

Table 3.2.5 Commodity Flow in Region (1989)

Unit : 1000 ton/year

| Region | Inbound | | Outbound | | Total | |
|-------------------|---------|------|----------|------|--------|------|
| | | | | | | |
| Central | 8,076 | 0.20 | 1,492 | 0.14 | 9,568 | 0.18 |
| North | 2,250 | 0.06 | 2,293 | 0.21 | 4,543 | 0.11 |
| Northeast | 1,945 | 0.05 | 2,017 | 0.19 | 3,962 | 0.08 |
| East | 5,928 | 0.15 | 1,602 | 0.15 | 7,530 | 0.15 |
| South | 1,298 | 0.03 | 1,096 | 0.10 | 2,394 | 0.05 |
| West | 19,923 | 0.51 | 2,325 | 0.21 | 22,248 | 0.44 |
| Whole Kingdom (1) | 39,420 | 1.00 | 10,825 | 1.00 | 50,245 | 1.00 |

Source : LTD

(1) As total is sum up by each region, does not coincide with that of LTD

Table 3.2.6 Industrial Products' Flows in Region

Unit : 1000 ton/year

| Region | Inbound | | | Outbound | | | Total | | |
|-------------------|---------|-----|-------|----------|-------|-------|-------|-------|-------|
| | (2) | (3) | Total | 21 | 22 | Total | 21 | 22 | Total |
| Central | 32 | 50 | 82 | 51 | 285 | 336 | 83 | 335 | 418 |
| North | 35 | 54 | 89 | 45 | 847 | 892 | 80 | 901 | 981 |
| Northeast | 63 | 36 | 99 | 32 | 596 | 628 | 95 | 632 | 727 |
| East | 65 | 90 | 155 | 51 | 417 | 468 | 116 | 507 | 623 |
| South | 18 | 23 | 41 | 14 | 573 | 587 | 32 | 596 | 628 |
| West | 213 | 112 | 325 | 113 | 514 | 627 | 326 | 626 | 952 |
| Whole Kingdom (1) | 426 | 365 | 791 | 306 | 3,232 | 3,538 | 732 | 3,597 | 4,329 |

Source : LTD

(1) As total is sum up by each region, does not coincide with that of LTD
 (2) Personnel effects
 (3) Miscellaneous goods

3.3 Physical Distribution Mechanism

3.3.1 Results of Interview Survey for Freight-related Companies

A. Outline of the Survey

JICA Study Team carried out an interview survey for various private companies to clarify the prevailing physical distribution system in Thailand. The outline of the survey is as follows:

1. Companies Interviewed

| Type of Business | Number |
|-------------------|--------|
| Trucking Company | 6 |
| Warehouse Company | 3 |
| Wholesaler | 2 |
| Manufacturer | 19 |

2. Items of Questionnaire

- a) Outline of the companies
- b) Cargo flow and channel handled by the company
- c) Equipment for transport
- d) Possibility of use of truck terminals

The details are described in the next sections.

B. Cargo Flow and Channel

1. Cargo Flow, Transport, Management and Administration

Major answers concerning cargo flow, transport equipment, management and administration are summarized in Table 3.3.1 through Table 3.3.3.

2. Possibility of Use of Truck Terminals

a) Trucks ban for 24 hours

Most companies answered they would provide the new cargo handling places or would change large trucks to small vehicles. Results are summarized below:

Table 3.3.1 Major Answers on Cargo Flow

| Type of Company | Major Answers |
|---------------------|--|
| Trucking Company | <ul style="list-style-type: none">- Working system of line-haul and delivery/collection are operated separately in Bangkok city and that large truck for line-haul seldom carry its cargo on delivery/ collection.- Loading and unloading is generally operated at warehouses except sea container transport and it takes 10-60 minutes in ordinary case.- Peak months are from March to April and off-peak months are from January to February. |
| Warehousing Company | <ul style="list-style-type: none">- In general, warehousing company does not operated cargo transportation. |
| Wholesale | <ul style="list-style-type: none">- Peak month is around October. |
| Manufacturer | <ul style="list-style-type: none">- The production of companies interviewed cover industrial products, food processing, mineral and so forth, the channel of cargo is as follows- The time of loading and unloading varies widely from 10 to 60 minutes.- Delivery and collection are completely separated for line haul transport. |

