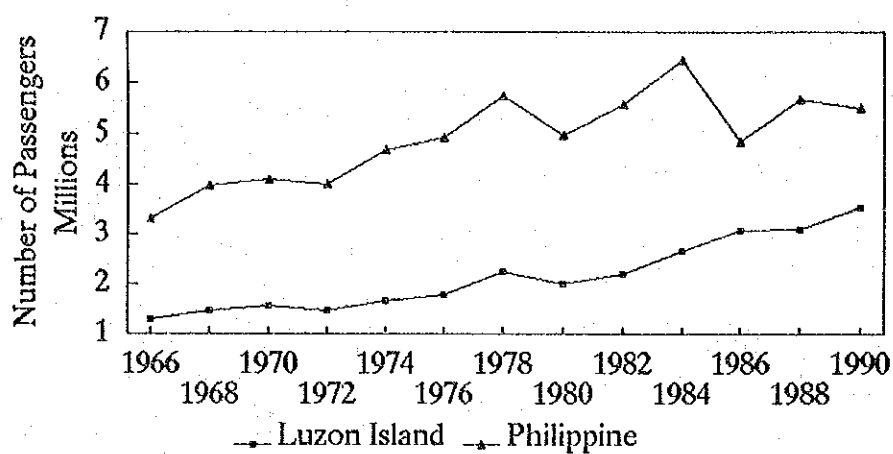


FIGURE 5.4-2 TREND OF AIR PASSENGER MOVEMENT

Source: Air Transportation Office.

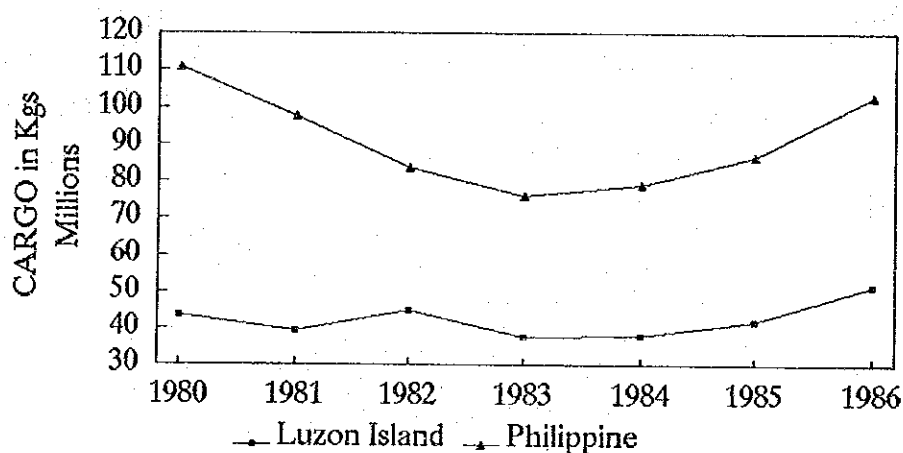


FIGURE 5.4-3 TREND OF AIR CARGO MOVEMENT

Source: Air Transportation Office.

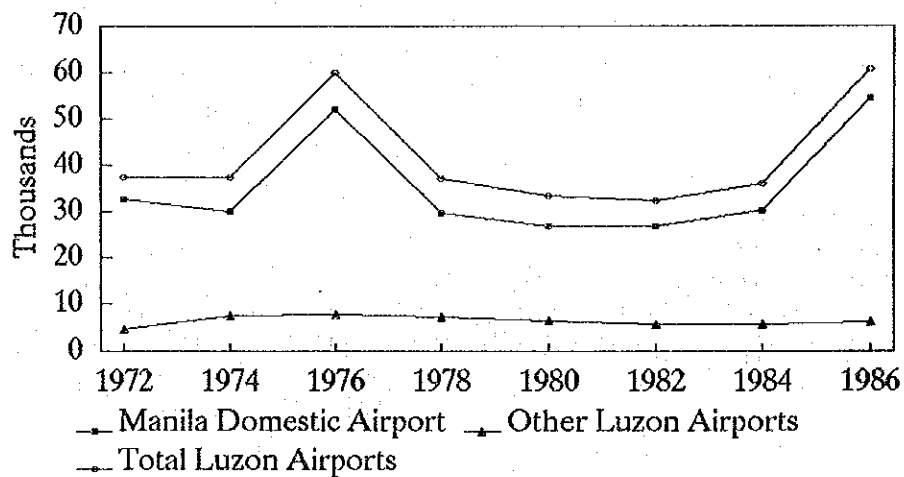


FIGURE 5.4-4 COMMERCIAL AIRCRAFT OPERATION IN LUZON ISLAND

Source: Air Transportation Office.

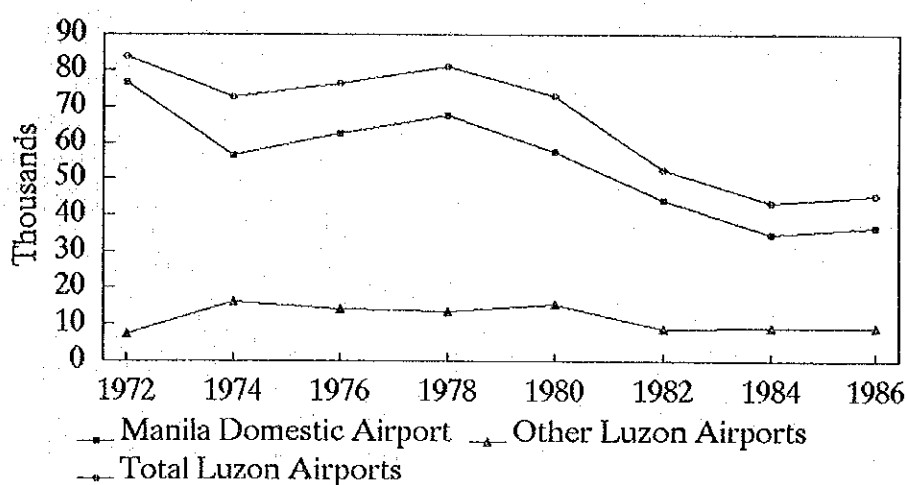


FIGURE 5.4-5 GENERAL AVIATION AIRCRAFT OPERATION IN LUZON ISLAND

Source: Air Transportation Office.

Island for the year from April 1991 to March 1992 are presented in Table 5.4-1. Legaspi Airport is in the second place after Manila, either for the inward or outward passenger and cargo movements, and is followed by Naga Airport which is also in the southern part of Luzon. Number of passengers for the intra-island air movement between Manila and other airports in Luzon Island on an OD matrix base is presented in Table 5.4-2. The OD matrix of the total cargo handled by PAL is given in Table 5.4-3. As most of the cargo transported by air differs completely with those transported by other modes, Table 5.4-4 gives the share of the main commodities transported by air in 1990.

TABLE 5.4-1 DOMESTIC AIR PASSENGER AND CARGO MOVEMENT - 1991/92

| Luzon Airports | Passengers | | Cargo (kg) | |
|-------------------|------------|-----------|------------|------------|
| | Departing | Arriving | Loaded | Unloaded |
| Baguio | 3,831 | 3,686 | 25,747 | 4,660 |
| Daet | 1,407 | 1,315 | 111 | 3,245 |
| Tuguegarao | 13,120 | 13,930 | 25,064 | 87,411 |
| Legaspi | 39,067 | 55,176 | 161,683 | 223,271 |
| Manila | 1,388,161 | 1,396,390 | 25,468,482 | 29,394,015 |
| Naga | 23,121 | 23,604 | 29,601 | 99,639 |
| San Fernando | 5,068 | 4,773 | 21,929 | 8,750 |
| TOTAL | 1,473,793 | 1,498,874 | 25,732,617 | 29,820,991 |

Source: Corporate Statistics, Philippine Airlines, Inc.

TABLE 5.4-2 LUZON INTRA-ISLAND AIR PASSENGERS OD MATRIX - 1991/92

| | D E S T I N A T I O N | | | | | | | | (Pax) |
|----------------|-----------------------|--------|------------|--------------|-------|---------|------|-------|--------|
| | MANILA | BAGUIO | TUGUEGARAO | SAN FERNANDO | LAOAG | LEGASPI | DAET | NAGA | TOTAL |
| O MANILA | | 3686 | 13930 | 4773 | 5150 | 39952 | 1315 | 23604 | 92410 |
| R BAGUIO | 3831 | | | | | | | | 3831 |
| I TUGUEGARAO | 13120 | | | | | | | | 13120 |
| G SAN FERNANDO | 5068 | | | | | | | | 5068 |
| I LAOAG | 4193 | | | | | | | | 4193 |
| N LEGASPI | 39614 | | | | | | | | 39614 |
| DAET | 1407 | | | | | | | | 1407 |
| NAGA | 23024 | | | | | | | | 23024 |
| TOTAL | 90257 | 3686 | 13930 | 4773 | 5150 | 39952 | 1315 | 23604 | 182667 |

Source: Corporate Statistics, Philippine Airlines, Inc.

TABLE 5.4-3 LUZON INTRA-ISLAND AIR CARGO OD MATRIX - 1991/92

| | D E S T I N A T I O N | | | | | | | | (kg) |
|----------------|-----------------------|--------|------------|--------------|-------|---------|------|-------|--------|
| | MANILA | BAGUIO | TUGUEGARAO | SAN FERNANDO | LAOAG | LEGASPI | DAET | NAGA | TOTAL |
| O MANILA | | 4660 | 87846 | 8750 | 10340 | 173657 | 3245 | 99639 | 298137 |
| R BAGUIO | 25747 | | | | | | | | 25747 |
| I TUGUEGARAO | 24629 | | | | | | | | 24629 |
| G SAN FERNANDO | 21929 | | | | | | | | 21929 |
| I LAOAG | 4993 | | | | | | | | 4993 |
| N LEGASPI | 143402 | | | | | | | | 143402 |
| DAET | 111 | | | | | | | | 111 |
| NAGA | 29263 | | | | | | | | 29263 |
| TOTAL | 250074 | 4660 | 87846 | 8750 | 10340 | 173657 | 3245 | 99639 | 548211 |

Source: Corporate Statistics, Philippine Airlines, Inc.

TABLE 5.4-4 AIR CARGO MAIN COMMODITIES - 1990

| Commodity | Quantity (kg) |
|--|---------------|
| Non-Agricultural Products | 21,817,576 |
| Including: 1. Printed Matters | 10,537,174 |
| 2. Medicinal and Pharmaceutical Products | 1,628,656 |
| 3. Parts and Accessories of Motor Vehicles | 1,591,966 |
| Agricultural Products | 24,538,425 |
| Including: 1. Fish; fresh, chilled or frozen | 8,272,446 |
| 2. Fruits & Nuts | 7,965,659 |
| 3. Crustaceans & Mollusks | 1,973,181 |
| Rice | 11,708 |
| Corn | 4,005 |
| Copra | - |

Source: Trade Division, National Statistical Office.

PART II

FUTURE DEVELOPMENT PLANS AND TRAFFIC DEMAND

CHAPTER 6 REVIEW OF FUTURE DEVELOPMENT PLANS

CHAPTER 7 FUTURE SOCIO-ECONOMIC FRAMEWORK

CHAPTER 8 FUTURE TRAFFIC DEMAND

CHAPTER 6

REVIEW OF FUTURE DEVELOPMENT PLAN

6.1 OUTLINE OF MEDIUM-TERM PHILIPPINE DEVELOPMENT PLAN, 1993-1998

6.1.1 Assessment of Performance, 1987-1991

The Medium-Term Philippine Development Plan (MTPDP) for 1987-91 was formulated in 1986 aiming at four development goals of alleviation of poverty, the generation of productive employment, the promotion of equity and social justice, and the attainment of sustainable economic growth. The growth of the gross national product (GNP) was targeted at an average of 6.5% per year. While the favorable developments in the initial years of the Plan period were encouraging, these were not sustained. After reaching a peak of 7.2% in 1988, the growth in real output decelerated to 0.2% and 1.2% in 1991 and 1992, respectively. As a result, the overall economic picture over 1987-1992 was less favorable rate of 3.6%/year than the target.

The MTPDP Report, 1993-98 concludes that unexpected external factors such as the Gulf crisis in August 1991 and economic recession of the industrial countries and weakness in the internal economy prevented the attainment of sustained high economic growth. The economy has suffered from import-dependent structure, infrastructure bottlenecks especially in energy, underdeveloped money and capital markets, and unbalanced regional development.

6.1.2 Goals and Objectives of the Plan, 1993-1998

The major macroeconomic goals of the Plan are set at: a) a sustained and broad-based growth of output and employment; b) price stability; and c) sound balance of payments position. Economic stabilization shall be designed to provide a stable and predictable environment for the private sector. Economic restructuring shall be undertaken in all sectors of the economy to attain international competitiveness through the following measures:

- (1) Fiscal policy shall shape a revenue and expenditure program that yields a manageable consolidated public sector deficit; accords with sound public debt management; and adheres to the principles of transparency and accountability.
- (2) Monetary policy shall emphasize price stability without unduly sacrificing output and employment; improve the efficiency of financial intermediation; and develop the capital market to improve domestic resource mobilization.
- (3) External policy shall ensure a sustainable balance of payments position;

- (3) External policy shall ensure a sustainable balance of payments position; continue the liberalization of the trade and capital accounts; and reduce the burden of external debt.
- (4) Macroeconomic policies shall be consistent with the vision of attaining international competitiveness by accommodating, continued trade liberalization and tariff reform, increased investments in infrastructure, and increased investments in human capital
- (5) Regional development policies shall ensure the maximization of production potentials and geographic advantages by eliminating the policy and investment bias for the National Capital Region, reducing socio-economic disparities within and among the regions, providing the regions and localities with opportunities to develop on the basis of their potentials and advantages, and widening the access of the population to productive resources and social services.

Population management, preservation of the environment, political stability, peace and order, and an efficient bureaucracy shall be taken as the complementary strategies.

6.1.3 Macro-economic Targets

The annual growth of Gross Domestic Product (GDP) is targeted at an average of 7.6% over the Plan period from 1993 to 1998. The GDP is to increase from a rate of 4.5% in 1993 to 10.0% in 1998. The target growth of Gross Regional Domestic Products (GRDP) is set as shown in Table 6.1-1.

TABLE 6.1-1 GRDP GROWTH TARGET, 1993-98 (%/year)

| Region | GRDP Total |
|-------------|------------|
| NCR | 6.1 |
| CAR | 6.1 |
| I | 8.2 |
| II | 5.9 |
| III | 8.7 |
| IV | 9.1 |
| V | 5.8 |
| Philippines | 7.6 |

Source: Preliminary Medium-Term
Philippine Development Plan, 1993-1998

Real per capita income is to increase at an annual rate of 5.4% from the estimated ₱ 11,600 in 1993 to ₱ 15,500 by 1998. Inflation is to decline from 7.5% in 1993 to 5.5% in 1998. The population growth rate will be reduced from 2.2% in 1993 to 1.9% by 1998. Job generated shall average 1.2 million annually over the Plan period. The unemployment rate shall decline from 10.3% in 1993 to 6.6% by 1998.

6.1.4 Government Revenue and Expenditure

The national government revenue effort is to improve revenue from 17.9% of GNP in 1993 to 18.7% by 1998. The ratio of national government expenditure in GNP will be increased from 19.5% in 1993 to 20.0% by 1998 as shown in Table 6.1-2.

TABLE 6.1-2 GOVERNMENT EXPENDITURE PROGRAM (1993-98) (P Billion)

| Item | Estimate 1992 | Targets | | Growth Rate |
|---------------------------------------|------------------|-----------------|-----------------|----------------|
| | | 1993 | 1998 | |
| I. Total Revenues (% of GNP) | 252.8 (18.2) | 278.6 (17.9) | 579.0 (18.7) | (14.9) |
| II. Total Disbursements (% of GNP) | 267.5 (19.3) | 304.2 (19.5) | 618.6 (20.0) | (15.0) |
| III. Deficit Financing | 14.7 | 25.6 | 39.6 | (18.0) |

* : Average annual growth rate from 1992 to 1998

The total Medium-Term Public Investment Program resources will average to P148.8 billion for the period 1994-1998 as shown in Table 6.1-3. The bulk of investments is allocated for infrastructure development.

TABLE 6.1-3 SECTORAL ALLOCATION OF MEDIUM-TERM PUBLIC INVESTMENT PROGRAM (1993-98)

| Item | Annual Average (1987-91) | 1993 | Targets | | Annual Average (1994-98)* |
|-------------------------------------|--------------------------------|------|---------|-------|---------------------------------|
| | | | 1994 | 1998 | |
| I. Public Inv. Program (Billion) | 133.3 | 28.7 | 85.8 | 218.8 | 148.8 |
| II. Sectoral Distribution | 100 | 100 | 100 | 100 | 100 |
| 1. Agro-Industrial Development | 9 | 14 | 6 | 19 | 13 |
| 2. Human Development | 11 | 9 | 9 | 14 | 13 |
| 3. Infrastructure Development | 77 | 71 | 83 | 61 | 71 |
| 4. Development Administration | 3 | 5 | 1 | 3 | 2 |
| 5. Disaster Mitigation | - | 1 | 1 | 3 | 2 |

6.2 AGRO-INDUSTRIAL DEVELOPMENT PLAN

6.2.1 Assessment of Performance, 1987-92

The agricultural sector grew annually at 2.2% on average over the previous Plan period and contributed an annual average share of 23% to GDP from 1987 to 1992. It was the source of employment for 45% of the labour force during the period. Despite several policy reforms, the productivity and income of majority of farmers and fisherfolks remain low. Productivity differentials

between urban and rural households continue to be wide with a ratio of 2.13. The MTPDP Report reviews that the general weakness of the agricultural sector is attributed to its poor linkages with the rest of the economy. Agricultural productivity growth has also been tapering off owing to inadequate investments in research and irrigation.

The industrial sector exhibited a modest growth of 4.1% during the period 1987-91, which was 3.4% lower than the target growth rate of the previous Plan. This was due to unfavorable domestic and international conditions. The sector, however, contributed an average of 36% to GDP from 1987 to 1991.

The MTPDP Report concludes that the past development plan treated the agriculture and industry sectors as separate sectors, resulting in an agriculture sector dominated by the production of primary products and an industry sector dominated by import-dependent manufacturing and processing industries, with no structural shifts occurring in either over time. Agriculture and industry must be treated under a common framework in order to emphasize the links between them.

6.2.2 Goals and Objectives of the Plan, 1993-1998

The Plan of the agro-industrial sector is geared towards the attainment of the following major goals:

- (1) Industrial restructuring for worldwide competitiveness and expanded production of goods and services for the domestic and export markets;
- (2) Strong productive and ecologically sound links between agriculture and industry; and
- (3) Increasing incomes, productivity and access to resources among small entrepreneurs, farmers and fisherfolks.