Table 3.3.2 Major Answers on Transport Equipment

| Type of Company | Major Answers |
|-------------------|--|
| Trucking Company | <ul style="list-style-type: none"> - Fixed packaging is utilized in case of sea container transport, and pallet and forklift are also used. - Loading and unloading are operated mainly by labour power except sea container. - Industrial products are generally packaged in carton box but most of agricultural products are packaged in bamboo bag. - As for transportation of small lot mingled, the answers of "pro" and "con" shares 50% respectively. However the answer to be increased in future is remarkable. |
| Warehouse Company | <ul style="list-style-type: none"> - Warehouse company does not possess their own trucks. However there exist two groups: one which possesses equipments such as forklift and conveyor for loading and unloading, and the other does not possess any equipments. |
| Wholesaler | <ul style="list-style-type: none"> - There exist many companies to possess own pick-up and 6 wheels trucks, and some companies have forklifts for loading and unloading. |
| Manufacturer | <ul style="list-style-type: none"> - Most of the cargoes handled by manufactures are packaged in carton box, of which weight is around 10-20 kg except some special cases such as cement. - The size of pallet is about 1.0 m x 1.2 m. - The spaces of warehouse widely varies. - With respect to small lot mingled, although they don't handled at present, they answered to be expected in future. |

Table 3.3.3 Major Answers on Management and Administration

| Type of Company | Major Answers |
|-----------------|--|
| Manufacturer | <ul style="list-style-type: none"> - Most of the companies consign their cargoes transport to trucking company. - Two kinds of contract share a half of the total contract for each: One is one-year contract, and the other is occasional contract. - Transport cost widely ranges, depending on transport distance and a kind of commodity. However it costs around 1,000 - 1,500 Baht/trip in case of short line haul. - They cannot continue their business any more at the present location. - There must be better solutions than the truck ban for 24 hours. |

It should be considered that there exist much implication more than the contents of answers.

b) Utilization of Truck Terminals

About 40% answers that it depends on conditions, and 30% was for "Con" and remaining 30% for "Pro."

The merit of truck terminals, the majority answered, was a reduction in numbers of truck. All items concerning difficulties to use the truck terminals are agreed because of multiple answer method.

c) Necessary Facility

All facilities listed in the questionnaire are answered necessary, and additional facilities requested are security service, medical center, and integrated service facilities.

3.3.2 Physical Distribution System

A. Distribution Channel

Major distribution channels for agricultural and industrial sectors that relate to the study of truck terminal, are summarized in this section.

1. Agricultural product

General agricultural products follow two paths: domestic and international. Agricultural products harvested in the upcountry are transported into BMR, by mainly trucks. Some products like tapioca and rice are exported from the Port of Klong Toey in Bangkok.

As for the commodity for domestic consumption, Fig. 3.3.1 shows markets and physical distribution channels in a diagrammatic manner. A remarkable portion of the vegetables and fruits harvested in upcountry are transported into BMR by trucks.

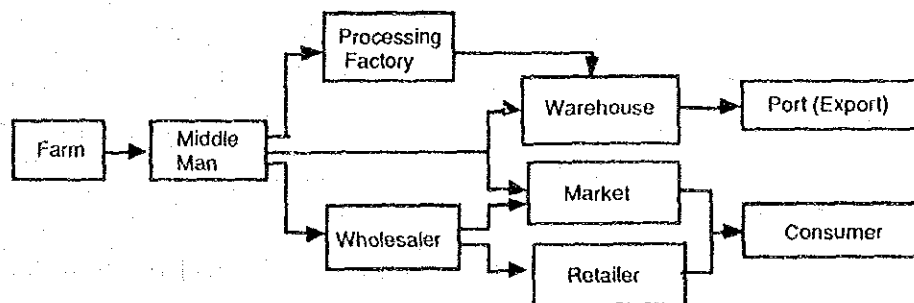


Figure 3.3.1 Typical Distribution Channel

In the up-countries, the agricultural commodities are handled by a middle man; the farm manager-the co-ordinator plays an important role in the distribution process. The products that left the middleman are transported to processing factories and wholesaler. Processed agricultural foods are stored in a warehouse before export from the port.

In case of export, products are stored in warehouses after a first processing in factories and transported to the Klong Toey Port in Bangkok. In case of domestic consumption, the products flow to consumers via market and wholesaler /retailer

On the other hand agricultural products flow from the Klong Toey Port to the storing facilities which are operated by consignors or traders, and are delivered to consumers mainly in BMR. However, this volume is small.

2. Industrial Products

a) Inflow to BMR

Industrial products flowing into BMR are mainly those which are produced at industrial estates located in up-country. Total volume is not so significant at present.

b) Outflow to BMR

Many of industrial products which are produced in BMR are transported from BMR to other regions and foreign countries. These industrial products form the major commodities of outflow from BMR to up-country and is anticipated to become the most important commodity when truck terminals are opened.

These industrial products come from light industry including personnel effect and miscellaneous goods.

Generally, light industrial products manufactured in BMR are consumed in rural area. The flow is outward from BMR. However, recent industrial complex constructions make the cargo flow more complex as shown in Fig.3.3.2. Mechanical parts for assembly are transported from BMR to industrial complex in rural areas, upcountry for example. Some final products from upcountry are transported and consumed in BMR, and others are exported from the international seaport as Fig.3.3.3 shows. This in-out flows of large commodity volumes are to be handled in truck terminals.

c) Import/Export

The international freight flows are confined to those handled at the Klong Toey Port in Bangkok alone since the subject is limited to the commodity flows in BMR at present. Table 3.3.4 shows the volume of all kinds of freight handled at this port.

Table 3.3.4 Cargo Traffic via Bangkok Port (Klong Toey)

| | | (Unit: 1,000 tons/year) | | |
|---------|--------------|-------------------------|-------|--------|
| Year | | 1980 | 1985 | 1990 |
| Inward | Conventional | 2,747 | 2,474 | 3,963 |
| | Container | 839 | 1,549 | 4,203 |
| | Total | 3,586 | 4,023 | 8,165 |
| Outward | Conventional | 122 | 5 | 115 |
| | Container | 895 | 2,332 | 6,088 |
| | Total | 1,017 | 2,337 | 6,203 |
| Total | Conventional | 2,869 | 2,479 | 4,078 |
| | Container | 1,734 | 3,881 | 10,291 |
| | Total | 4,603 | 6,360 | 14,368 |