The following six (6) specific objectives are listed up in the Plan :

- (1) Rural industrialization including the dispersal of industries to regions outside of the National Capital Region (NCR);
- (2) Speedy and effective implementation of the Comprehensive Agrarian Reform Program (CARP);
- (3) Rehabilitation and sustainable utilization of the country's natural resources;
- (4) Modernization of the production sectors through technology upgrading;
- (5) Greater contribution of tourism to economic growth and regional development; and

- (6) Economic empowerment of men and women workers and employers as partners in the development process.

Based on the economic restructuring concept through acceleration of regional development and a location-specific approach to agro-industrial development, regional growth centers are identified in the order of priority as presented in Table 6.2-1.

TABLE 6.2-1 REGIONAL INDUSTRIAL CENTERS (RICs) TARGET (1993-98)

| Region by Priority | RIC | Site of Existing/ Proposed Industrial Area |
|-----------------------|------------------------|---|
| VII | Metro Cebu | Mactan EPZ |
| X | Cagayan de Oro | PHIVIDEDEC IE |
| IV* | Cavite City | Cavite EPZ |
| III* | Mariveles, Bataan | Bataan EPZ |
| CAR* | Baguio City | Baguio City EPZ |
| XII | Iligan City | Ma. Cristina-Fuentes |
| XI | Davao City | Panacan, Panabo, Iligan |
| I* | San Fernando, La Union | Bactonan |
| XI | General Santos City | Hacienda Espina |
| IV* | Batangas City | Tabungao-Bauan |
| VI | Iloilo City | Pavia |
| IX | Zamboanga City | Ayala-Recodo |
| V* | Legaspi City | Lamba |
| VIII | Tacloban City | New kawayan |
| II* | Cauayan | Cauaya, Isabel |
| ARMM | Parang | Polloc, Prang |
| XII | Cotabato | |

* : Regions in the study area

In addition to the RICs presented in the table, the following development networks/cores which link two or more RICs in the study area are identified in the order of priority:

- (1) Cavite-Laguna-Batangas-Rizal-Quezon (CALABARZON);
- (2) Laoag-San Fernando-Dagupan-Baguio
(Northwestern Luzon Growth Quadrangle);
- (3) Bulacan-Pampanga-Bataan-Zambales (West Central Luzon); and
- (4) Tuguegarao-Iligan-Cauayan.

The promotion of tourism development in the study area is recommended as follows:

- (1) Batangas/Taal/Tagaytay/Ternate; and
- (2) Northwestern Luzon (Baguio, La Union, Ilocos Sur and Norte and Pangasinan).

6.3 INFRASTRUCTURE DEVELOPMENT PLAN

6.3.1 Assessment of Performance, 1987-92

The MTPDP reports review that the delivery of infrastructure services was inadequate during the Plan period 1987-1992. The country experienced acute power supply shortage. Transportation, communications, and water resource facilities were insufficient in keeping up with their growing demand. The report indicates the following major problems hampered the development efforts in infrastructure sector:

- (1) Insufficient coordination among agencies/units in the implementation of infrastructure plans, policies, programs, and projects;
- (2) Tight budgetary constraints to support capital investments and O & M expenditures; and
- (3) Inadequate project preparation and lack of clear procedures for resolving environmental and community related issues that affect project implementation.

Regarding land transportation development, about 62% out of the total road network with around 160,600 km. have been upgraded for all-weather use from the 49% coverage in 1986.

6.3.2 Goals and Objectives of the Plan, 1993-1998

The Plan of the infrastructure sector is geared towards the attainment of the following major goals:

- (1) Provide the primary needs of the population such as reliable and adequate water, health facilities and transportation; and
- (2) Provide facilities to support the productive sectors and act as catalyst of development in desired areas.

The goals and objectives of the transportation development in the Plan are put on: 1) to provide facilities for basic human mobility and strengthen inter-regional and urban-rural linkages through all-weather flow of agro-industrial commodities; and 2) to ensure safe, efficient, economical and responsive transport services to meet dynamic market demands. The following strategies for the transportation development related to the road sub-sector are included in the Plan:

- (1) Identify and provide basic transport infrastructure;
- (2) Properly maintain existing transport facilities to lengthen use and save

huge investment;

- (3) Continuously upgrade transport facilities and service standards;
- (4) Promote multi-modal transport and trade facilitation;
- (5) Develop an arterial road network consisting of the north-south backbone, east-west laterals, and other strategic roads;
- (6) Provide the transport facility requirements of agriculture, fishing, and agrarian reform areas, regional industrial centers, and tourism areas;
- (7) Implement urban transport management measures and development alternative modes of transport in coordination with local government units to alleviate traffic congestion. Expand existing mass transit systems and pursue new projects including expressways and tollways, wherever feasible;
- (8) Intensify transport safety programs through the implementation of relevant recommendations of the Civil Aviation Master Plan, Maritime Safety Master Plan, and the Road Safety Program;
- (9) Strictly enforce environmental protection measures to control vehicle emissions, water pollution, and noise pollution;
- (10) Strengthen institutional and inter-agency coordination of planning and project implementation to ensure effective and efficient inter-modal linkage and reduce disruption of services;
- (11) Promote private sector participation in transport development, i.e. construction, maintenance, and operations of road, expressways, mass transit systems, ports, railways, terminals, etc.;
- (12) Enhance the capability of local government units in administering and implementing/developing infrastructure facilities;
- (13) Pursue efficiency and competition enhancing measures such as deregulation, decentralization, appropriate pricing mechanism, rationalization of user charges; and
- (14) Adjust truck load limits along with road design standards to achieve a proper balance between trucking and infrastructure costs, and strictly enforce load limits.

The government investment required for infrastructure development during 1993-1998 accounts for ₱765.6 billion as shown in Table 6.3-1. The transportation sector investments, including the land transportation, are ₱236.2 billion (31% of the total investment) and ₱152.8 billion (20%) respectively.

TABLE 6.3-1 GOVERNMENT INFRASTRUCTURE INVESTMENT PROGRAM
(1993-98) (P Billion)

| Item | Annual Disbursement | | Total (1993- 1998) | Share by Sector (%) |
|--|---------------------|----------------|--------------------------|---------------------------|
| | 1993 | 1998 | | |
| 1. Energy | 41.6 | 47.7 | 319.6 | 41.7 |
| 2. Transportation (Land Transportation) | 23.8 (10.5) | 44.1 (36.9) | 236.2 (152.8) | 30.9 (20.0) |
| 3. Communication | 7.4 | 1.2 | 36.3 | 4.7 |
| 4. Water Resources | 14.4 | 24.6 | 117.7 | 15.4 |
| 5. Social Infrastructure | 4.1 | 14.0 | 55.8 | 7.3 |
| Total | 91.3 | 131.6 | 765.6 | 100.0 |

The existing, on-going and proposed major infrastructure projects in the study area are summarized in Appendix 6.1 and located on Figure 6.3-1. The listed on-going and proposed projects are assumed to be implemented or prepared for the implementation during the Plan period.

6.3.3 Transport Development in Luzon Island

1) Road Transport Development Plan

The road development plan sets the following targets;

- (1) Rehabilitate and improve 100% of national arterial roads and national secondary roads into all-weather condition;
- (2) Convert all bridges along national roads into permanent structures;
- (3) Increase the percentage of all-weather barangay roads to 90% of the total;
- (4) Provide access roads to schools;
- (5) Establish one regional motor vehicle inspection station per region; and
- (6) Explore the feasibility of implementing the following major Build-Operation-Transfer (BOT) projects:
 - Manila South Tollway
 - San Mateo-Batasan Road
 - Manila-Cavite Expressway
 - New North Luzon Expressway
 - Manila-Bataan-Subic Coastal Road

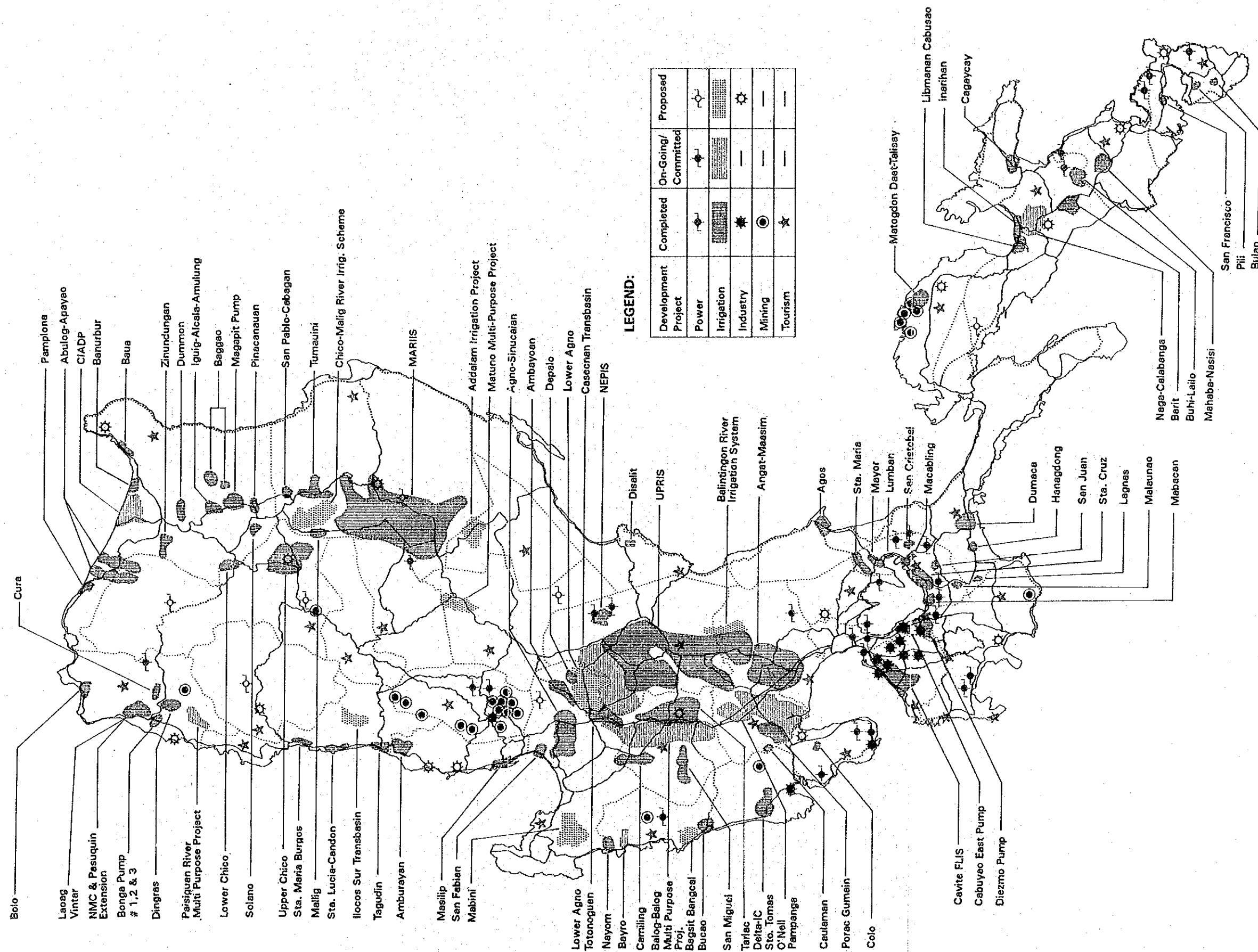


FIGURE 6.3-1 MAJOR DEVELOPMENT PROJECTS IN LUZON ISLAND

Major implemented, on-going and committed projects for roads and bridges in Luzon Island are clarified on Figure 6.3-2 according to the classification of the foreign assisted financing source, and the summarized list of projects is presented in Appendix 6.2

2) Railway Transport Development Plan

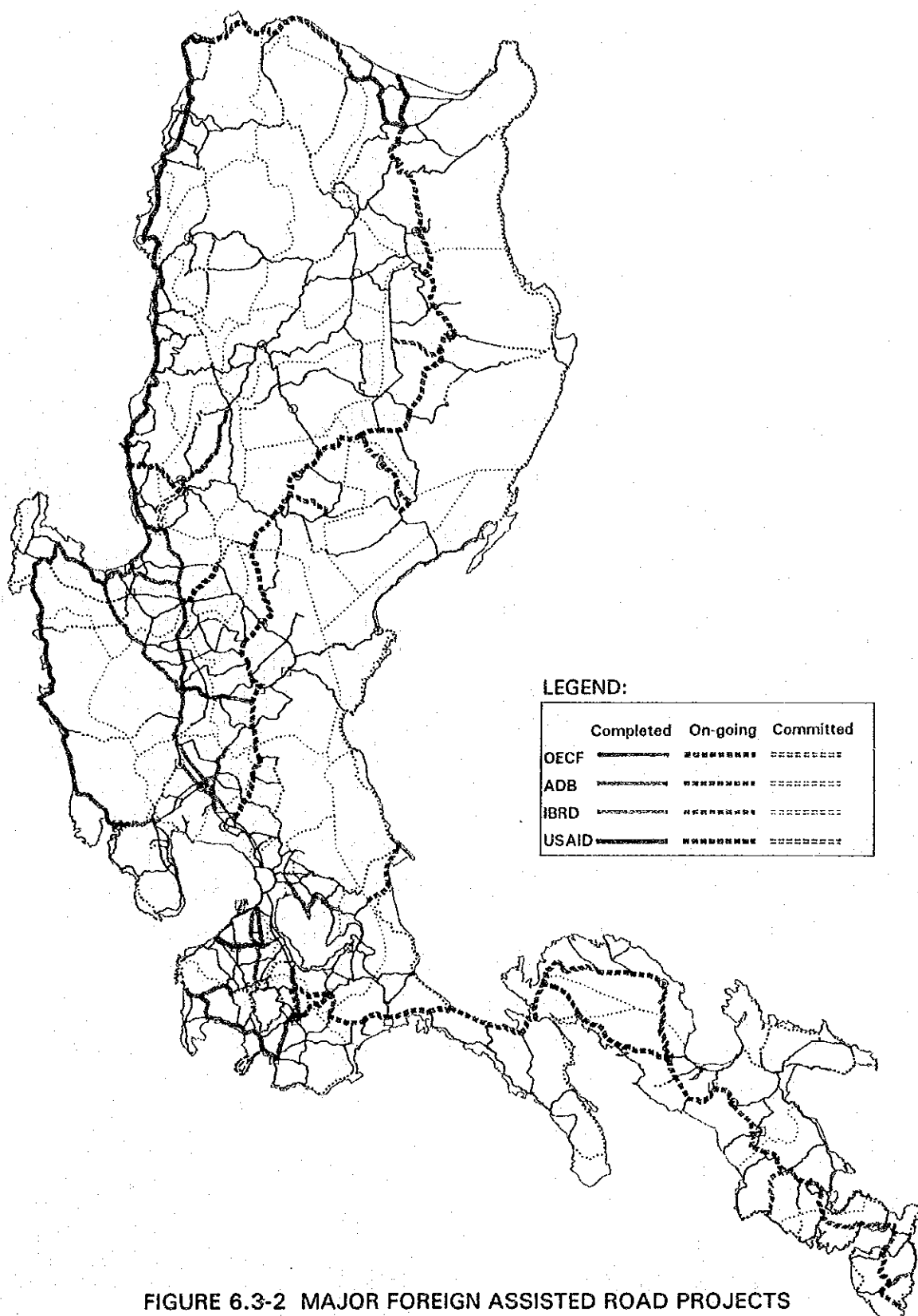
The Philippines National Railways (PNR) has established the Medium Term Public Investment Program of 1992 which includes the future projects till 1994 and later years. The program includes both ongoing and proposed projects either locally funded or foreign assisted. For long distance operations, locally funded ongoing projects include the rolling stock repair program, reconstruction works for damages due to earthquake and the Main Line North rehabilitation. Foreign assisted ongoing projects include the revitalization of the Main Line South while the proposed projects are mainly extension projects for the railway lines to Cagayan Valley and Sorsogon. Total funds required for the program are about ₱ 11 billion in which ₱ 3.5 billion are locally funded and ₱ 7.5 billion as foreign funds.

The Main Line North Rehabilitation Project, with a total cost of about ₱ 1.0 billion, includes the reballasting of bridges and stations and improvement of signals and communications and rehabilitation of rolling stock. The line runs from Manila and is passing through the provinces of Bulacan, Pampanga, Pangasinan up to San Fernando, La Union. A branch line to San Jose in Nueva Ecija Province, with a track distance of 55 kilometers, connects with the main line from Tarlac. The project proposes to construct spur line to Porac and San Miguel Brewery, both in Pampanga Province. Phase I of the project is to rehabilitate the section between Caloocan and Tarlac and Phase II will be the section between Tarlac to San Fernando, La Union, including the branch line from Tarlac to San Jose, Nueva Ecija. Implementation of Phase I requires two years and was scheduled to complete by June 1993, however, eruption of Mt. Pinatubo in Pampanga Province caused the suspension of the project. The period of Phase II is also two years between 2001 and 2003.

3) Sea Transport Development Plan

The Philippine Ports Authority (PPA) controls and supervises the Port District Offices (PDOs) and provides port service facilities and other port structures. It facilitates the implementation of an integrated program for the planning, development, financing operations and maintenance of ports/port districts for the entire country.

The Medium Term Public Investment Program of the PPA (1992-1998) includes 13 foreign assisted projects and 51 locally funded projects. Most of the foreign assisted projects are concentrated in Luzon Island for the development of the ports of Manila and Batangas in addition to a Master Plan Study for the port of San Fernando.



**FIGURE 6.3-2 MAJOR FOREIGN ASSISTED ROAD PROJECTS
IN LUZON ISLAND**

Locally funded projects in Luzon Island are mainly for the construction of port facilities and piers. As the ports of Luzon Island are used mainly for inter-island shipping routes to the south, their development plans do not expect to produce great impact on the intra-island traffic movement and the development plan of the road network. A summary of the future projects of the program for ports in Luzon Island is presented in Table 6.3-2.

TABLE 6.3-2 FUTURE PROJECTS OF PPA IN LUZON ISLAND (P '000)

| Project | Total Cost | Years |
|--|----------------|----------------|
| a. Foreign Assisted Projects: | | |
| 1. Second Manila Port Project | 1,724,640 | 1992/94 |
| 2. Fourth IBRD Port Project | 470,727 | 1992/93 |
| 3. Batangas Port Development Project, | | |
| Phase I | 1,536,411 | 1992/95 |
| Phase II | 27,088 | 1997/98 |
| 4. Manila Grain Terminal Project | 1,500 | 1992/95 |
| 5. South Harbor Bulk Terminal Project | 4,000 | 1992/96 |
| 6. Greater Capital Region Integrated Port Development Project | 250 | 1995 |
| 7. Port of San Fernando Master Plan Study | 250 | 1992 |
| 8. National Port Plan Study | 750 | 1993/94 |
| 9. Various Ports Development Projects | 400,000 | 1995/98 |
| b. Locally Funded Projects: Total | 241,809 | 1992/95 |

4) Air Transport Development Plan

Civil aviation provides a number of social and economic benefits which are mostly similar to those of all other transport modes. Government plans and programs for the next few years are geared towards the upgrading of the airport facilities to meet the increasing demand, the modernization of air navigation facilities to improve aviation safety, and promotion of efficiency in airline services.

Future projections of air passengers for selected airports in Luzon Island are presented in Table 6.3-3, while projections for air passenger demand in the whole country are shown in Figure 6.3-3 by airport classification.

TABLE 6.3-3 PROJECTIONS OF AIR PASSENGERS OF SELECTED AIRPORTS IN LUZON ISLAND

| Airport | 1990 | 1995 | 2000 | 2005 | 2010 |
|------------|---------|---------|---------|---------|---------|
| BAGUIO | 14,707 | 10,429 | 36,554 | 62,185 | 87,815 |
| TUGUEGARAO | 27,689 | 24,823 | 21,958 | 19,092 | 16,227 |
| LAOAG | 13,293 | 9,383 | 5,474 | 1,546 | 2,346 |
| LEGASPI | 163,454 | 221,550 | 279,556 | 337,561 | 395,567 |
| DAET | 28,203 | 102,383 | 176,498 | 250,613 | 324,728 |

Source: Civil Aviation Master Plan, October 1991.

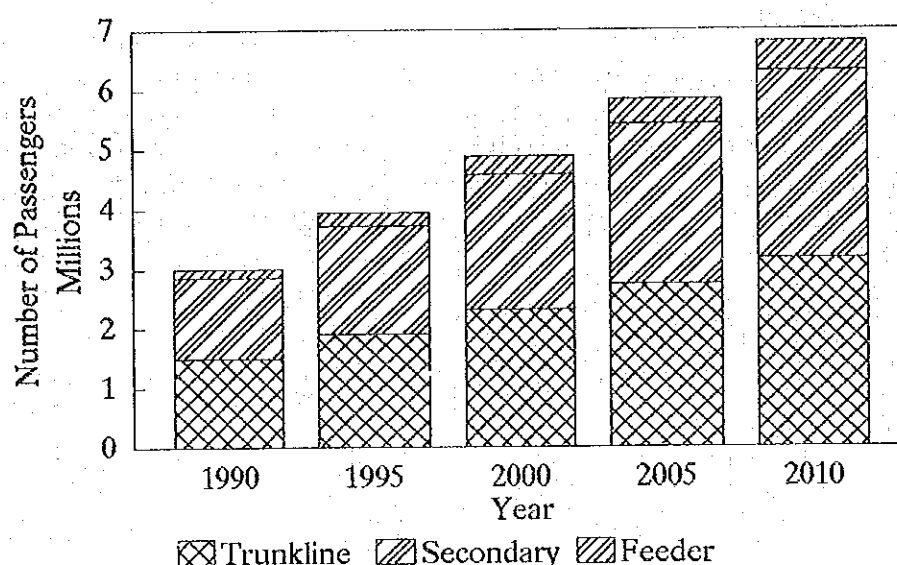


FIGURE 6.3-3 FUTURE AIR PASSENGERS BY AIRPORT CLASSIFICATION

Source: Civil Aviation Master Plan, October 1991.

To cope with the expected growth in air traffic demand and to support the targets of the air transport development plans, the Civil Aviation Master Plan (1991) recommends the development of the infrastructure through upgrading the airport facilities and increasing the runway dimensions as proposed in Table 6.3-4 for the three airports of Legaspi, Naga and Daet in Luzon Island. The Plan established also the investment program presented in Table 6.3-5 which includes mainly providing new air navigation facilities and communication systems for eight airports in the island. The Plan includes also improving the existing condition of the terminal buildings in some airports.

TABLE 6.3-4 PRESENT AND PROPOSED RUNWAY DIMENSIONS

| Airport | Present Runway (m) | Proposed Runway (m) |
|---------|--------------------|---------------------|
| Legaspi | 1974 x 36 | 2400 x 45 |
| Naga | 1282 x 30 | 1500 x 30 |
| Daet | 1120 x 30 | 1200 x 30 |

Source: Civil Aviation Master Plan, October 1991.

TABLE 6.3-5 PROPOSED INVESTMENT PROGRAM

| Airport and Upgrading Works | Total Cost (P'000) |
|---|--------------------|
| MANILA | 44,700 |
| ANF & Communications | |
| LAOAG | 19,600 |
| ANF & Communications | |
| LEGASPI | 96,299 |
| Runway & Terminal Building | |
| BAGUIO | 2,025 |
| Runway, Apron, Taxiway & Terminal Building | |
| NAGA | 34,830 |
| Runway, Apron, Taxiway, Terminal Building, ANF & Communications | |
| TUGUEGARAO | 12,175 |
| Runway, Apron, Taxiway, Terminal Building, ANF & Communications | |
| SAN FERNANDO | 14,000 |
| ANF & Communications | |
| DAET | 15,247 |
| Runway, Apron, Taxiway & Terminal Building | |

Source: Civil Aviation Master Plan, October 1991.

CHAPTER 7

FUTURE SOCIO-ECONOMIC FRAMEWORK

7.1 OBJECTIVES AND METHODOLOGY

7.1.1 Objectives of Framework Setting

Since this study aims at the formulation of a master plan for a period of about 20 years, target years for the socio-economic framework are set at 2000, 2010 and 2020 to cover about 10 years after the final year of the plan. This road network development is needed to coordinate closely with existing or proposed regional development plans or projects to support or accelerate the regional development.

The road network plan should be formulated taking into consideration the future traffic demand. In addition, several effects accrued from improvement of regional accessibility i.e. acceleration of various developments, increase of living standard as well as income, improvement of social welfare, etc. will be expected by the LISR development. Formulation of socio-economic framework aims not only at preparation of basic data required for the future traffic demand estimate but also at presentation of the future promising socio-economic features through the LISR development as well as other socio-economic development.

7.1.2 Zoning for LISR Network

Zone will be a minimum unit in order to forecast traffic demand, to evaluate road network, and to formulate road improvement or construction plans. The zones for the LISR study are made on the basis of the existing and proposed national road network and population distribution by a unit of municipality. The total number of 634 municipalities in the study area are subdivided into 98 zones in total. One zone consists of 6 to 7 municipalities on the average.

7.1.3 Data Required for the Study

Most of the available data covers only up to the year of 1990 and the recent 1991 and 1992 data is not yet issued or prepared. Hence socio-economic framework is prepared at the base year of 1990 and targeted to the year of 2020. Beside demographic framework, the GRDP growth target in the year of 2020 is formulated and utilized to prepare other economic indicators. The following socio-economic indicators as a framework were prepared by a unit of zone.

- 1) Population,
- 2) Gross Value Added (GVA) by agricultural and non-agricultural sectors,
- 3) Agricultural production by crop, livestock, fishery and forestry, and
- 4) Annual income and expenditure

7.1.4 Data Source and Forecast Method

Demographic framework is prepared on the basis of past trend of population increase and population projection collected from the National Statistics Office (NSO). Economic framework is based on the GRDP growth target in the year of 2020. Past GRDP data and economic parameters are collected from the National Statistical Coordination Board (NSCB). There are no provincial account like Gross Provincial Domestic Product (GPDP). Only agricultural production and price data by a unit of province is available and considered accurate. Hence bottom-up approach could be applied only for agricultural GVA estimate by a unit of province using the above agricultural statistics. Subdivision from a province to zones is made using data on the present agricultural land use and future land development potential by a unit of zone. Non-agricultural GVA could be estimated by a balance between the agricultural GVA and the future total GVA target. The forecast methods to formulate a socio-economic framework are detailed in the following sections.

7.2 DEMOGRAPHIC FRAMEWORK

7.2.1 Philippine Population Projection

In 1985, the National Census and Statistics Office (NCSO) made a long term population projection for the period of 1990-2030, in collaboration with the Inter-Agency Committee, in order to formulate a basis for policy making and planning for development. The results have been approved by the Statistical Advisory Board of NEDA and thereafter planners and policymakers have been enjoined to use the official population projections for the preparation of development plans for the country.

The projection results were reported in a volume titled as "Philippine Population Projection, 1980-2030 (PPP)" where future population by each five year were broken down into sex and age groups, and also into administrative units: Regions, Provinces, and Cities/Municipalities.

In this LISR Study, the projection of PPP will be used as the demographic framework, after reviewing and modifying where necessary. The method of PPP are summarized below.

1) Basic Equation

National, regional and provincial population are projected following the most common demographic procedure of forecasting population by age and sex, namely, the cohort-component method. The method is simply the successive application of the population bookkeeping equation.

$$P^{t+n} = P^t + B^{t+n} - D^{t+n} + I^{t+n} - O^{t+n}$$

where: P^{t+n} : the projected population n years after time t

P^t : the population at an initial period t

B^{t+n} : the total number of births that occur to the population during the n-year interval t to t + n

D^{t+n} : the total number of deaths that occur to the population during the same period

I^{t+n} : number of in-migrants during the same period

O^{t+n} : number of out-migrants during the same period

The terms on the right hand side of the equation are determined from the base population and the assumptions to be formulated about the trends of fertility, mortality and migration. The results of the 1980 Census were used as the base population.

2) Mortality

Mortality levels are considered to be reduced further and the projected values of life expectancy at birth are assumed as shown in Table 7.2-1.

TABLE 7.2-1 PROJECTED LIFE EXPECTANCY AT BIRTH

| Year | Both Sexes | Male | Female |
|------|------------|------|--------|
| 1970 | 55.7 | 54.2 | 57.2 |
| 1975 | 58.4 | 56.9 | 59.9 |
| 1980 | 61.6 | 59.8 | 63.3 |
| 1990 | 64.6 | 62.8 | 66.4 |
| 2000 | 67.6 | 66.0 | 69.2 |
| 2010 | 70.3 | 68.8 | 71.8 |
| 2020 | 73.5 | 72.8 | 74.4 |

3) Fertility

For future trend of fertility, the following three alternative assumptions were adopted:

Assumption 1: (Rapid Fertility Decline) Fertility will decline from its 1980 level such that the net reproduction rate (NRR) of 1.0 will be achieved by the year 2000.

Assumption 2: (Moderate Fertility Decline) Fertility will decline from its 1980 level such that an NRR of 1.0 will be achieved by the year 2010.

Assumption 3: (Slow Fertility Decline) Fertility will decline from its 1980 level such that an NRR of 1.0 will be achieved by the year 2020.

According to these three assumptions, age specific fertility rates are projected as shown in Table 7.2-2.

TABLE 7.2-2 AGE SPECIFIC FERTILITY RATES (PER 1,000)

| Year | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | T.F.R. |
|--|-------|-------|-------|-------|-------|-------|-------|--------|
| Assumption 1 Rapid Fertility Decline | | | | | | | | |
| 1980 | 43 | 189 | 225 | 217 | 163 | 82 | 23 | 4.70 |
| 1990 | 32 | 139 | 166 | 160 | 120 | 60 | 17 | 3.46 |
| 2000 | 20 | 89 | 106 | 101 | 77 | 38 | 11 | 2.21 |
| 2010 | 19 | 86 | 103 | 99 | 75 | 37 | 11 | 2.15 |
| 2020 | 19 | 83 | 100 | 96 | 72 | 36 | 10 | 2.08 |
| 2030 | 18 | 81 | 97 | 93 | 70 | 35 | 10 | 2.02 |
| Assumption 2 Moderate Fertility Decline | | | | | | | | |
| 1980 | 43 | 189 | 225 | 217 | 163 | 82 | 23 | 4.70 |
| 1990 | 35 | 155 | 185 | 178 | 134 | 67 | 19 | 3.86 |
| 2000 | 28 | 121 | 144 | 139 | 104 | 52 | 15 | 3.01 |
| 2010 | 20 | 87 | 104 | 100 | 74 | 37 | 11 | 2.17 |
| 2020 | 19 | 84 | 101 | 97 | 73 | 36 | 11 | 2.10 |
| 2030 | 18 | 81 | 97 | 93 | 70 | 35 | 10 | 2.10 |
| Assumption 3 Slow Fertility Decline | | | | | | | | |
| 1980 | 43 | 189 | 225 | 217 | 163 | 82 | 23 | 4.70 |
| 1990 | 37 | 163 | 194 | 187 | 141 | 71 | 20 | 4.06 |
| 2000 | 31 | 137 | 164 | 158 | 118 | 60 | 17 | 3.42 |
| 2010 | 25 | 112 | 133 | 128 | 96 | 49 | 14 | 2.78 |
| 2020 | 20 | 86 | 102 | 99 | 74 | 37 | 10 | 2.14 |
| 2030 | 18 | 81 | 97 | 93 | 70 | 35 | 10 | 2.02 |

4) Migration

On account of difficulty of projection future migration patterns, a continuation of the 1975-1980 migration patterns described in Chapter 2.3.4 was assumed though at a progressively diminishing rate.

7.2.2 Modification of PPP

Calculating the Study Area population using PPP forecasts, future population under three alternative case are shown in Figure 7.2.1. Population in the year 1990 are forecast to be 23.5 million in High case, 23.0 in Medium case and 22.7 million in Low case, respectively. Actual population by census was 22.9 million which showed that Medium case gave the most accurate figure. In this LISR Study, forecast under Medium case will be adopted as the demographic framework.

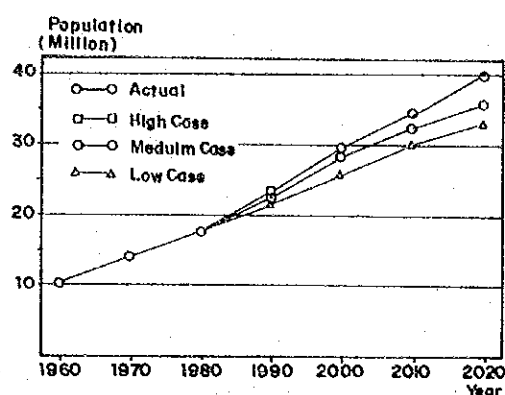


FIGURE 7.2-1 POPULATION OF THE STUDY AREA FORECASTED BY PPP

Although the difference between the forecast and the actual population is only 0.7% for the Study Area as a whole, there are several regions with bigger error if checking region by region. Check in provincial level and furthermore in city/municipality level identified several projections with error not to overlook. Therefore, it is decided to modify the PPP forecast in Medium case, using the 1990 census results through the following steps:

- Step 1 : Total of future Study Area population is modified, at first, by multiplying the rate of error (actual value to forecast value for the year 1990) to the forecast up to 2020.
- Step 2 : The same modification is done to regional population and then the results are re-adjusted so that their total meet the Study Area total.
- Step 3 : The same modification is done to provincial population and then the results are re-adjusted so that their total meet their region total.
- Step 4 : The same modification is done to cities and municipalities population and then the results are re-adjusted so that their total meet their province total.

Table 7.2-3 compares modified population and original population by region. Region IV modified upward while Regions II and V downward although not remarkable. Modified population are shown in Table 7.2-4 and Figure 7.2-2. Significant increases are observed not only in the provinces near NCR but also remote provinces. This is mainly because PPP assumes that migration would diminish in the future.

TABLE 7.2-3 REGIONAL POPULATION FORECAST BY PPP AND MODIFICATION
(unit:1,000)

| Region | Actual | | Projected | | | | Modified | | | |
|--------|--------|--------|-----------|--------|--------|--------|----------|--------|--------|--------|
| | 1980 | 1990 | 1990 | 2000 | 2010 | 2020 | 1990 | 2000 | 2010 | 2020 |
| CAR | 918 | 1,146 | 1,141 | 1,429 | 1,586 | 1,755 | 1,146 | 1,435 | 1,593 | 1,762 |
| I | 2,922 | 3,551 | 3,515 | 4,140 | 4,662 | 5,111 | 3,551 | 4,181 | 4,708 | 5,162 |
| II | 1,918 | 2,326 | 2,457 | 3,045 | 3,570 | 4,049 | 2,326 | 2,882 | 3,379 | 3,832 |
| III | 4,827 | 6,199 | 6,142 | 7,529 | 8,713 | 9,700 | 6,199 | 7,598 | 8,793 | 9,790 |
| IV | 4,733 | 6,492 | 6,285 | 7,935 | 9,394 | 10,651 | 6,492 | 8,194 | 9,700 | 11,000 |
| V | 2,727 | 3,123 | 3,446 | 4,222 | 4,914 | 5,562 | 3,123 | 3,825 | 4,452 | 5,040 |
| Total | 18,045 | 22,836 | 22,986 | 28,300 | 32,839 | 36,827 | 22,836 | 28,116 | 32,625 | 36,586 |

TABLE 7.2-4 POPULATION PROJECTION BY PROVINCE

| Region/ Province | Actual | | Modified | | | |
|---------------------|------------|------------|------------|------------|------------|------------|
| | 1980 | 1990 | 1990 | 2000 | 2010 | 2020 |
| CAR | 918,187 | 1,145,880 | 1,145,880 | 1,398,297 | 1,592,641 | 1,762,355 |
| Abra | 160,094 | 184,743 | 184,743 | 220,213 | 247,918 | 274,066 |
| Benguet | 357,312 | 485,546 | 485,546 | 611,994 | 704,951 | 785,941 |
| Mt. Province | 103,152 | 116,535 | 116,535 | 128,162 | 135,519 | 141,470 |
| Ifugao | 111,575 | 147,281 | 147,281 | 175,156 | 197,683 | 216,707 |
| K. Apayao | 186,054 | 211,775 | 211,775 | 262,771 | 306,569 | 344,171 |
| Region I | 2,922,219 | 3,550,606 | 3,550,606 | 4,181,455 | 4,708,119 | 5,162,004 |
| Ilocos Norte | 389,428 | 461,661 | 461,661 | 539,248 | 604,007 | 659,290 |
| Ilocos Sur | 442,250 | 519,930 | 519,930 | 627,889 | 724,175 | 816,153 |
| La Union | 453,031 | 548,742 | 548,742 | 667,449 | 770,732 | 869,460 |
| Pangasinan | 1,637,510 | 2,020,273 | 2,020,273 | 2,346,870 | 2,609,205 | 2,817,101 |
| Region II | 1,917,627 | 2,325,626 | 2,325,626 | 2,881,705 | 3,378,853 | 3,832,393 |
| Cagayan | 713,485 | 829,974 | 829,974 | 993,116 | 1,133,110 | 1,258,586 |
| Isabela | 877,178 | 1,080,341 | 1,080,341 | 1,353,067 | 1,595,900 | 1,813,800 |
| Nueva Vizcaya | 242,946 | 301,179 | 301,179 | 380,442 | 453,283 | 523,014 |
| Quirino | 84,018 | 114,132 | 114,132 | 155,080 | 196,559 | 236,993 |
| Region III | 4,826,669 | 6,198,957 | 6,198,957 | 7,597,756 | 8,792,706 | 9,789,695 |
| Bataan | 326,074 | 425,803 | 425,803 | 554,793 | 670,611 | 772,344 |
| Bulacan | 1,103,198 | 1,505,219 | 1,505,219 | 1,878,132 | 2,207,923 | 2,485,056 |
| Nueva Ecija | 1,074,028 | 1,312,610 | 1,312,610 | 1,573,549 | 1,790,529 | 1,970,612 |
| Pampanga | 1,187,772 | 1,532,682 | 1,532,682 | 1,901,915 | 2,221,999 | 2,493,252 |
| Tarlac | 690,268 | 859,651 | 859,651 | 1,001,586 | 1,112,658 | 1,198,121 |
| Zambales | 445,329 | 562,992 | 562,992 | 687,782 | 798,991 | 870,309 |
| Region IV | 4,733,017 | 6,491,710 | 6,491,710 | 8,194,104 | 9,700,312 | 11,000,097 |
| Aurora | 107,479 | 139,586 | 139,586 | 191,017 | 240,810 | 286,695 |
| Batangas | 1,166,869 | 1,476,783 | 1,476,783 | 1,764,289 | 2,000,930 | 2,193,933 |
| Cavite | 771,165 | 1,152,534 | 1,152,534 | 1,537,216 | 1,895,244 | 2,223,098 |
| Laguna | 974,969 | 1,370,232 | 1,370,232 | 1,745,682 | 2,073,594 | 2,356,851 |
| Quezon | 1,145,188 | 1,372,381 | 1,372,381 | 1,666,767 | 1,921,819 | 2,144,273 |
| Rizal | 567,347 | 980,194 | 980,194 | 1,289,134 | 1,567,916 | 1,795,247 |
| Region V | 2,726,842 | 3,122,884 | 3,122,884 | 3,825,356 | 4,452,045 | 5,039,775 |
| Albay | 812,265 | 903,023 | 903,023 | 1,077,358 | 1,225,820 | 1,360,293 |
| Camarines Norte | 309,208 | 390,982 | 390,982 | 486,215 | 572,345 | 658,355 |
| Camarines Sur | 1,102,721 | 1,305,919 | 1,305,919 | 1,615,902 | 1,896,632 | 2,158,329 |
| Sorsogon | 502,648 | 522,960 | 522,960 | 645,881 | 757,248 | 862,798 |
| Study Area | 18,044,561 | 22,835,663 | 22,835,663 | 28,078,674 | 32,624,676 | 36,586,319 |