Source : PAT

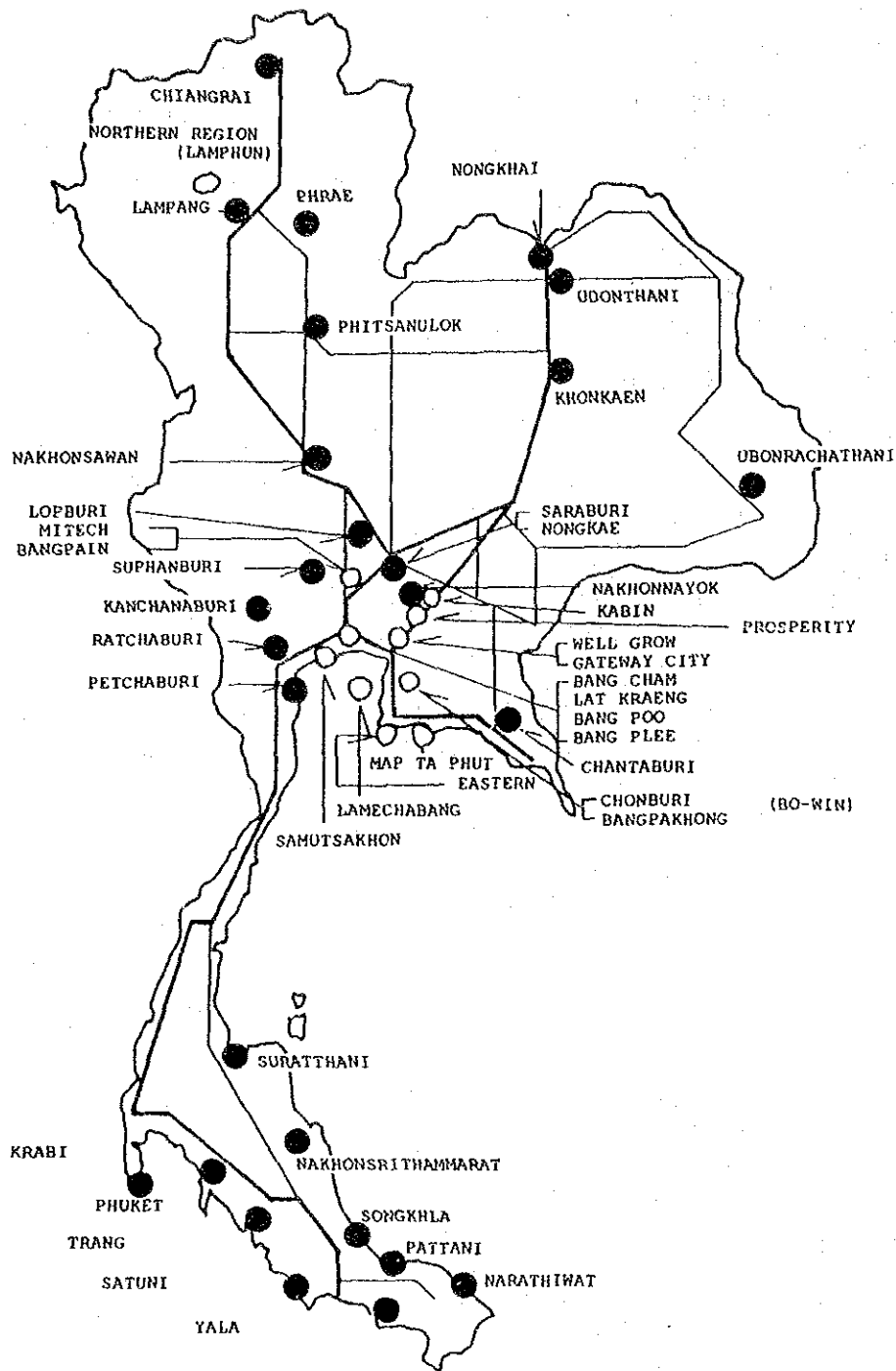


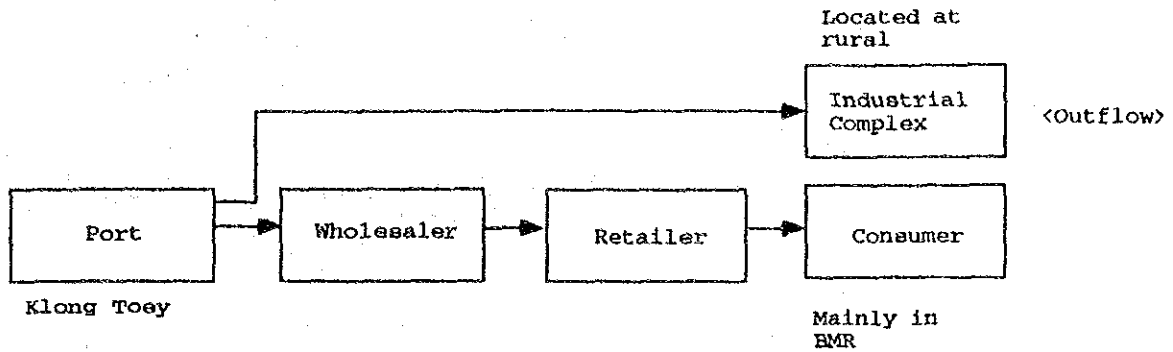
Figure 3.3.2

Industrial Estates in Thailand

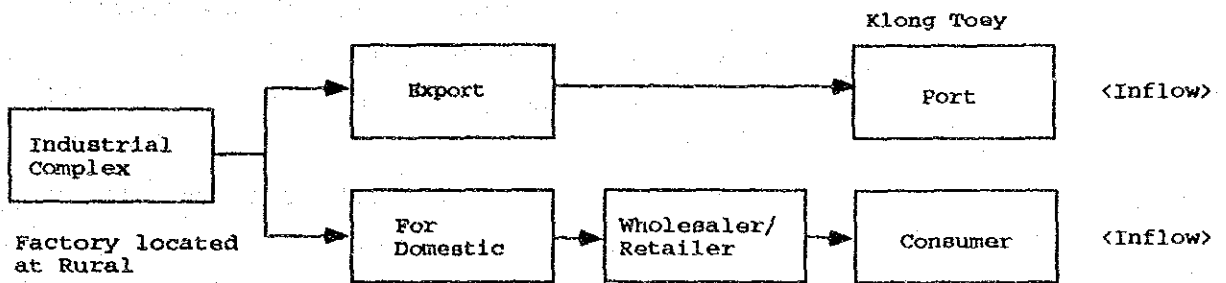
LEGENED:

- Completed
- Planning

i) Import



ii) Flow Related to Domestic Industrial Products



iii) Other General Cargo

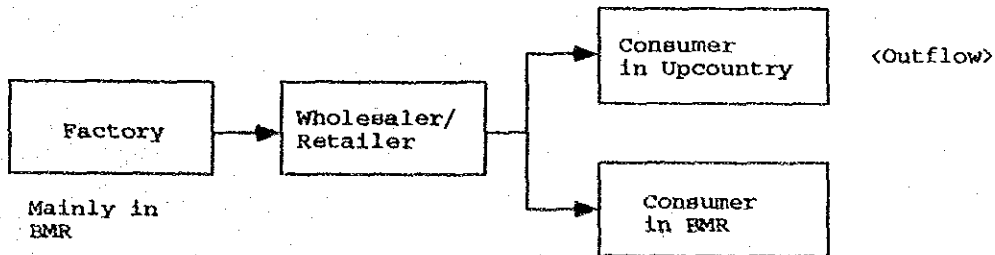


Figure 3.3.3 Distribution Channel on Industrial Products

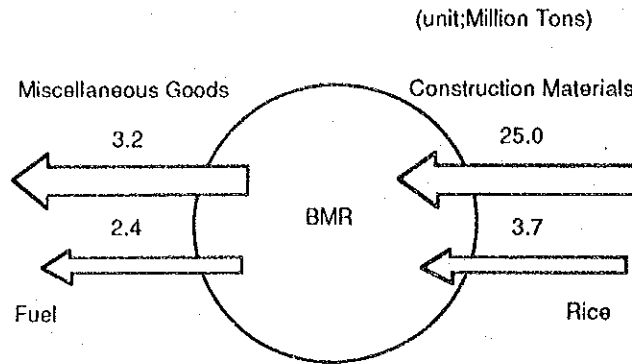


Figure 3.3.4 Main Commodities of Inflow and Outflow

As for the import, main items of commodity consists of petroleum product (fuel), cotton, parts of automobile, metal products, light industrial products and miscellaneous goods. These are consumed mainly in BMR via wholesalers and retailers as shown in Figure 3.3.4.

Almost all of the industrial products have been transported and handled in container style (sea container). Volume of container cargo has increased considerably in a recent decade.

It can be divided into two groups: One is agricultural products as tabulated in conventional statistics. This has a small volume. The other is industrial products, which shows the remarkable growth. The high growth rate is attributable to the recent prosperity of Thai economy.

As for sea container, it has quite different channels from that of general cargo. Fig. 3.3.5 presents this situation.