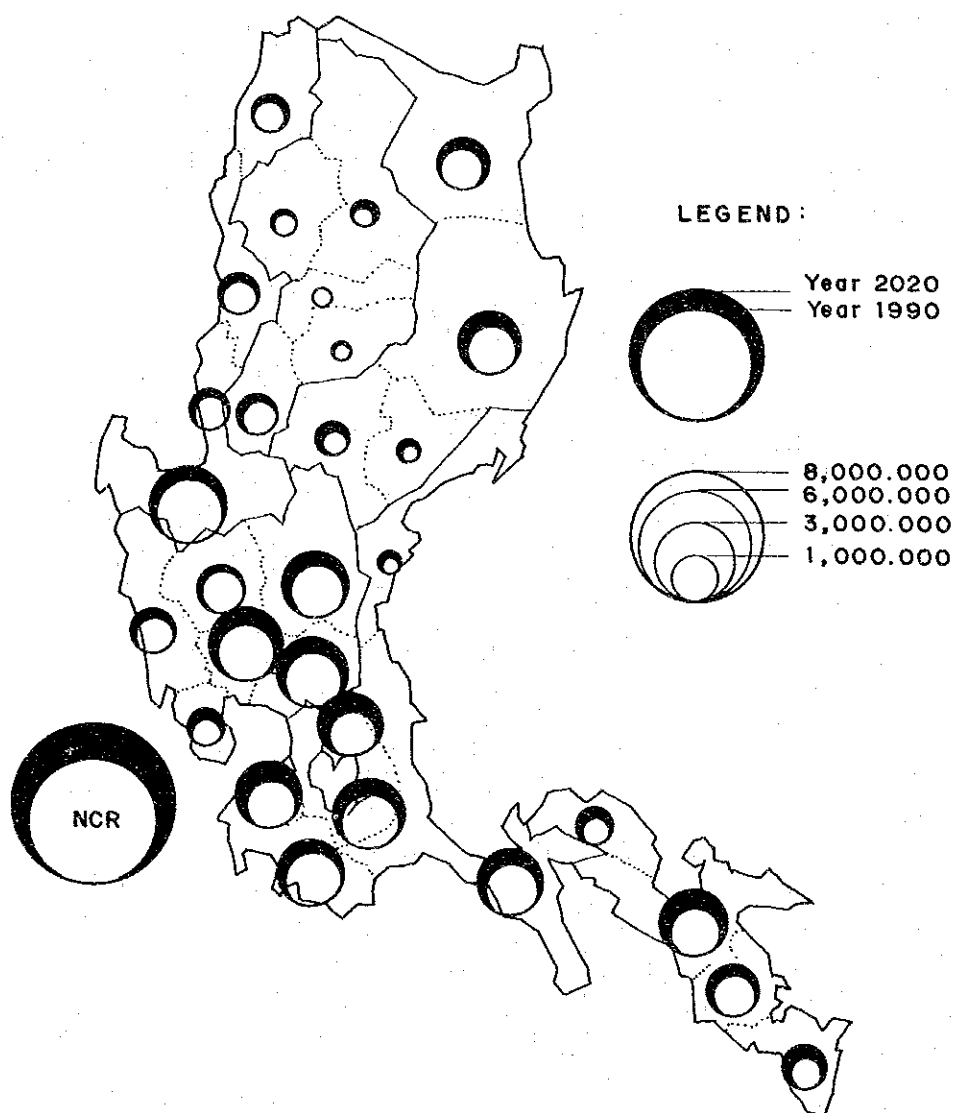


FIGURE 7.2-2 PRESENT AND FUTURE PROVINCIAL POPULATION

7.2.3 Age and Sex Structure

Figure 7.2-3 illustrates future age and sex structure in the Study Area, comparing to the present one. Due to the declining trend of fertility and mortality, age structure pattern will be changed significantly from a pyramid pattern to a vase-pattern. By this, dependent population rate will drop from 77 in 1990 to 44 in 2020, which will affect preferably to the regional economy. Granting male population as 100, female population will slightly changed from 98.4 in 1990 to 99.2 in 2020.

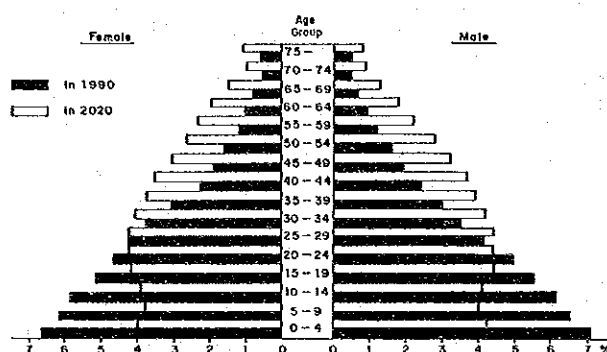


FIGURE 7.2-3 FUTURE POPULATION STRUCTURE BY AGE AND SEX

7.3 FUTURE AGRICULTURAL PRODUCTION FRAMEWORK

7.3.1 Land Development Potential for Production Use

Before the assessment of future agricultural land use plan, land use framework is formulated on the basis of the forestry conservation and reforestation programs, and future increase in built-up area. Some portion of pasture and idle grassland more than 18% of slope degrees could be converted to forestry and agro-forestry. Land use framework in the study area is prepared by province and summarized in Table 7.3-1. In the future, the share of agricultural land to the total study area will be decreased from 54% to 51% and that of forestry be increased from 35% to 38%.

TABLE 7.3-1 LAND USE FRAMEWORK IN THE STUDY AREA (Km²)

| Item | Agricultural Land | Forestry | Built-up & Others | Total |
|---------|-------------------|-----------------|-------------------|-------------------|
| Present | 58,070 (54%) | 37,956 (35%) | 11,508 (11%) | 107,534 (100%) |
| Future | 54,726 (51%) | 40,747 (38%) | 12,061 (11%) | 107,534 (100%) |

Agricultural land use plan in lowland is summarized in Table 7.3-2. Based on the NIA's assessment on irrigation development potential, irrigated paddy field could be increased. Total paddy field in the future will be increased by the land conversion from diversified crop land to paddy land through irrigation water supply or land and soil improvement. Diversified crop land will be also increased through utilization of idle grassland. Agricultural crop land in the study area will be increased from the present 19.6 thousand km² to 22.5 thousand km² in the future.

TABLE 7.3-2 AGRICULTURAL LAND USE PLAN IN LOWLAND (Km²)

| Item | Paddy Field | | | Diversi- fied Crop Land | Grassland (Idle) | Total |
|----------|-------------|---------|--------|-------------------------------|---------------------|--------|
| | Irrigated | Rainfed | Total | | | |
| Present | 7,071 | 6,506 | 13,577 | 6,046 | 2,832 | 22,455 |
| Future | 10,691 | 3,623 | 14,314 | 8,150 | 564 | 23,028 |
| Increase | 3,620 | -2,883 | 737 | 2,104 | -2,268 | 573 |

Agricultural land use in upland should be formulated taking land and soil conservation requirement into consideration. Permanent crop land will be increased through the conversion of pasture and idle grassland. Agricultural land in upland of the study area will be decreased by the promotion of reforestation or agro-forestry programs from the present 35.6 thousand km² to 31.7 thousand km². Agricultural land for permanent crop and pasture will be increased from the present 29.7 km² to 30.4 km² in the future as shown in Table 7.3-3.

TABLE 7.3-3 AGRICULTURAL LAND USE PLAN IN UPLAND (Km²)

| Item | Permanent Crop Land | Pasture | Grassland (Idle) | Total |
|------------------------|------------------------|-----------------|---------------------|------------------|
| Present | 16,376 (46%) | 13,344 (37%) | 5,895 (17%) | 35,615 (100%) |
| Future | 21,065 (66%) | 9,320 (29%) | 1,314 (4%) | 31,699 (100%) |
| Increase (Decrease) | 4,689 | (4,024) | (4,581) | (3,916) |

7.3.2 Agricultural Production Estimate

The future agricultural crop production is assessed on the basis of future agricultural land use plan, crops' potential unit yields as shown in Table 7.3-4, and harvesting area by crops.

TABLE 7.3-4 CROPS POTENTIAL YIELD ESTIMATE

(t/ha)

| Palay | | Corn | Eggplant | Tomato | Cabbage |
|-------------------|----------------|----------------|-------------------|----------------|------------------|
| Irrigated 5.0 | Rainfed 3.5 | 3.5 | 11.0 | 15.0 | 15.0 |
| Onion 15.0 | Mongo 1.2 | Peanut 1.4 | Garlic 8.0 | Camote 12.0 | Cassava 10.0 |
| Sugarcane 85.0 | Tobacco 1.5 | Banana 13.0 | Pineapple 16.0 | Mango 10.0 | Calamansi 6.0 |
| Coconut 7.0 | Cacao 2.0 | Coffee 2.0 | Abaca 1.0 | | |

Source: Bureau of Plant Industry

The palay harvested area is determined by both irrigated and rainfed area. It is assumed that the future cropping intensity at irrigated paddy field will be more than 160%. The corn will be planted as a main crop at the future diversified crop land at least once a year. This study excludes the future demand and supply study on the respective crop, while the sugarcane and coconut area could be retained at the present level due to the recent stagnant or decreasing production as well as export demand. The other crop's harvested area is determined according to the respective present share of harvested area. The future potential crop production is estimated by province and summarized in Table 7.3-5. Crop production in the study area will be 56.3 million tons in total which accounts for 80% of the 6 regions. The share of palay and corn to the total crop production of the study area will be 20% and 10% respectively.

TABLE 7.3-5 POTENTIAL PRODUCTION ESTIMAE FOR CROPS

('000 t)

| Regions | Palay | Corn | Others | Total |
|------------|--------|-------|--------|--------|
| CAR | 382 | 137 | 4,495 | 5,014 |
| I | 3,350 | 415 | 3,247 | 7,012 |
| II | 1,446 | 1,486 | 5,444 | 8,376 |
| III | 3,835 | 184 | 7,555 | 11,574 |
| IV | 2,182 | 2,573 | 24,261 | 29,016 |
| V | 1,760 | 2,230 | 5,549 | 9,539 |
| 6 Regions | 12,955 | 7,025 | 50,551 | 70,531 |
| Study Area | 11,523 | 5,647 | 39,158 | 56,328 |

Note: Figures are rounded

The future livestock and fishery production is assessed taking the future increase in population and per capita consumption into consideration. It is considered that the present forestry production is reached at a maximum level due to limited forestry resources and necessity of logging restriction. Production potential of livestock, fishery and forestry is estimated by province and summarized in Table 7.3-6. The study area will occupy 83% of those production in the 6 regions.

TABLE 7.3-6 PRODUCTION POTENTIAL FOR OTHER AGRICULTURAL PRODUCTS ('000 t)

| Regions | Livestock | Fishery | Forestry |
|------------|-----------|---------|----------|
| CAR | 53 | 21 | 119 |
| I | 103 | 185 | 2 |
| II | 51 | 54 | 1,072 |
| III | 380 | 507 | 7 |
| IV | 782 | 3,544 | 350 |
| V | 69 | 503 | 7 |
| 6 Regions | 1,438 | 4,814 | 1,557 |
| Study Area | 1,369 | 3,771 | 1,379 |

Note: Figures are rounded.

Based on the potential production estimate, agricultural GVA is estimated by province applying farmgate prices and GVA ratios to production quantities. The provincial potential agricultural GVAs are subdivided into the zones taking the future agricultural land development potentials into consideration. The agricultural potential GVA in the study area is estimated at around 208.6 billion pesos at 1990 constant price which accounts for 88% of the regions' as shown in Table 7.3-7. The value of crops occupies 82% of the total GVA in the study area followed by livestock (14%) and fishery (3%).

TABLE 7.3-7 AGRICULTURAL POTENTIAL PRODUCTION VALUE ESTIMATE (Million Pesos, 1990 Constant Price)

| Regions | Crops | Livestock | Fishery | Forestry | Total |
|------------|---------|-----------|---------|----------|---------|
| CAR | 19,974 | 1,017 | 20 | 211 | 21,222 |
| I | 34,256 | 2,336 | 354 | 13 | 36,959 |
| II | 28,581 | 1,098 | 93 | 1,218 | 30,990 |
| III | 33,920 | 8,495 | 1,891 | 11 | 44,317 |
| IV | 54,453 | 16,854 | 4,421 | 620 | 76,348 |
| V | 24,043 | 1,464 | 721 | 4 | 26,232 |
| 6 Regions | 195,227 | 31,264 | 7,500 | 2,077 | 236,068 |
| Study Area | 170,978 | 29,715 | 6,100 | 1,783 | 208,576 |

Note: Figures are rounded.

7.4 ECONOMIC FRAMEWORK

7.4.1 Economic Growth and Future GRDP

(1) GRDP Target

There are no official forecast or target of GRDP up to the year of 2020. The new "Medium-Term Philippine Development Plan (MTPDP)" indicates the

growth targets of GRDP, while their target year is limited up to 1988. The MTPDP basically aims at increase in share of GRDP outside of the NCR. The MTPDP focuses on the economic restructuring through acceleration of regional development by maximizing production potentials and geographical advantages. Individual and linked development of Regional Industrial Centers (RICs) is also recommended. In addition, the Local Government Code issued aims at the strengthening of provincial administration and development promotion based on the local demands.

Based on the recent development policy issues, the balanced regional socio-economic development concept could be applied to formulate long-run target up to 2020. Imbalanced productions and incomes between NCR and other regions should be improved and minimized by the proper allocation of regional development. The study team discussed with the regional and central NEDA personnels for the formulation of an economic framework up to 2020. Upon the request of the study team, some NEDA regional offices prepared their own GRDP forecast or target based on the available socio-economic indicators. The study team verified the data collected and GRDP targets for the study were prepared on the basis of the balanced regional development concept as follows:

- 1) Based on per capita GRDP in 1990, the following per capita GRDP targets to be achieved by 2020 are assumed:
 - NCR level (P43,631)
 - Average of 7 regions including the NCR (P20,631)
 - Average of 6 study regions (P13,455)
- 2) Taking the population growth rates up to 2020 into consideration, the required GRDP growth rates to be achieved are analyzed as follows:

TABLE 7.4-1 ASSESSMENT OF GRDP TARGET IN 2020

| Regions | Annual GRDP Growth Rate up to 2020 to be required (%) | | |
|---------|--|----------------------|----------------------|
| | NCR Level | 7 Regions Average | 6 Regions Average |
| CAR | 4.94 | 2.39 | - |
| I | 6.77 | 4.17 | 2.71 |
| II | 7.20 | 4.60 | 3.14 |
| III | 5.11 | 2.56 | - |
| IV | 4.77 | 2.23 | - |
| V | 7.44 | 4.83 | 3.37 |

- 3) Through the assessment on the above annual average GRDP growth rates, the study team concluded the following target GRDPs to be considered achievable in the respective regions. The target per capita GRDPs in the year of 2020 set at the NCR level for CAR, Region III and IV, and at the average of 7 regions including the NCR for Region I, II and V.

TABLE 7.4-2 GRDP TARGET FOR SOCIO-ECONOMIC FRAMEWORK

| Regions | GRDP Growth Rate 1990-2020 (%/year) | Per Capita GRDP Target | GRDP in 2020 * (Million Pesos 1990 Constant) |
|---------|--|------------------------------|--|
| CAR | 4.94 | NCR Level | 75,809 |
| I | 4.17 | Average (7 Regions) | 105,681 |
| II | 4.60 | Average (7 Regions) | 78,599 |
| III | 5.11 | NCR Level | 419,926 |
| IV | 4.77 | NCR Level | 597,303 |
| V | 4.83 | Average (7 Regions) | 127,103 |

* Rounding figures

(2) Agricultural Development Target

Agricultural development target is assessed on the basis of the agricultural GVA in 1990 and the potential GVA presented in Chapter 7.3. Alternative agricultural development targets are set at 60% to 90% of the potential GVAs and the required annual GVA growth rates in the 6 regions are analyzed as follows.

TABLE 7.4-3 ASSESSMENT OF AGRICULTURAL GVA TARGET IN 2020

| Regions | GVA Growth Rate (%/year) | | | |
|-----------|--------------------------|------------------|------------------|------------------|
| | 60% Potential | 70% Potential | 80% Potential | 90% Potential |
| CAR | 3.81 | 4.35 | 4.81 | 5.23 |
| I | 1.83 | 2.35 | 2.81 | 3.21 |
| II | 1.91 | 2.43 | 2.89 | 3.29 |
| III | 0.71 | 1.23 | 1.68 | 2.08 |
| IV | 0.21 | 0.72 | 1.17 | 1.57 |
| V | 0.69 | 1.20 | 1.66 | 2.06 |
| 6 Regions | 1.00 | 1.53 | 1.98 | 2.38 |

Based on the different situation for agricultural development in the 6 regions as well as achievable annual GVA growth rates, the study team decided the following agricultural GVA targets by region. Development achievement in the 6 regions will be around 75% of the total potential GVA in 2020.

TABLE 7.4-4 AGRICULTURAL GVA TARGET IN 2020

| Regions | GVA Growth Rate 1990-2020 (%/year) | Development Level to Potential | GRDP in 2020 (Million Pesos 1990 Constant) |
|-----------|---|--------------------------------------|--|
| CAR | 3.81 | 60 | 12,733 |
| I | 2.35 | 70 | 25,871 |
| II | 2.43 | 70 | 21,692 |
| III | 1.68 | 80 | 35,454 |
| IV | 1.17 | 80 | 61,079 |
| V | 1.66 | 80 | 20,986 |
| 6 Regions | 1.77 | 75 | 177,815 |

(3)Economic Framework

Economic framework for the study is prepared on the basis of both GRDP and agricultural GVA targets mentioned above. Non-agricultural GVAs in the 6 regions are decided at the balances between the GRDPs and agricultural GVAs. To determine GRDPs or agricultural and non-agricultural GVAs from 1990 to 2020, constant value increase is considered. The economic framework for the study is prepared in Table 7.4-5.

TABLE 7.4-5 ECONOMIC FRAMEWORK UP TO 2020

(P'000; 1990 Constant Price)

| Region/Sector | 1990 | 2000 | 2010 | 2020 |
|-----------------|-------------|-------------|---------------|---------------|
| CAR | 17,843,883 | 37,552,046 | 56,680,557 | 75,809,069 |
| Agriculture | 4,142,057 | 7,062,926 | 9,897,887 | 12,732,848 |
| Non-Agriculture | 13,701,826 | 30,489,120 | 46,782,670 | 63,076,221 |
| I | 31,025,307 | 56,408,168 | 81,044,474 | 105,680,781 |
| Agriculture | 12,877,279 | 17,295,158 | 21,583,099 | 25,871,040 |
| Non-Agriculture | 18,148,028 | 39,113,010 | 59,461,375 | 79,809,741 |
| II | 20,392,382 | 40,182,723 | 59,390,995 | 78,599,267 |
| Agriculture | 10,545,936 | 14,335,830 | 18,014,256 | 21,692,682 |
| Non-Agriculture | 9,846,446 | 25,846,893 | 41,376,739 | 56,906,585 |
| III | 94,156,825 | 204,918,385 | 312,422,252 | 419,926,119 |
| Agriculture | 21,479,211 | 26,230,624 | 30,842,289 | 35,453,954 |
| Non-Agriculture | 72,677,614 | 178,687,761 | 281,579,963 | 384,472,165 |
| IV | 147,599,996 | 300,499,002 | 448,900,978 | 597,302,955 |
| Agriculture | 43,054,482 | 49,182,726 | 55,130,728 | 61,078,730 |
| Non-Agriculture | 104,545,514 | 251,316,276 | 393,770,251 | 536,224,225 |
| V | 30,873,686 | 63,591,678 | 95,347,376 | 127,103,075 |
| Agriculture | 12,819,827 | 15,596,275 | 18,291,063 | 20,985,850 |
| Non-Agriculture | 18,053,859 | 47,995,403 | 77,056,314 | 106,117,225 |
| 6 Regions | 341,892,079 | 703,152,002 | 1,053,786,632 | 1,404,421,266 |
| Agriculture | 104,918,792 | 129,703,538 | 153,759,322 | 177,815,104 |
| Non-Agriculture | 236,973,287 | 573,448,465 | 900,027,310 | 1,226,606,162 |

7.4.2 Gross Provincial Account

The GRDP or agricultural and non-agricultural GVAs in the respective region are allocated to the provincial and zonal accounts. The procedures to estimate Gross Provincial Domestic Product (GPDP) are summarized as follows:

(1) Agricultural GVA

Agricultural GVA is estimated by province and zone to assess development potentials and targets mentioned in Chapter 7.3 as well as the agricultural production in 1990 mentioned in Chapter 2.5. During 1990 to 2020, the constant value increase is applied and the GVA in the respective province and zone is determined.

(2) Non-Agricultural GVA

Non-agricultural GVA in 1990 is estimated on the basis of number of families by industry mentioned in Chapter 2.4. The non-agricultural GVA in 2020 is allocated from a region to provinces and zones as follows:

- 1) The future regional, provincial and zonal urban population in 2020 is estimated on the basis of the respective urban populations in 1990 and urban population growth rates;
- 2) The share of urban population to the total population by province and zone is determined; and
- 3) Based on the assumption that non-agricultural GVA will accrue according to the urban population distribution, the non-agricultural GVA in the regional level is allocated to the respective province and zone using the above urban population shares in 2020.

During 1990 to 2020, the constant value increase is applied same as GRDPs and agricultural GVAs, and the non-agricultural GVA in the respective province and zone is determined.

(3) GPDP

Gross Provincial Domestic Product (GPDP) in the respective province and their zonal breakdown are determined by the sum of agricultural and non-agricultural GVAs. The GPDPs by sector and their growth rates by 10 years from 1990 to 2020 are shown in Table 7.4-6 and 7.4-7 respectively.

TABLE 7.4-6 GROSS PROVINCIAL ACCOUNT UP TO 2020

(P'000, 1990 Constant Price)

| Region/ Province | Agriculture | | | | Non-Agriculture | | | | Total | | | |
|---------------------|-------------|------------|------------|------------|-----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 1990 | 2000 | 2010 | 2020 | 1990 | 2000 | 2010 | 2020 | 1990 | 2000 | 2010 | 2020 |
| CAR | 4,142,057 | 7,062,926 | 9,897,887 | 12,732,848 | 13,701,826 | 30,489,120 | 46,782,670 | 63,076,221 | 17,843,883 | 37,552,046 | 56,680,557 | 75,809,069 |
| Abra | 526,041 | 1,328,292 | 2,106,947 | 2,885,603 | 1,637,863 | 3,508,667 | 5,324,447 | 7,140,228 | 2,163,904 | 4,836,959 | 7,431,394 | 10,025,831 |
| Benguet | 1,404,157 | 1,818,670 | 2,220,991 | 2,623,312 | 8,140,236 | 20,326,792 | 32,154,920 | 43,983,049 | 9,544,393 | 22,145,462 | 34,375,911 | 46,606,361 |
| Mt. Province | 497,048 | 783,852 | 1,062,221 | 1,340,590 | 1,296,755 | 1,915,273 | 2,515,619 | 3,115,965 | 1,793,783 | 2,699,125 | 3,577,840 | 4,456,555 |
| Ifugao | 538,467 | 991,538 | 1,431,283 | 1,871,029 | 1,648,728 | 2,469,278 | 3,265,694 | 4,062,110 | 2,187,195 | 3,460,816 | 4,696,977 | 5,933,139 |
| K. Apeyao | 1,176,344 | 2,140,574 | 3,076,444 | 4,012,315 | 978,264 | 2,269,110 | 3,521,990 | 4,774,869 | 2,154,608 | 4,409,684 | 6,598,434 | 8,787,184 |
| Region I | 12,877,279 | 17,295,157 | 21,583,099 | 25,871,040 | 18,148,028 | 39,113,010 | 59,461,375 | 79,809,741 | 31,025,307 | 56,408,167 | 81,044,474 | 105,680,781 |
| Ilocos Norte | 1,403,623 | 2,833,988 | 4,222,283 | 5,610,579 | 2,400,243 | 4,210,859 | 5,968,221 | 7,725,583 | 3,803,866 | 7,044,847 | 10,190,504 | 13,336,162 |
| Ilocos Sur | 1,674,046 | 2,506,716 | 3,314,896 | 4,123,075 | 2,624,390 | 4,502,613 | 6,325,594 | 8,148,575 | 4,298,436 | 7,009,329 | 9,640,490 | 12,271,650 |
| La Union | 1,648,292 | 2,320,405 | 2,972,750 | 3,625,096 | 3,478,825 | 5,804,621 | 8,062,011 | 10,319,400 | 5,127,117 | 8,125,026 | 11,034,761 | 13,944,496 |
| Pangasinan | 8,151,318 | 9,634,048 | 11,073,168 | 12,512,289 | 9,644,570 | 24,594,918 | 39,105,550 | 53,616,183 | 17,795,888 | 34,228,966 | 50,178,718 | 66,128,472 |
| Region II | 10,545,936 | 14,335,830 | 18,014,257 | 21,692,682 | 9,846,446 | 25,846,893 | 41,376,739 | 56,906,585 | 20,392,382 | 40,182,723 | 59,390,996 | 78,599,267 |
| Cagayan | 2,112,083 | 3,330,876 | 4,513,822 | 5,696,769 | 4,132,767 | 9,062,240 | 13,846,728 | 18,631,216 | 6,244,850 | 12,393,116 | 18,360,550 | 24,327,985 |
| Isabela | 7,045,637 | 9,152,653 | 11,197,698 | 13,242,742 | 4,303,508 | 11,734,701 | 18,947,329 | 26,159,957 | 11,349,145 | 20,887,354 | 30,145,027 | 39,402,699 |
| Nueva Viscaya | 799,157 | 1,091,093 | 1,374,443 | 1,657,792 | 1,038,989 | 3,315,158 | 5,524,361 | 7,733,605 | 1,838,146 | 4,406,251 | 6,898,824 | 9,391,397 |
| Quirino | 562,400 | 703,194 | 839,847 | 976,500 | 306,295 | 1,525,574 | 2,708,992 | 3,892,410 | 868,695 | 2,228,768 | 3,548,839 | 4,868,910 |
| Others | 26,659 | 58,014 | 88,447 | 118,879 | 64,887 | 209,220 | 349,308 | 489,397 | 91,546 | 267,234 | 437,755 | 608,276 |
| Region III | 21,479,211 | 26,242,504 | 30,848,229 | 35,453,954 | 72,677,614 | 178,687,761 | 281,579,963 | 384,472,165 | 94,156,825 | 204,930,265 | 312,428,192 | 419,926,119 |
| Bataan | 923,606 | 1,380,354 | 1,823,668 | 2,266,982 | 5,589,237 | 16,499,509 | 27,088,891 | 37,678,272 | 6,512,843 | 17,879,863 | 28,912,559 | 39,945,254 |
| Bulacan | 4,403,238 | 5,911,528 | 7,375,456 | 8,839,384 | 21,814,591 | 56,280,490 | 89,732,686 | 123,184,882 | 26,217,829 | 62,192,018 | 97,108,142 | 132,024,266 |
| Nueva Ecija | 6,529,680 | 7,290,213 | 8,028,377 | 8,766,541 | 10,876,995 | 24,198,631 | 37,128,454 | 50,058,276 | 17,406,675 | 31,488,844 | 45,156,831 | 58,824,817 |
| Pampanga | 3,758,862 | 4,750,340 | 5,712,657 | 6,674,975 | 18,891,229 | 51,279,138 | 82,714,462 | 114,149,786 | 22,650,091 | 56,029,478 | 88,427,119 | 120,824,761 |
| Tarlac | 3,350,757 | 3,920,612 | 4,473,707 | 5,026,802 | 7,263,098 | 12,702,237 | 17,981,401 | 23,260,566 | 10,613,855 | 16,622,849 | 22,455,108 | 28,287,368 |
| Zambales | 2,513,068 | 2,977,577 | 3,428,424 | 3,879,270 | 8,242,464 | 17,727,757 | 26,934,071 | 36,140,384 | 10,755,552 | 20,705,334 | 30,362,495 | 40,019,654 |
| Region IV | 43,054,482 | 49,182,726 | 55,130,728 | 61,078,730 | 104,545,514 | 251,316,276 | 393,770,250 | 536,224,225 | 147,599,996 | 300,499,002 | 448,900,978 | 597,302,955 |
| Aurora | 1,546,517 | 1,800,340 | 2,046,698 | 2,293,056 | 1,505,455 | 4,038,282 | 6,496,614 | 8,954,945 | 3,051,972 | 5,838,622 | 8,543,312 | 11,248,001 |
| Batangas | 6,992,048 | 8,033,126 | 9,043,594 | 10,054,042 | 9,890,006 | 20,985,082 | 31,753,832 | 42,522,581 | 16,882,054 | 29,018,208 | 40,797,416 | 52,576,623 |
| Cavite | 4,595,984 | 4,986,145 | 5,364,830 | 5,743,515 | 21,735,012 | 56,569,548 | 90,379,539 | 124,189,631 | 26,330,996 | 61,555,693 | 95,744,369 | 129,933,046 |
| Laguna | 5,742,607 | 6,616,600 | 7,464,887 | 8,313,174 | 25,258,196 | 61,046,181 | 95,781,578 | 130,516,976 | 31,000,803 | 67,662,781 | 103,246,465 | 138,830,150 |
| Quezon | 8,111,465 | 9,338,923 | 10,530,279 | 11,721,635 | 11,196,825 | 24,782,873 | 37,969,332 | 51,155,791 | 19,308,290 | 34,121,796 | 48,499,611 | 62,877,426 |
| Rizal | 4,064,343 | 4,986,672 | 5,881,873 | 6,777,074 | 23,041,831 | 56,866,868 | 89,697,051 | 122,527,236 | 27,106,174 | 61,853,540 | 95,578,924 | 129,304,309 |
| Others | 12,001,518 | 13,420,921 | 14,798,577 | 16,176,233 | 11,918,189 | 27,027,441 | 41,692,303 | 56,357,166 | 23,919,707 | 40,448,362 | 58,490,880 | 72,533,399 |
| Region V | 12,819,827 | 15,596,275 | 18,291,063 | 20,985,850 | 18,053,859 | 47,995,403 | 77,056,313 | 106,117,225 | 30,873,686 | 63,591,678 | 95,347,376 | 127,103,075 |
| Albay | 1,974,253 | 2,423,258 | 2,859,057 | 3,294,855 | 5,126,529 | 14,005,419 | 22,623,165 | 31,240,911 | 7,100,782 | 16,428,677 | 25,482,222 | 34,535,766 |
| Camarines N. | 1,243,523 | 1,604,861 | 1,955,571 | 2,306,281 | 1,987,679 | 4,227,121 | 6,400,697 | 8,574,272 | 3,231,202 | 5,831,982 | 8,356,268 | 10,880,553 |
| Camarines S. | 5,320,228 | 5,901,029 | 6,464,748 | 7,028,467 | 5,155,452 | 19,165,888 | 32,764,252 | 46,362,616 | 10,475,680 | 25,066,917 | 39,229,000 | 53,391,083 |
| Sorsogon | 1,343,518 | 1,796,085 | 2,235,341 | 2,674,598 | 2,504,412 | 3,539,888 | 4,544,909 | 5,549,931 | 3,847,930 | 5,335,973 | 6,780,250 | 8,224,529 |
| Others | 2,938,305 | 3,871,042 | 4,776,346 | 5,681,650 | 3,279,787 | 7,057,088 | 10,723,292 | 14,389,496 | 6,218,092 | 10,928,130 | 15,499,638 | 20,071,146 |

TABLE 7.4-7 GDPG GROWTH RATE BY SECTOR

(%/Year)