In both cases of import and export, vanning and de-vanning of containers have been in effect inside the port. However, since the handling volume has been increased year by year, there exist no space any more for its incremental volume. Therefore, Port

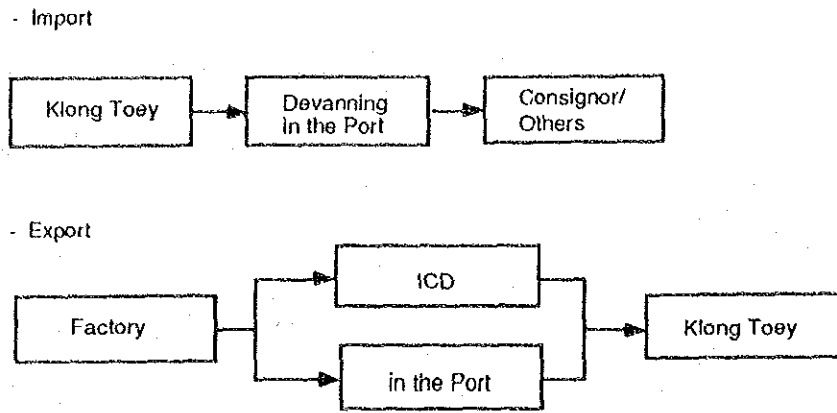


Figure 3.3.5 Container Flow Image

Authority of Thailand (PAT) designated some 20 places as a off-dock facilities, many of which locate around the port in order to carry out the export custom registrations more smoothly. However a few places are set up for import custom registration and are not fully functioned at present.

B. Feature of Transportation

1. Traffic Restriction

Traffic restriction on large trucks has been put in effect in BMR now. The details of restriction are summarized in Fig.3.3.6. Large trucks are prohibited to enter into the city of Bangkok during this time period. Therefore, a large number of trucks have to wait on roadside out of the boundary of Bangkok city until this restriction time is over.

The traffic congestion in BMR is supposed to be the worst one in the world. It is urgently necessary to provide mass transit to alleviate the current traffic congestion. And comprehensive traffic control is important at present including one-way control device and parking restriction policy on large trucks in CBD.

Judging from these points, prevailing traffic restriction on large trucks is inevitable.

| Time | Contents of Restriction | | |
|-------|--|---|---|
| 6:00 | 4 wheels and 6 wheels except public holidays | 10 wheels, more than 2 axles and Trailer except public holidays. They can pass on some roads in Bangkok during restriction time | loaded truck with heavy materials such as log, Cement pole etc. |
| 7:00 | | | |
| 8:00 | | | loaded truck with gas tank (more than 6 wheels and trailer) except Sunday |
| 9:00 | | | |
| 10:00 | | | |
| 11:00 | | | They can pass on some roads in Bangkok during restriction time |
| 12:00 | | | They can pass on some roads in Bangkok during restriction time |
| 13:00 | | | |
| 14:00 | | | |
| 15:00 | | | |
| 16:00 | 4 wheels and 6 wheels except public holidays | 10 wheels, more than 2 axles and Trailer except public holidays. They can pass on some roads in Bangkok during restriction time | |
| 17:00 | | | |
| 18:00 | | | |
| 19:00 | | | |
| 20:00 | | | |
| 21:00 | | | |
| 22:00 | | | |

Restriction all day for fuel tank truck with more than 6 wheels and trailer. But they can pass on some roads in Bangkok during 21:00 - 06:00.

Fig. 3.3.6 Current Traffic Restriction on Trucks in Bangkok

2. Transport Mode

An inland waterway and railway transport, are also available. But almost all of the inflow and outflow of BMR is conducted by truck transportation. Table 3.3.5 shows the main cargo items being transported by railway. More than one-thirds is petroleum product, mainly fuel.

Table 3.3.5 Railway Freight

| Item | (Unit : 1,000 tons/year) | |
|-------------------|--------------------------|--------------|
| | 1985 | 1989 |
| Paddy Rice | 435 | 339 |
| Maize | 21 | 110 |
| Timber | 64 | 112 |
| Cement | 1,265 | 2,145 |
| Sugar | 73 | 116 |
| Petroleum Product | 2,560 | 2,634 |
| Gypsum | 242 | 266 |
| Rubber | 174 | 213 |
| Military effects | 38 | 32 |
| Others | 548 | 1,063 |
| Total | 5,615 | 7,030 |

Source : SRT

3. Average Trip Length

Of both the inflow and outflow transportation in BMR, an average trip length by cargo item are shown in Table 3.3.7, and its characteristics are summarized as follows:

a) Inflow

(1) Groups 1 (construction materials and others)

Its average trip length is 96 kilometers, rather short distance. It means these cargoes are carried from neighboring areas of BMR.