| Region/ Province | Agriculture | | | | | | Non-Agriculture | | | | | | Total | | | |
|---------------------|---------------|------|---------------|------|---------------|------|-----------------|------|---------------|------|---------------|------|---------------|------|---------------|------|
| | 1990- 2000 | | 2000- 2010 | | 2010- 2020 | | 1990- 2000 | | 2000- 2010 | | 2010- 2020 | | 1990- 2000 | | 2000- 2010 | |
| | | | | | | | | | | | | | | | | |
| CAR | 5.48 | 3.43 | 2.55 | 3.81 | 8.33 | 4.37 | 8.33 | 4.37 | 3.03 | 5.22 | 7.72 | 4.20 | 7.72 | 4.20 | 2.95 | 4.94 |
| Abra | 9.71 | 4.72 | 3.19 | 5.84 | 7.92 | 4.26 | 7.92 | 4.26 | 2.98 | 5.03 | 8.38 | 4.39 | 8.38 | 4.39 | 3.04 | 5.24 |
| Benguet | 2.62 | 2.02 | 1.68 | 2.11 | 9.58 | 4.69 | 9.58 | 4.69 | 3.18 | 5.78 | 8.37 | 4.50 | 8.37 | 4.50 | 3.09 | 5.43 |
| Mt. Province | 4.66 | 3.09 | 2.35 | 3.36 | 3.98 | 2.76 | 3.98 | 2.76 | 2.16 | 2.97 | 4.17 | 2.86 | 4.17 | 2.86 | 2.22 | 3.08 |
| Ifugao | 6.30 | 3.74 | 2.72 | 4.24 | 4.12 | 2.83 | 4.12 | 2.83 | 2.21 | 3.05 | 7.42 | 3.10 | 7.42 | 3.10 | 2.36 | 3.38 |
| K. Apayao | 6.17 | 3.69 | 2.69 | 4.17 | 8.78 | 4.49 | 8.78 | 4.49 | 3.09 | 5.43 | 7.42 | 4.11 | 7.42 | 4.11 | 2.91 | 4.80 |
| REGION I | 2.99 | 2.24 | 1.83 | 2.35 | 7.98 | 4.28 | 7.98 | 4.28 | 2.99 | 5.06 | 6.16 | 3.69 | 6.16 | 3.69 | 2.69 | 4.17 |
| Ilocos Norte | 7.28 | 4.07 | 2.88 | 4.73 | 5.78 | 3.55 | 5.78 | 3.55 | 2.61 | 3.97 | 6.36 | 3.76 | 6.36 | 3.76 | 2.73 | 4.27 |
| Ilocos Sur | 4.12 | 2.83 | 2.21 | 3.05 | 5.55 | 3.46 | 5.55 | 3.46 | 2.56 | 3.85 | 5.01 | 3.24 | 5.01 | 3.24 | 2.44 | 3.56 |
| La Union | 3.48 | 2.51 | 2.00 | 2.66 | 5.25 | 3.34 | 5.25 | 3.34 | 2.50 | 3.69 | 4.71 | 3.11 | 4.71 | 3.11 | 2.37 | 3.39 |
| Pangasinan | 1.69 | 1.40 | 1.23 | 1.44 | 9.81 | 4.75 | 9.81 | 4.75 | 3.21 | 5.88 | 6.76 | 3.90 | 6.76 | 3.90 | 2.80 | 4.47 |
| REGION II | 3.12 | 2.31 | 1.88 | 2.43 | 10.13 | 4.82 | 10.13 | 4.82 | 3.24 | 6.02 | 7.02 | 3.98 | 7.02 | 3.98 | 2.84 | 4.60 |
| Cagayan | 4.66 | 3.09 | 2.35 | 3.36 | 8.17 | 4.33 | 8.17 | 4.33 | 3.01 | 5.15 | 7.09 | 4.01 | 7.09 | 4.01 | 2.85 | 4.64 |
| Isabela | 2.65 | 2.04 | 1.69 | 2.13 | 10.55 | 4.91 | 10.55 | 4.91 | 3.28 | 6.20 | 6.29 | 3.74 | 6.29 | 3.74 | 2.71 | 4.24 |
| N. Vizcaya | 3.16 | 2.34 | 1.89 | 2.46 | 12.30 | 5.24 | 12.30 | 5.24 | 3.42 | 6.92 | 9.14 | 4.59 | 9.14 | 4.59 | 3.13 | 5.59 |
| Quirino | 2.26 | 1.79 | 1.52 | 1.86 | 17.42 | 5.91 | 17.42 | 5.91 | 3.69 | 8.84 | 9.88 | 4.75 | 9.88 | 4.75 | 3.21 | 5.91 |
| Others | 8.09 | 4.31 | 3.00 | 5.11 | 12.42 | 5.26 | 12.42 | 5.26 | 3.43 | 6.97 | 11.31 | 5.06 | 11.31 | 5.06 | 3.34 | 6.52 |
| REGION III | 2.02 | 1.63 | 1.40 | 1.68 | 9.41 | 4.65 | 9.41 | 4.65 | 3.16 | 5.71 | 8.09 | 4.31 | 8.09 | 4.31 | 3.00 | 5.11 |
| Bataan | 4.10 | 2.82 | 2.20 | 3.04 | 11.43 | 5.08 | 11.43 | 5.08 | 3.35 | 6.57 | 10.63 | 4.92 | 10.63 | 4.92 | 3.29 | 6.23 |
| Bulacan | 2.99 | 2.24 | 1.83 | 2.35 | 9.94 | 4.78 | 9.94 | 4.78 | 3.22 | 5.94 | 9.02 | 4.56 | 9.02 | 4.56 | 3.12 | 5.54 |
| N. Eclja | 1.11 | 0.97 | 0.88 | 0.99 | 8.32 | 4.37 | 8.32 | 4.37 | 3.03 | 5.22 | 6.11 | 3.67 | 6.11 | 3.67 | 2.68 | 4.14 |
| Pampanga | 2.37 | 1.86 | 1.57 | 1.93 | 10.50 | 4.90 | 10.50 | 4.90 | 3.27 | 6.18 | 9.48 | 4.67 | 9.48 | 4.67 | 3.17 | 5.74 |
| Tarlac | 1.58 | 1.33 | 1.17 | 1.36 | 5.75 | 3.54 | 5.75 | 3.54 | 2.61 | 3.96 | 4.59 | 3.05 | 4.59 | 3.05 | 2.34 | 3.32 |
| Zambales | 1.71 | 1.42 | 1.24 | 1.46 | 7.96 | 4.27 | 7.96 | 4.27 | 2.98 | 5.05 | 6.77 | 3.90 | 6.77 | 3.90 | 2.80 | 4.48 |
| REGION IV | 1.34 | 1.15 | 1.03 | 1.17 | 9.17 | 4.59 | 9.17 | 4.59 | 3.14 | 5.60 | 7.37 | 4.10 | 7.37 | 4.10 | 2.90 | 4.77 |
| Aurora | 1.53 | 1.29 | 1.14 | 1.32 | 10.37 | 4.87 | 10.37 | 4.87 | 3.26 | 6.12 | 6.70 | 3.88 | 6.70 | 3.88 | 2.79 | 4.44 |
| Batangas | 1.40 | 1.19 | 1.06 | 1.22 | 7.81 | 4.23 | 7.81 | 4.23 | 2.96 | 4.98 | 5.57 | 3.47 | 5.57 | 3.47 | 2.57 | 3.86 |
| Cavite | 0.82 | 0.73 | 0.68 | 0.75 | 10.04 | 4.80 | 10.04 | 4.80 | 3.23 | 5.98 | 8.86 | 4.52 | 8.86 | 4.52 | 3.10 | 5.47 |
| Laguna | 1.43 | 1.21 | 1.08 | 1.24 | 9.23 | 4.61 | 9.23 | 4.61 | 3.14 | 5.63 | 8.12 | 4.32 | 8.12 | 4.32 | 3.01 | 5.12 |
| Quezon | 1.42 | 1.21 | 1.08 | 1.23 | 8.27 | 4.36 | 8.27 | 4.36 | 3.03 | 5.19 | 5.86 | 3.58 | 5.86 | 3.58 | 2.63 | 4.01 |
| Rizal | 2.07 | 1.66 | 1.43 | 1.72 | 9.45 | 4.66 | 9.45 | 4.66 | 3.17 | 5.73 | 8.50 | 4.45 | 8.50 | 4.45 | 3.07 | 5.35 |
| Others | 1.12 | 0.98 | 0.89 | 1.00 | 8.53 | 4.43 | 8.53 | 4.43 | 3.06 | 5.32 | 5.39 | 3.40 | 5.39 | 3.40 | 2.53 | 3.77 |
| REGION V | 1.98 | 1.61 | 1.38 | 1.66 | 10.27 | 4.85 | 10.27 | 4.85 | 3.25 | 6.08 | 7.49 | 4.13 | 7.49 | 4.13 | 2.92 | 4.83 |
| Albay | 2.07 | 1.67 | 1.43 | 1.72 | 10.57 | 4.91 | 10.57 | 4.91 | 3.28 | 6.21 | 8.75 | 4.49 | 8.75 | 4.49 | 3.09 | 5.41 |
| Camarinés N. | 2.58 | 2.00 | 1.66 | 2.08 | 7.84 | 4.24 | 7.84 | 4.24 | 2.97 | 4.99 | 6.08 | 3.66 | 6.08 | 3.66 | 2.67 | 4.13 |
| Camarinés S. | 1.04 | 0.92 | 0.84 | 0.93 | 14.03 | 5.51 | 14.03 | 5.51 | 3.53 | 7.60 | 9.12 | 4.58 | 9.12 | 4.58 | 3.13 | 5.58 |
| Sorsogon | 2.95 | 2.21 | 1.81 | 2.32 | 3.52 | 2.53 | 3.52 | 2.53 | 2.02 | 2.69 | 3.32 | 2.42 | 3.32 | 2.42 | 1.95 | 2.56 |
| Others | 2.80 | 2.12 | 1.75 | 2.22 | 7.96 | 4.27 | 7.96 | 4.27 | 2.98 | 5.05 | 5.80 | 3.56 | 5.80 | 3.56 | 2.62 | 3.98 |

7.4.3 Other Socio-Economic Framework

(1) Future Agricultural Production

Future agricultural production by province and zone is estimated on the basis of the agricultural GVA growth in the respective province and zone mentioned above. The agricultural production targets in 2020 are determined same as agricultural GVA targets. During 1990 to 2020, the constant production increase is applied same as agricultural GVAs, and agricultural production of crop, livestock, fishery and forestry is determined. Beside production increase in crop, livestock and fishery, forestry production is decreased up to 60% to 80% of the production level by region. The future agricultural production estimate by province is shown in Table 7.4-8.

(2) Future Family Income and Expenditure

Future family income and expenditure in the respective province and zone are estimated on the basis of the assumption that those will be increased at the same rate of GDP growth. The future family income and expenditure estimate by province is shown in Table 7.4-9.

Table 7.4-8 FUTURE AGRICULTURAL PRODUCTION ESTIMATE

(Unit : ton)

| Region / Province | 1990 | | | | | 2000 | | | | |
|-------------------|------------|-----------|-----------|-----------|------------|------------|-----------|-----------|-----------|------------|
| | Crops | Livestock | Fishery | Forestry | Total | Crops | Livestock | Fishery | Forestry | Total |
| CAR | 946,815 | 20,257 | 3,272 | 118,731 | 1,089,075 | 1,647,824 | 24,121 | 6,399 | 102,583 | 1,780,927 |
| Abra | 111,933 | 2,685 | 368 | 23,425 | 138,411 | 378,019 | 3,185 | 434 | 20,239 | 401,857 |
| Benguet | 327,067 | 11,119 | 526 | 7,895 | 346,607 | 444,110 | 13,364 | 3,200 | 6,821 | 467,485 |
| Mt. Province | 99,535 | 713 | 1,075 | 63,135 | 164,458 | 158,982 | 807 | 1,216 | 54,549 | 215,554 |
| Iligao | 119,016 | 4,912 | 742 | 10,314 | 143,984 | 205,550 | 5,788 | 874 | 16,687 | 228,890 |
| K. Apayao | 289,264 | 828 | 561 | 4,962 | 295,615 | 461,163 | 997 | 675 | 4,287 | 467,122 |
| REGION I | 2,503,956 | 40,936 | 73,885 | 2,261 | 2,621,038 | 3,321,350 | 51,609 | 92,700 | 2,030 | 3,467,689 |
| Ilocos Norte | 228,580 | 7,018 | 2,221 | 594 | 238,413 | 470,628 | 8,806 | 2,787 | 533 | 482,754 |
| Ilocos Sur | 255,971 | 5,590 | 3,519 | 186 | 265,268 | 419,950 | 7,172 | 4,515 | 167 | 431,804 |
| La Union | 239,260 | 7,237 | 9,315 | 179 | 255,991 | 368,268 | 9,312 | 11,986 | 161 | 389,727 |
| Pangasinan | 1,780,145 | 21,691 | 58,830 | 1,302 | 1,861,368 | 2,062,504 | 26,319 | 73,412 | 1,169 | 2,163,404 |
| REGION II | 2,513,358 | 19,115 | 20,824 | 1,071,735 | 3,625,030 | 3,652,316 | 24,666 | 26,614 | 982,419 | 4,666,015 |
| Cagayan | 484,334 | 5,604 | 17,545 | 406,888 | 914,371 | 914,573 | 7,130 | 22,323 | 365,386 | 1,309,412 |
| Isabela | 1,710,806 | 9,453 | 2,456 | 510,657 | 2,233,372 | 2,256,883 | 12,320 | 3,201 | 458,570 | 2,730,974 |
| N. Vizcaya | 203,016 | 3,006 | 705 | 4,505 | 211,232 | 297,406 | 3,952 | 927 | 4,046 | 306,331 |
| Oquirino | 115,191 | 795 | 118 | 123,078 | 239,182 | 175,604 | 1,094 | 163 | 110,524 | 287,385 |
| Others | 9 | 257 | 0 | 26,607 | 26,873 | 7,850 | 170 | 0 | 23,893 | 31,913 |
| REGION III | 7,563,620 | 143,033 | 189,790 | 7,110 | 7,903,553 | 8,140,024 | 197,848 | 263,316 | 6,627 | 8,607,815 |
| Bataan | 290,124 | 7,432 | 20,367 | 78 | 318,001 | 321,201 | 10,579 | 28,991 | 73 | 360,844 |
| Bulacan | 792,869 | 62,331 | 54,702 | 367 | 910,269 | 848,535 | 86,699 | 76,087 | 342 | 1,011,663 |
| N. Ecija | 1,488,651 | 10,025 | 8,037 | 596 | 1,507,409 | 1,611,797 | 13,591 | 10,898 | 649 | 1,636,933 |
| Pampanga | 1,768,034 | 48,133 | 92,756 | 319 | 1,909,224 | 1,963,319 | 66,645 | 128,431 | 297 | 2,158,692 |
| Tarlac | 2,678,642 | 9,049 | 3,329 | 285 | 2,691,305 | 2,805,841 | 12,052 | 4,434 | 266 | 2,822,593 |
| Zambales | 545,300 | 6,063 | 10,599 | 5,365 | 567,327 | 599,331 | 8,282 | 14,477 | 5,000 | 617,990 |
| REGION IV | 10,789,850 | 284,778 | 1,296,838 | 349,652 | 12,721,118 | 20,953,815 | 400,634 | 1,819,941 | 325,877 | 23,500,267 |
| Aurora | 552,799 | 2,296 | 109 | 129,365 | 684,569 | 591,403 | 3,383 | 161 | 120,568 | 715,515 |
| Batangas | 3,030,123 | 35,626 | 149,745 | 1,424 | 4,116,918 | 4,197,384 | 48,227 | 202,710 | 1,328 | 4,446,649 |
| Cavite | 1,517,532 | 58,438 | 40,390 | 761 | 1,617,121 | 1,576,855 | 84,628 | 58,492 | 709 | 1,720,484 |
| Laguna | 1,706,607 | 109,535 | 72,534 | 2,004 | 1,890,680 | 1,779,952 | 153,763 | 101,822 | 1,868 | 2,037,405 |
| Quezon | 3,408,530 | 23,187 | 175,139 | 64,764 | 3,671,620 | 3,687,756 | 31,767 | 239,944 | 60,360 | 4,019,827 |
| Rizal | 569,614 | 32,379 | 519,989 | 566 | 1,122,548 | 599,093 | 46,234 | 742,485 | 528 | 1,388,340 |
| Others | 8,104,645 | 23,317 | 338,932 | 150,768 | 8,617,662 | 8,521,572 | 32,632 | 474,327 | 140,516 | 9,169,047 |
| REGION V | 5,425,989 | 25,920 | 187,662 | 7,504 | 5,647,075 | 6,175,742 | 35,834 | 260,607 | 6,993 | 6,479,176 |
| Albay | 1,137,176 | 6,788 | 7,742 | 1,724 | 1,153,430 | 1,163,566 | 9,216 | 10,512 | 1,607 | 1,184,901 |
| Camarinas N | 508,030 | 4,412 | 44,639 | 759 | 557,840 | 626,964 | 6,165 | 62,376 | 707 | 695,212 |
| Camarinas S | 2,316,590 | 10,025 | 60,145 | 3,258 | 2,390,018 | 2,417,490 | 13,944 | 83,658 | 3,036 | 2,518,129 |
| Sorsogon | 730,332 | 2,794 | 20,373 | 1,029 | 763,428 | 801,607 | 3,881 | 40,655 | 959 | 847,102 |
| Others | 733,861 | 1901 | 45,663 | 734 | 782,359 | 1,166,115 | 2,628 | 63,406 | 684 | 1,232,833 |
| Study Area | 38,743,586 | 534,039 | 1,772,271 | 1,556,993 | 42,608,889 | 43,891,071 | 734,712 | 2,469,577 | 1,406,529 | 48,501,889 |

(Unit : ton)

| Region / Province | 2010 | | | | | 2020 | | | | |
|-------------------|------------|-----------|-----------|-----------|------------|------------|-----------|-----------|-----------|------------|
| | Crops | Livestock | Fishery | Forestry | Total | Crops | Livestock | Fishery | Forestry | Total |
| CAR | 2,328,216 | 27,871 | 9,435 | 86,910 | 2,452,432 | 3,008,608 | 31,617 | 12,470 | 71,238 | 3,123,933 |
| Abra | 636,279 | 3,631 | 498 | 17,147 | 657,555 | 894,539 | 4,097 | 562 | 14,055 | 913,253 |
| Benguet | 557,711 | 15,543 | 5,796 | 5,779 | 584,829 | 671,312 | 17,721 | 8,392 | 4,737 | 702,162 |
| Mt. Province | 216,681 | 898 | 1,353 | 46,215 | 265,147 | 274,379 | 988 | 1,490 | 37,881 | 314,738 |
| Iligao | 289,539 | 6,638 | 1,002 | 14,137 | 311,316 | 373,529 | 7,487 | 1,129 | 11,588 | 393,733 |
| K. Apayao | 628,006 | 1,161 | 786 | 3,632 | 633,585 | 794,849 | 1,324 | 897 | 2,977 | 800,047 |
| REGION I | 4,114,703 | 61,968 | 110,961 | 1,806 | 4,289,438 | 4,908,057 | 72,328 | 129,223 | 1,582 | 5,111,190 |
| Ilocos Norte | 705,557 | 10,541 | 3,336 | 474 | 719,908 | 940,486 | 12,277 | 3,885 | 416 | 957,064 |
| Ilocos Sur | 579,106 | 8,708 | 5,482 | 149 | 593,445 | 738,263 | 10,244 | 6,449 | 130 | 755,086 |
| La Union | 493,482 | 11,326 | 14,578 | 143 | 519,529 | 618,696 | 13,340 | 17,170 | 125 | 649,331 |
| Pangasinan | 2,336,558 | 31,393 | 87,565 | 1,040 | 2,466,556 | 2,610,612 | 36,467 | 101,719 | 911 | 2,749,709 |
| REGION II | 4,757,777 | 30,053 | 32,232 | 856,317 | 5,676,379 | 5,863,237 | 35,440 | 37,850 | 750,216 | 6,686,743 |
| Cagayan | 1,332,158 | 8,611 | 26,960 | 325,104 | 1,692,833 | 1,749,742 | 10,092 | 31,597 | 284,822 | 2,076,253 |
| Isabela | 2,786,899 | 15,103 | 3,924 | 408,015 | 3,213,941 | 3,316,914 | 17,886 | 4,647 | 357,460 | 3,696,907 |
| Nueva Vizcaya | 389,020 | 4,870 | 1,142 | 3,600 | 399,632 | 480,634 | 5,788 | 1,357 | 3,154 | 490,933 |
| Oquirino | 234,240 | 1,384 | 206 | 98,339 | 334,169 | 292,876 | 1,674 | 249 | 86,155 | 380,954 |
| Others | 15,460 | 85 | 0 | 21,259 | 36,804 | 23,071 | 0 | 0 | 18,625 | 41,696 |
| REGION III | 8,699,476 | 251,050 | 334,679 | 6,158 | 9,291,363 | 9,258,926 | 304,253 | 406,044 | 5,688 | 9,974,911 |
| Bataan | 351,364 | 13,633 | 37,362 | 68 | 402,427 | 381,526 | 16,688 | 45,733 | 62 | 444,009 |
| Bulacan | 902,564 | 110,350 | 96,843 | 318 | 1,110,075 | 956,592 | 134,001 | 117,600 | 294 | 1,208,487 |
| Nueva Ecija | 1,731,321 | 17,052 | 13,671 | 603 | 1,762,647 | 1,850,845 | 20,514 | 16,446 | 557 | 1,888,362 |
| Pampanga | 2,152,861 | 84,613 | 163,056 | 278 | 2,400,806 | 2,342,403 | 102,581 | 197,681 | 255 | 2,642,920 |
| Tarlac | 2,929,299 | 14,967 | 5,506 | 247 | 2,950,019 | 3,052,758 | 17,881 | 6,578 | 228 | 3,077,445 |
| Zambales | 632,067 | 10,435 | 18,241 | 4,646 | 665,389 | 674,802 | 12,588 | 22,006 | 4,292 | 713,688 |
| REGION IV | 22,083,545 | 513,082 | 2,327,658 | 302,802 | 25,227,087 | 23,213,276 | 625,530 | 2,835,377 | 279,724 | 26,953,907 |
| Aurora | 628,871 | 4,438 | 211 | 112,030 | 745,550 | 666,339 | 5,494 | 262 | 103,492 | 775,587 |
| Batangas | 4,456,785 | 60,457 | 254,117 | 1,235 | 4,772,594 | 4,716,186 | 72,687 | 305,524 | 1,142 | 5,095,539 |
| Cavite | 1,634,039 | 110,048 | 76,061 | 659 | 1,820,807 | 1,691,424 | 135,468 | 93,630 | 609 | 1,921,131 |
| Laguna | 1,851,140 | 196,690 | 130,249 | 1,736 | 2,179,815 | 1,922,327 | 239,618 | 158,675 | 1,603 | 2,322,223 |
| Quezon | 3,958,766 | 40,095 | 302,843 | 56,086 | 4,357,793 | 4,229,783 | 48,422 | 365,742 | 51,811 | 4,695,758 |
| Rizal | 627,705 | 59,681 | 958,437 | 491 | 1,646,314 | 656,316 | 73,128 | 1,174,390 | 453 | 1,904,287 |
| Others | 8,926,236 | 41,673 | 605,740 | 130,585 | 9,704,214 | 9,330,901 | 50,713 | 737,154 | 120,614 | 10,239,382 |
| REGION V | 6,903,444 | 45,457 | 331,406 | 6,497 | 7,286,804 | 7,631,146 | 55,080 | 402,205 | 6,002 | 8,094,433 |
| Albay | 1,189,180 | 11,573 | 13,200 | 1,493 | 1,215,446 | 1,214,794 | 13,930 | 15,888 | 1,379 | 1,245,991 |
| Camarinas N | 742,400 | 7,866 | 79,561 | 657 | 830,514 | 857,836 | 9,568 | 96,806 | 607 | 964,817 |
| Camarinas S | 2,515,423 | 17,748 | 108,480 | 2,821 | 2,642,472 | 2,613,356 | 21,552 | 129,302 | 2,806 | 2,766,816 |
| Sorsogon | 870,788 | 4,936 | 51,702 | 891 | 928,315 | 939,965 | 5,990 | 62,750 | 823 | 1,009,528 |
| Others | 1,585,655 | 3,334 | 80,433 | 635 | 1,670,057 | 2,005,195 | 4,040 | 97,459 | 587 | 2,107,281 |
| Study Area | 48,887,161 | 929,481 | 3,146,371 | 1,260,490 | 54,223,503 | 53,883,250 | 1,124,246 | 3,823,169 | 1,114,450 | 59,945,117 |

Table 7.4.9 FUTURE FAMILY INCOME AND EXPENDITURE ESTIMATE

(Unit : P'000)

| Region / Province | Total Income | | | | Expenditure | | | |
|-------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 1990 | 2000 | 2010 | 2020 | 1990 | 2000 | 2010 | 2020 |
| CAR | 10,092,977 | 21,555,987 | 32,690,443 | 43,820,521 | 8,566,812 | 18,296,355 | 27,746,889 | 37,193,946 |
| Abra | 1,171,289 | 2,619,121 | 4,024,802 | 5,430,040 | 1,030,141 | 2,303,500 | 3,539,788 | 4,775,686 |
| Benguet | 5,365,220 | 12,447,384 | 19,330,407 | 26,208,341 | 4,477,996 | 10,389,012 | 16,133,818 | 21,872,708 |
| Mt. Province | 711,125 | 1,069,972 | 1,418,527 | 1,766,837 | 585,571 | 881,051 | 1,188,076 | 1,464,889 |
| Ifugao | 867,197 | 1,372,728 | 1,862,821 | 2,352,198 | 727,227 | 1,151,163 | 1,562,153 | 1,972,542 |
| K. Apayao | 1,978,146 | 4,046,782 | 6,053,886 | 8,065,105 | 1,745,877 | 3,571,619 | 5,343,054 | 7,118,121 |
| REGION I | 27,930,092 | 50,552,052 | 72,513,803 | 94,484,297 | 22,709,565 | 41,079,901 | 58,913,888 | 76,755,039 |
| Ilocos Norte | 3,672,152 | 6,803,054 | 9,840,191 | 12,881,796 | 3,338,129 | 6,184,241 | 8,945,117 | 11,710,054 |
| Ilocos Sur | 3,662,104 | 5,970,865 | 8,213,291 | 10,452,325 | 3,166,175 | 5,162,279 | 7,101,031 | 9,036,851 |
| La Union | 5,419,787 | 8,587,442 | 11,664,649 | 14,743,436 | 4,238,724 | 6,716,094 | 9,122,726 | 11,530,594 |
| Pangasinan | 15,176,049 | 29,190,691 | 42,795,672 | 56,406,740 | 11,966,537 | 23,017,287 | 33,745,014 | 44,477,540 |
| REGION II | 19,223,828 | 38,630,580 | 57,481,939 | 76,295,191 | 14,346,321 | 28,955,792 | 43,146,851 | 57,309,639 |
| Batanes | 117,286 | 342,443 | 560,999 | 779,196 | 81,387 | 237,628 | 389,289 | 540,700 |
| Cagayan | 5,589,420 | 11,088,069 | 16,428,839 | 21,759,546 | 4,447,502 | 8,822,778 | 13,072,430 | 17,314,075 |
| Isabela | 9,562,287 | 17,598,913 | 25,406,701 | 33,195,221 | 6,737,914 | 12,400,795 | 17,902,429 | 23,390,486 |
| Hueva Viscay | 3,252,897 | 7,800,273 | 12,218,318 | 16,628,826 | 2,422,920 | 5,810,033 | 9,100,814 | 12,385,981 |
| Quirino | 701,938 | 1,800,882 | 2,867,082 | 3,932,402 | 656,598 | 1,684,558 | 2,681,889 | 3,678,397 |
| REGION III | 65,465,053 | 144,272,200 | 220,772,196 | 297,283,768 | 54,015,176 | 118,951,233 | 181,788,427 | 244,736,756 |
| Bataan | 4,114,589 | 11,209,405 | 18,265,787 | 25,247,662 | 3,699,078 | 10,158,337 | 16,421,221 | 22,698,033 |
| Bulacan | 19,281,782 | 45,730,815 | 71,427,375 | 97,116,659 | 15,907,328 | 37,727,586 | 58,927,059 | 80,120,529 |
| Nueva Ecija | 9,311,944 | 16,850,140 | 24,182,090 | 31,476,983 | 8,733,783 | 15,803,946 | 22,661,911 | 29,522,636 |
| Pampanga | 17,657,384 | 43,679,157 | 68,944,092 | 94,195,639 | 13,978,971 | 34,579,849 | 54,581,483 | 74,572,660 |
| Tarlac | 6,569,664 | 10,290,697 | 13,897,118 | 17,513,739 | 5,396,034 | 8,452,327 | 11,414,483 | 14,385,017 |
| Zambales | 8,529,690 | 16,421,986 | 24,075,824 | 31,733,086 | 6,299,982 | 12,129,188 | 17,782,270 | 23,437,881 |
| REGION IV | 72,310,005 | 142,330,285 | 210,354,495 | 278,367,338 | 60,985,545 | 120,460,089 | 178,239,254 | 236,009,297 |
| Aurora | 1,207,230 | 2,309,055 | 3,378,732 | 4,449,000 | 1,070,351 | 2,047,248 | 2,995,642 | 3,944,560 |
| Batangas | 15,811,778 | 27,188,542 | 38,241,103 | 49,287,179 | 12,048,253 | 20,717,116 | 29,138,943 | 37,555,829 |
| Cavite | 12,396,373 | 28,971,964 | 45,078,750 | 61,172,835 | 10,771,165 | 25,173,638 | 39,168,775 | 53,152,861 |
| Laguna | 16,815,977 | 36,709,839 | 56,034,856 | 75,379,306 | 14,649,633 | 31,980,637 | 48,816,079 | 65,668,450 |
| Quezon | 9,984,008 | 17,645,088 | 25,083,197 | 32,518,176 | 8,567,963 | 15,142,462 | 21,525,615 | 27,906,081 |
| Rizal | 3,887,013 | 8,869,609 | 13,708,777 | 18,549,041 | 3,278,269 | 7,480,710 | 11,561,848 | 15,644,080 |
| Others | 12,207,626 | 20,635,988 | 28,829,071 | 37,011,801 | 10,599,911 | 17,918,278 | 25,032,352 | 32,137,436 |
| REGION V | 25,635,192 | 53,192,190 | 79,942,084 | 106,695,614 | 22,435,183 | 46,338,140 | 69,541,283 | 92,747,628 |
| Albay | 5,903,651 | 13,658,825 | 21,191,448 | 28,729,365 | 5,135,000 | 11,880,456 | 18,432,337 | 24,988,823 |
| Camrines N. | 2,585,283 | 4,666,714 | 6,685,336 | 8,700,793 | 2,259,959 | 4,077,892 | 5,841,815 | 7,602,973 |
| Camrines S. | 9,348,127 | 22,375,264 | 35,015,033 | 47,654,588 | 7,921,797 | 18,961,264 | 29,672,467 | 40,383,489 |
| Sorsogon | 3,262,893 | 4,523,349 | 5,745,235 | 6,969,155 | 2,940,095 | 4,075,605 | 5,176,543 | 6,279,313 |
| Others | 4,534,138 | 7,968,038 | 11,305,032 | 14,641,713 | 4,178,422 | 7,342,923 | 10,418,121 | 13,493,030 |

CHAPTER 8

FUTURE TRAFFIC DEMAND

8.1 GENERAL

To forecast the future inter-zonal trip distribution pattern, prediction models for trip generation and attraction are developed through the application of the step-wise approach of multiple regression analysis techniques. In the forecasting procedure for future commodity movement pattern, which has different trip generation and attraction pattern depending on each commodity type, present trip pattern for four commodity groups OD matrices in tonnage and highly associated socio-economic indicators are introduced on zonal base and applied to predict the future commodity trip generation and attraction as shown in the procedure presented in Figure 8.1-1. For passengers movement, the trip generation model for passenger trips is applied directly on the present OD matrices for passenger trips which are consequently converted to passenger-vehicle trips according to their occupancy rates. Vehicle trip matrices are forecasted for the main four vehicle categories which are: car (including: taxi, jeep and pick-up), jeepney, bus and truck.

In the trip distribution analysis, several iteration procedures of Frater method are applied to synthesize the future trip interchange magnitudes and to conclude the

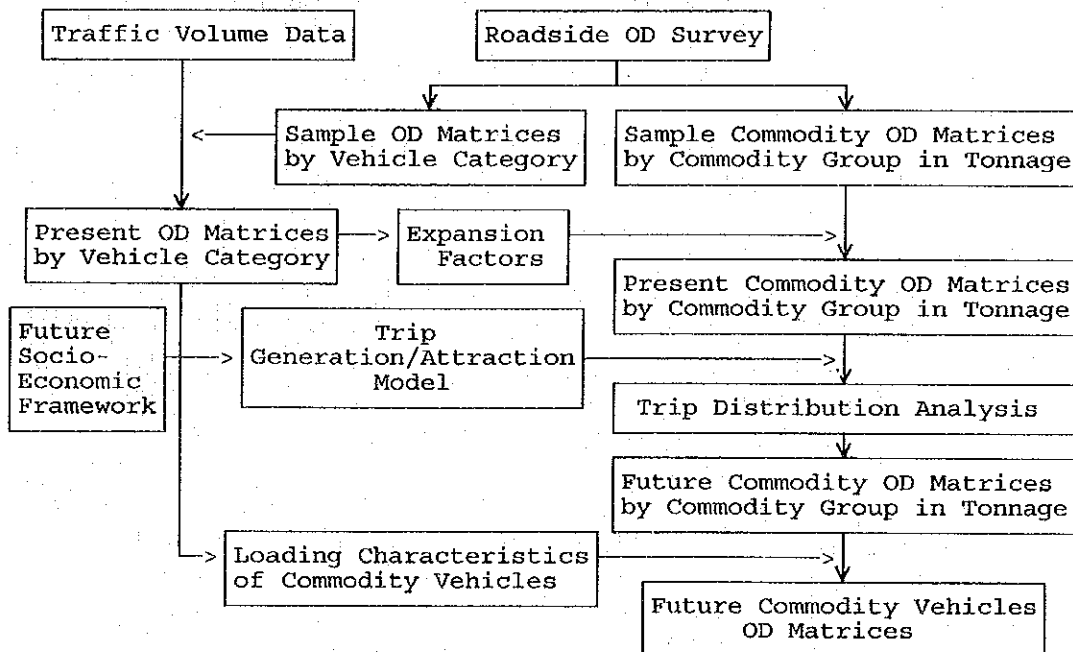


FIGURE 8.1-1 ESTABLISHMENT OF FUTURE COMMODITY OD MATRICES

future OD tables. Future traffic volumes are assigned, as in the procedure explained in Chapter 4, on the road network in the two cases of "Without Project" and "With Project".

8.2 DEVELOPMENT OF TRIP GENERATION AND ATTRACTION MODEL

In the travel demand forecasting process, a primary step is the developing of a model for the trip generation and attraction. Analysis of future socio-economic indicators with trip generation and attraction data by the use of stepwise multiple regression techniques produce prediction equations for the future traffic pattern. In this analysis, the trip pattern is divided for passengers and each of the four groups of commodities, which are agricultural products, manufacturing products, mining and mineral products and construction materials, separately. Future socio-economic frame work is used to apply the growth in the different indicators on the growth in trip generation and attraction. OD matrices of vehicle trips are concluded by converting the forecasted passenger and commodity matrices according to the vehicular loading characteristics. In the model structure, however, only highly associated parameters with the trip pattern are applied.

8.2.1 Socio-economic Indicators

In order to forecast the future trip generation by zone, a future socio-economic framework is established as included in the Progress Report of this study. The framework includes the zonal-base indicators of the population break-downed as urban, rural and total, as well as the economic indicators of the Gross Provincial Domestic Product (GPDP), agricultural Gross Value Added (GVA), potential agricultural production, income and expenditure. The relationship between these indicators of and the present trip generation and attraction is investigated to conclude the high potential indicators.

Regarding the effect of population on inter-zonal trip generation and attraction can not be considered as a proportional relationship. Highly populated areas may produce low number of trips depending on other socio-economic indicators. Also, rural and urban population are considered as separate indicators since they may produce different trip patterns. Urban and rural population as forecasted by NEDA between 1990 and 2030 are shown in Figure 8.2-1.

Rural population does not show significant increase in the future due to the highly expected urbanization in the country. In the present trip pattern, the relationship between zonal population and number of generated and attracted trips is investigated to get the trend of population influence on number of trips. Figure 8.2-2 present the relationships between the population and number of trips for passengers and agricultural products as an example.

In the passenger trips, which are expected to be affected mostly by population,

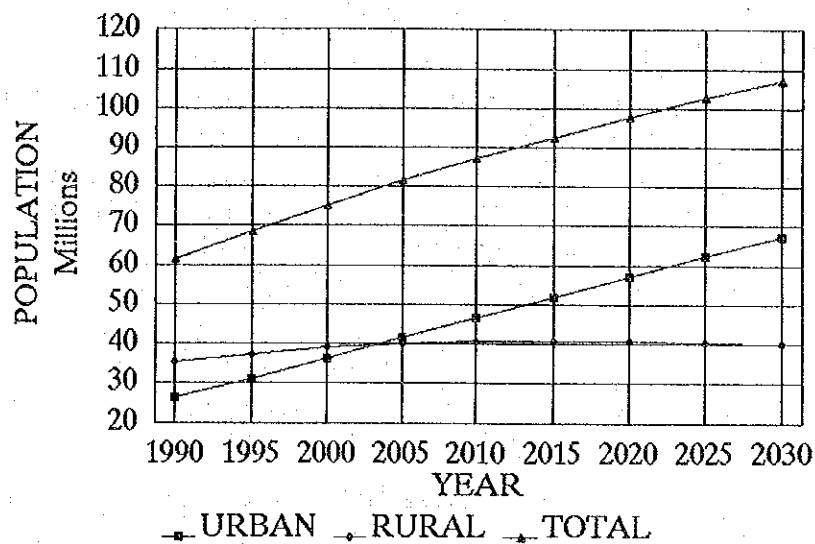


FIGURE 8.2-1 FORECASTED URBAN AND RURAL POPULATION

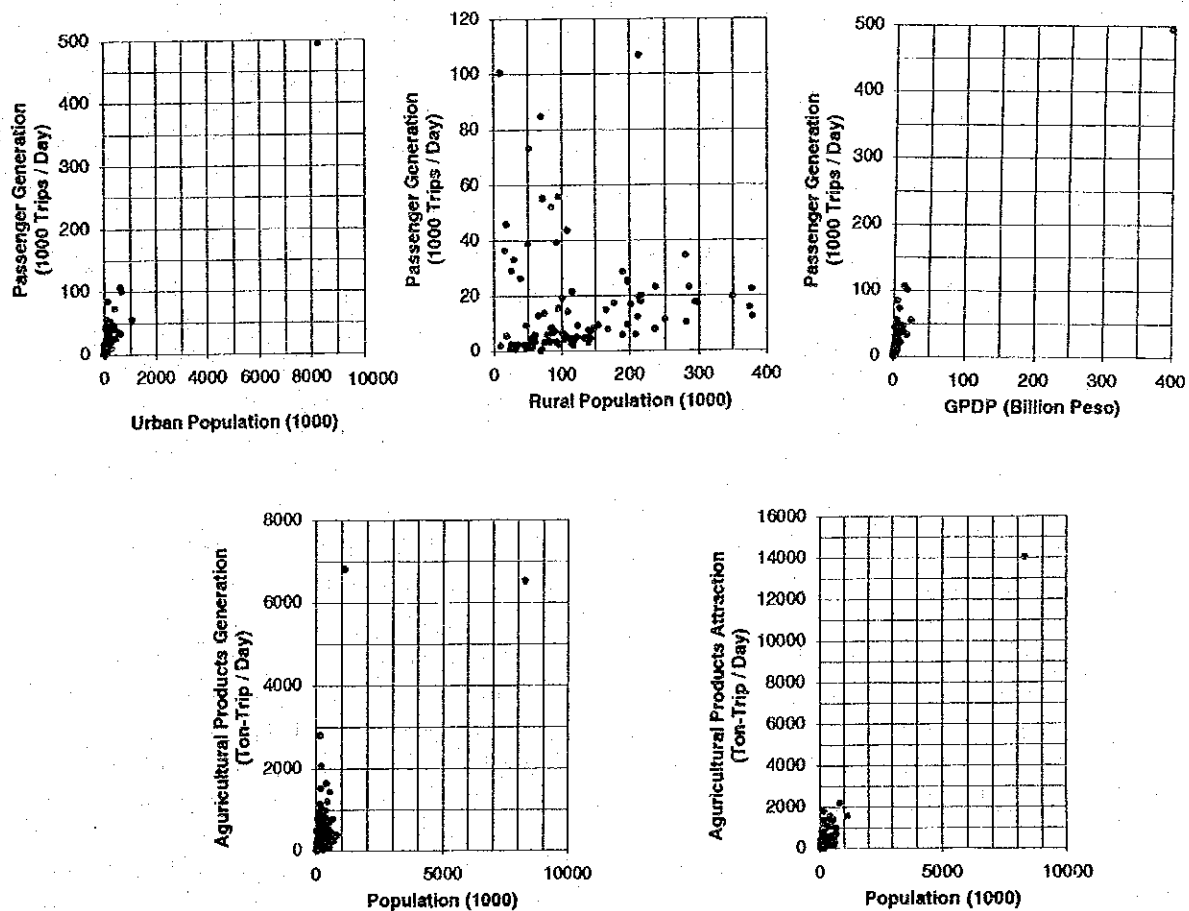


FIGURE 8.2-2 SOCIOECONOMIC INDICATORS AND DAILY TRIPS

the influence of the urban population on generated and attracted passenger trips is almost similar to that of the total population with a remote plotting for Metro Manila zone. The rural population pattern, which does not include in the Metro Manila zone, shows a completely different scattered pattern for trips. Considering one case in the commodity trips for the agricultural products, the relationship between total population shows also strong interaction with both attracted and generated trips, however, it has more influence on the attracted trips.

8.2.2 Model Structure

To develop the trip generation and attraction model for the different types of trips, the step-wise regression analysis programs are used to test the large number of potential regression equations using various combinations and transformations of both dependent and independent variables. The most appropriate prediction equations are selected based on the statistical criteria regarding the stability of the multiple correlation coefficients.

Independent variables of the zonal total population, urban population, rural population, agricultural GVA, agricultural potential production, GDP, income and expenditure are examined. Some indicators are excluded, in some or all models, which are found not to show high degree of association to particular type or all types of trips regarding the concluded values of the multiple correlation coefficient R^2 .

In addition to the socio-economic indicators included in the model, and due to the special nature and condition of the road network in Luzon Island, two additional accessibility parameters are added to the model. The first parameter express the average travel time to Metro Manila, as the center of socio-economic activities, from each zone in which the shorter the travel time, the higher rate of accessibility. The second indicator generalizes the accessibility to all other zones in terms of the average travel speed.

For passenger trips, the model is applied for both generated and attracted trips based on the hypothesis of the equality between both trips in each zone. Considering commodity trips, two models are developed separately for the generated and attracted trips for each of the two groups of agricultural and manufacturing products. For other commodity groups of the mining and mineral products and construction materials, which their generator zones are almost inflexible, models for attracted trips are only developed and a feedback process is used to apply the growth in forecasted attracted trips on the generated trips.

The developed prediction model for the different types of trips has the following regression equation:

$$y = k (a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + a_5 x_5 + c) (z_1^{\beta_1} * z_2^{\beta_2})$$

Where,

y : Number of generated/attracted trips

Socio-economic Indicators:

x_1 : Total population

x_2 : Urban population

x_3 : Rural population

x_4 : Agricultural Gross Value Added (GVA)

x_5 : Gross Provincial Domestic Product (GPDP)

Accessibility Indicators:

z_1 : Travel time to Metro Manila

z_2 : Average travel speed to all other zones

k, c, α & β : Parameters, which have the following values:

| | Passenger | Agriculture | | Manufacturing | | Mineral | Construction |
|------------------------------------|-----------|-------------|-------------|---------------|------------|------------|--------------|
| | | Generation | Attraction | Generation | Attraction | Attraction | Attraction |
| a_1 | - | 0.0007625 | - | 0.000935 | - | 0.0001392 | 0.0001742 |
| a_2 | 0.07865 | - | 0.000694 | - | 0.0005121 | - | - |
| a_3 | 0.02151 | - | - | - | 0.0003922 | - | - |
| a_4 | - | 0.00003421 | - | - | - | - | - |
| a_5 | 0.0008953 | - | 0.000005431 | 0.00001556 | - | - | 0.00005101 |
| c | 663.6 | 132.6 | 101.2 | 100.6 | 113 | 45.61 | 122.5 |
| β_1 | -0.1427 | -0.07994 | -0.06843 | - | -0.1633 | -0.2743 | -0.1477 |
| β_2 | 0.7024 | 0.3829 | 0.4575 | 0.4752 | 1.13432 | 0.8936 | 0.9031 |
| k^2 | -2.864 | -1.955 | -2.402 | -2.264 | -4.876 | -3.782 | -4.003 |
| R^2 | 0.97 | 0.81 | 0.94 | 0.94 | 0.82 | 0.71 | 0.97 |
| (Multiple Correlation Coefficient) | | | | | | | |

Values of the multiple correlation coefficient R^2 in all models indicate that there is a strong correlation with all the variation in the dependent variables being accounted for by changes in the independent variables. In addition, model goodness-of-fit in regard to all observed and estimated types of generated or attracted trips for the seven model cases is shown graphically in Figure 8.2-3.

8.2.3 Trip Distribution Analysis

Trip generation estimates the number of trips originating from one zone and terminating in all other zones as well as trips originating from all zones and terminating at one zone, while trip distribution is the process of computing the number of trips between each OD pair. The developed trip distribution process provides a full matrix of trips between all zones in the given zoning system. This procedure is based on the existing trip pattern and Frater method is applied with the basic premise that the distribution of future trips from a zone is proportional to the present trip distribution pattern modified by the growth

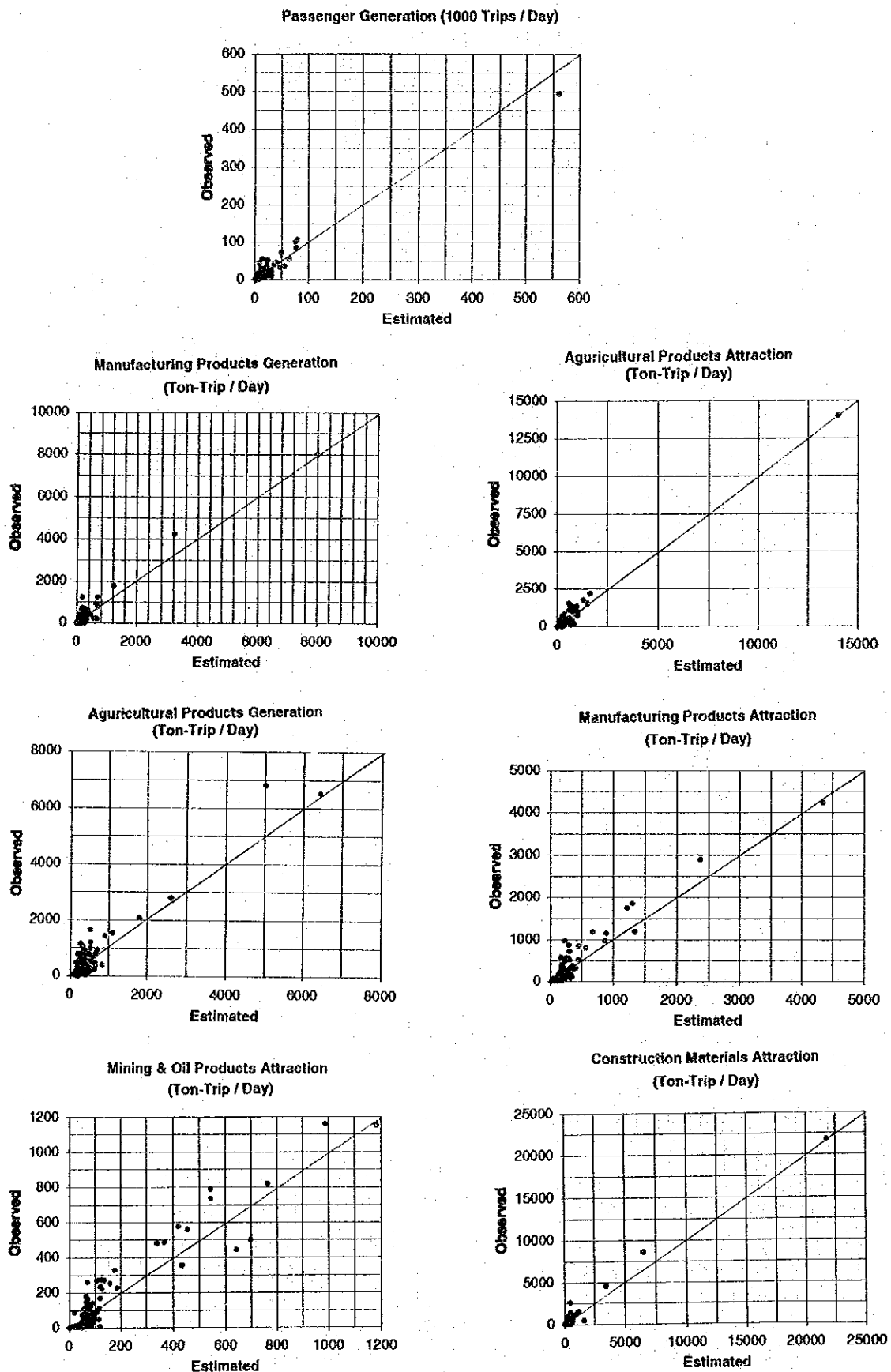


FIGURE 8.2-3 FITNESS OF GENERATION AND ATTRACTION MODEL

factors of all the zones. Because of the special nature of computation, successive iteration procedures are used as an adjusting steps in the trip distribution stage. The iteration process continues until the trips generated through the generation model for each zone equals to the trips distributed to that zone from all other zones. The method uses the following expressions to synthesize the future trip-interchange magnitudes and to overcome imbalances in the trip distribution so that interchanges ultimately balance by direction.

$$T_{ij} = (T_{ij(i)} + T_{ij(j)}) / 2$$

$$T_{ij(i)} = t_{ij} * F_i * F_j * L_i$$

$$T_{ij(j)} = t_{ij} * F_i * F_j * L_j$$

$$L_i = \sum t_{ix} / \sum t_{ix} * F_x$$

$$L_j = \sum t_{jx} / \sum t_{jx} * F_x$$

Where,

- T_{ij} : Future trips from zone i to zone j
- $T_{ij(i)}$: Future trips from zone i to zone j considering growth of zone i
- $T_{ij(j)}$: Future trips from zone i to zone j considering growth of zone j
- t_{ij} : Present trips from zone i to zone j
- F_i, F_j : Growth factors of trips for zones i and j
- L_i, L_j : Locational factors
- t_{ix}, j_{ix} : Present trips from zone i and j to another zone x
- F_x : Growth factor of trips for zone x

8.3 FUTURE OD MATRICES

Results of the trip distribution analysis for future generated and attracted trips produce the future inter-zonal OD matrices which are grouped and presented here on the provincial and regional levels. The following sections give the main characteristics of the future OD matrices of passenger, commodity and vehicle trips in the three future years of 2000, 2010 and 2020.

Future OD matrices are forecasted for the two cases of "Without Project" and "With Project" separately. With the improved condition of the roads of LISR network, it is expected that the trip pattern will be changed significantly. Trip destinations may be changed due to the improvement in the accessibility levels between OD pairs which will generate induced trips between some zones. Results presented here, however, are only those of the case of "With Project" while the other case of "Without Project" is presented as future traffic volumes in the next section of this chapter.

8.3.1 Provincial Trips

Future provincial OD matrices for the passenger, total commodity and vehicle trips are respectively presented in Appendix 8.1 for the year 2000, Appendix 8.2 for the year 2010 and Appendix 8.3 for the year 2020. A graphical presentation in the form of desire-line charts is illustrated in Figure 8.3-1 for passenger and commodity trip pattern in the years 1992 and 2020. In this figure, the regional-block zone, in which provinces in one region have more interaction together than with provinces in other region, is clearly shown for almost all the regions in the island. Passenger trips between Metro Manila and other provinces are expected to increase mainly with the surrounding provinces.

Provincial trip generation and attraction is clarified in Figure 8.3-2 for trips of passengers, commodities and vehicles in the year 2020, while Appendix 8.4 includes the results for both present and future years. For the passenger trips, the trip rate per 1000 persons of population is also included for each province. Cavite has the highest passenger inter-zonal trip rate per population and is followed by Bataan. As for the number of generated trips, the highest is for Metro Manila and is followed by Cavite and Pampanga.

Considering the future commodity trips, Metro Manila is expected to continue as the highest trip attractor and is followed by Pampanga while Rizal is the highest trip generator. Future generated and attracted vehicle trips are mostly concentrated from/to Metro Manila and Cavite is in the second place followed by Pampanga. Other high vehicle-generated-trip provinces include Batangas, Laguna, Rizal and Bulacan.

8.3.2 Regional Trips

Regional OD matrices for the three trip types of passengers, commodities and vehicles are presented in Table 8.3-1 for the year 2020. Regional OD matrices of the future years 2000 and 2010 are included in Appendix 8.5. The graphical presentations of the desire-line charts for regional trips are shown in Figure 8.3-3 for passenger, commodity and vehicle trips in the year 2020. Present and future regional desire-line charts are presented in Appendix 8.6 for passenger, commodity and vehicle trips. The figure shows that the high trip pattern is concentrated between NCR and Each of Regions III and IV. Regions II and V have good potential in the commodity trips while other regions have balanced pattern for the three types of trips.

Trip generation and attraction pattern on regional base is shown in Figure 8.3-4 for the year 2020 for the three types of trips, while other future years as well as the present pattern are presented in Appendices 8.7 for passenger, commodity and vehicle trips. Regional trip rates by 1000 persons in population included in the figure show that Regions IV-A, III and NCR, which have the highest trip generation, have also the highest trip rates while Region V has the lowest. Future commodity trips show high attraction in Regions NCR, III and

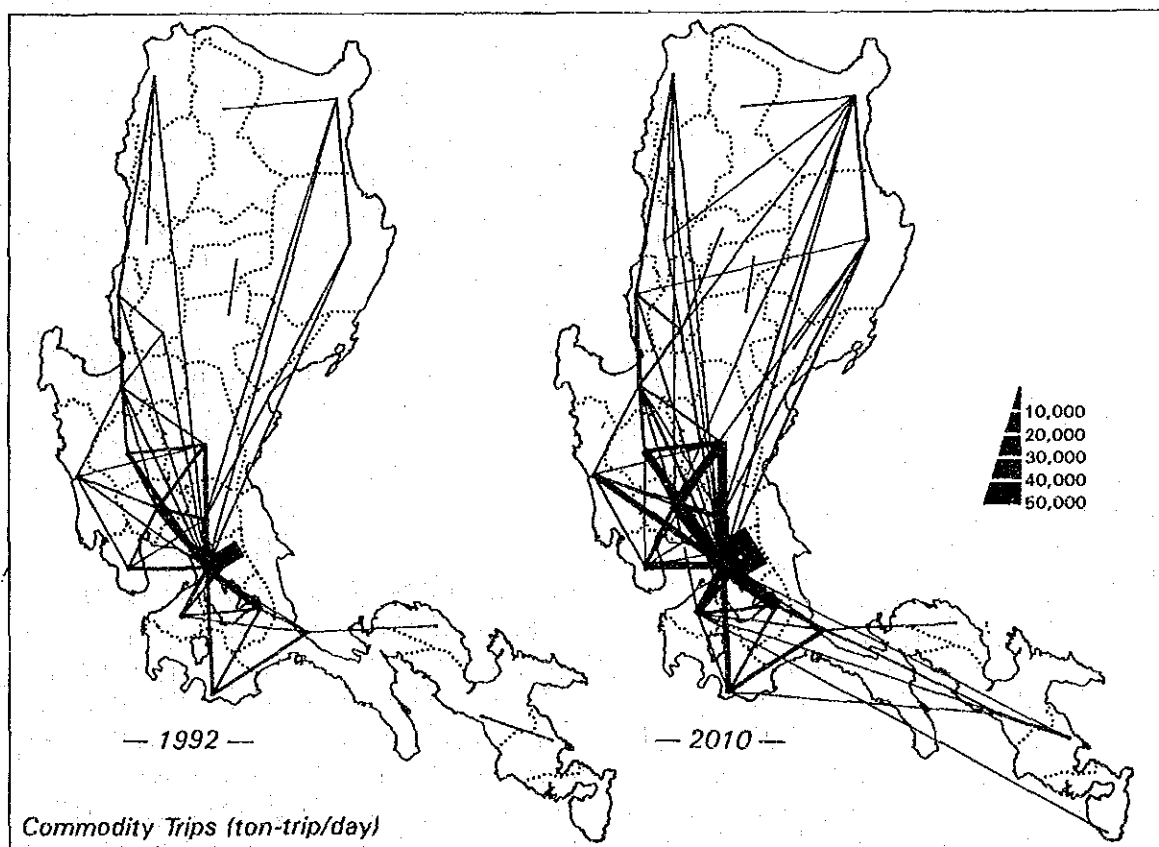
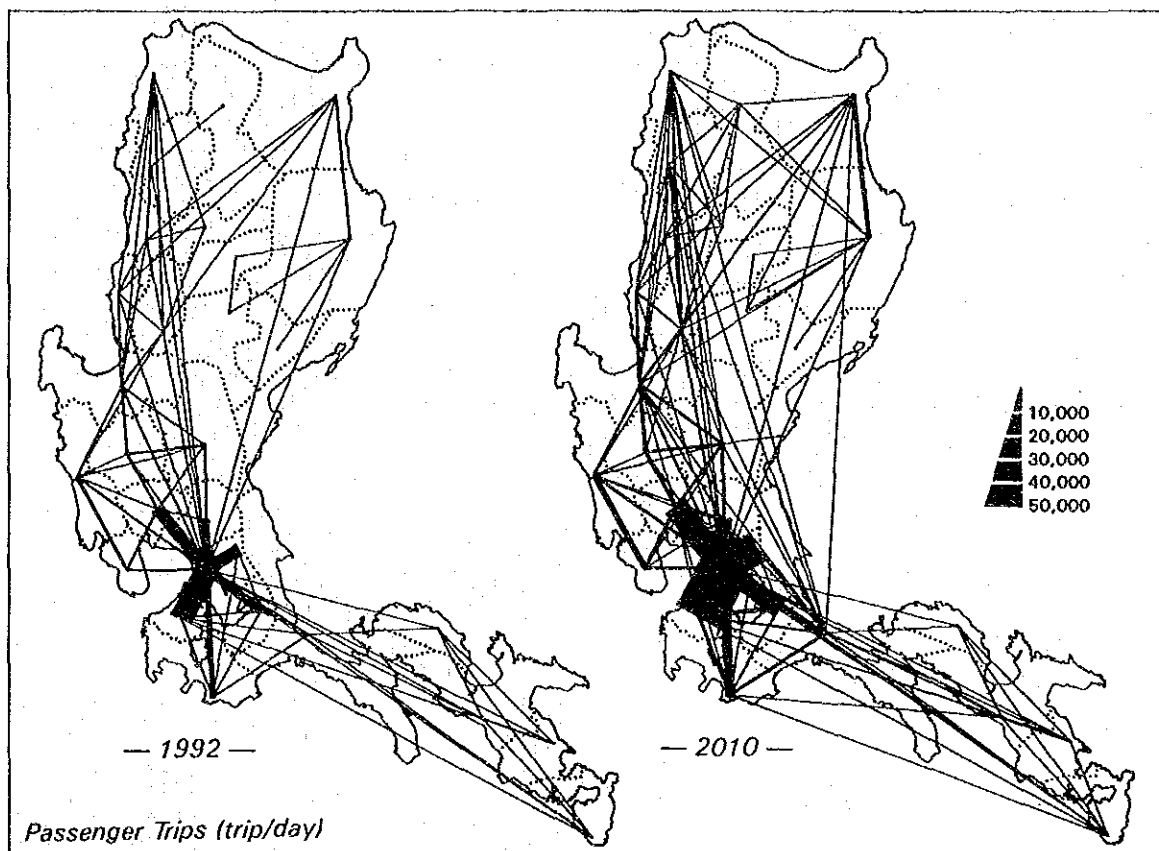


FIGURE 8.3-1 PRESENT AND FUTURE PROVINCIAL DESIRE-LINE CHART