Table 3.3.7 Average Trip Length by Commodity

| | Total | | | | IN | | | Out | | |
|----------------------------|-------------------|----------------|------------------------|-------------------|----------------|------------------------|-------------------|----------------|------------------------|--|
| | Ton-Km (1,000) | Ton (1,000) | Trip Length (Km) | Ton-Km (1,000) | Ton (1,000) | Trip Length (Km) | Ton-Km (1,000) | Ton (1,000) | Trip Length (Km) | |
| 1. Group Construction M | 2,983,748 | 28,648 | 104 | 2,647,183 | 27,555 | 96 | 310,203 | 1,093 | 283 | |
| 2. Group Mineral | 762,923 | 2,716 | 281 | 90,180 | 288 | 313 | 672,741 | 2,428 | 277 | |
| 3. Agricultural | 4,279,347 | 13,296 | 321 | 3,242,446 | 10,186 | 222 | 1,063,266 | 3,110 | 341 | |
| 4. Industry | 2,290,466 | 5,584 | 410 | 525,575 | 1,392 | 378 | 1,764,889 | 4,192 | 421 | |
| Total | 10,316,484 | 50,244 | 205 | 6,505,384 | 39,421 | 165 | 3,811,099 | 10,823 | 352 | |

- (2) Group 3 (agricultural products which are a major part of cargo)

It shows medium trip length of 222 kilometers.

- b) Outflow

Outflow trip has, in general, a long trip distance in comparison with that of inflow. Group 4 has the longest average trip length which is attributable to its distribution activities to all over the country.

4. Line haul and delivery/collection

- a) Forwarder

The forwarders, the truck transportation operators, usually have small sorting facilities of 30-50 m² and a few trucks.

One forwarding company is in charge of one-region or one-direction transport, and it does not deal with multi regional transportation. The operation is usually to and from BMR.

These forwarders are located in several densely built-up districts (mainly in four districts) in BMR as showed in Figure 3.3.7.

The districts A, B and C in Figure 3.3.7 occupy the center of BMR. Therefore, large and small trucks gather at these district and park on roadsides for loading and unloading. This results in tremendous traffic congestion on the main roads around these districts.

Since the existing terminals are located in the center of BMR, every physical distribution activities face inconvenience. The congestion caused by on-street loading/unloading and parking restriction make the forwarding business in this district almost impossible.

Because of these difficulties, some forwarders were moved to the D district, near the Klong Toey Port. Forwarders that deal

container, import and export transportation are concentrated along the Riap Maenam Road. Its reasons relate to the worsening traffic congestion and a fact that restriction on roadside parking had become a crucial problem to operate their daily works.

The circumstances mentioned above indicate that traffic congestion reaches to critical point to keep urban transportation normal since more densely use of land is almost impossible and therefore no space can be guaranteed for cargo handling in the CBD of BMR

b) Line haul

Figure 3.3.8 illustrates the transport circulation between Bangkok and certain city in upcountry around 600 kilometer far from Bangkok as an example.

This figure shows that transportation circular is restricted by this traffic regulation in Bangkok city since large truck movements are restricted inside Bangkok city during the rush hour. However, when trucks return to Bangkok from upcountry, its departure time at upcountry is not crucial because drivers can adjust arrival time on their way to Bangkok city.

The main points concerning transport circular are as follows:

A typical trip cycle takes about four days, and each truck makes 6-7 trips per month. The typical trip cycle is as follows:

Line-haul trucks depart the forwarders' offices in BMR at 9:00 p.m. and arrive at the destination in the upcountry in the early morning next day; Consignors picks up the cargoes with 4 wheel truck on the same day; Line-haul trucks load cargoes in the next morning, and leave for BMR in the afternoon; Line-haul trucks return to BMR early in the morning next day; Cosigners pick up their cargoes by a pick-up or 4 wheel trucks at the forwarders' offices.

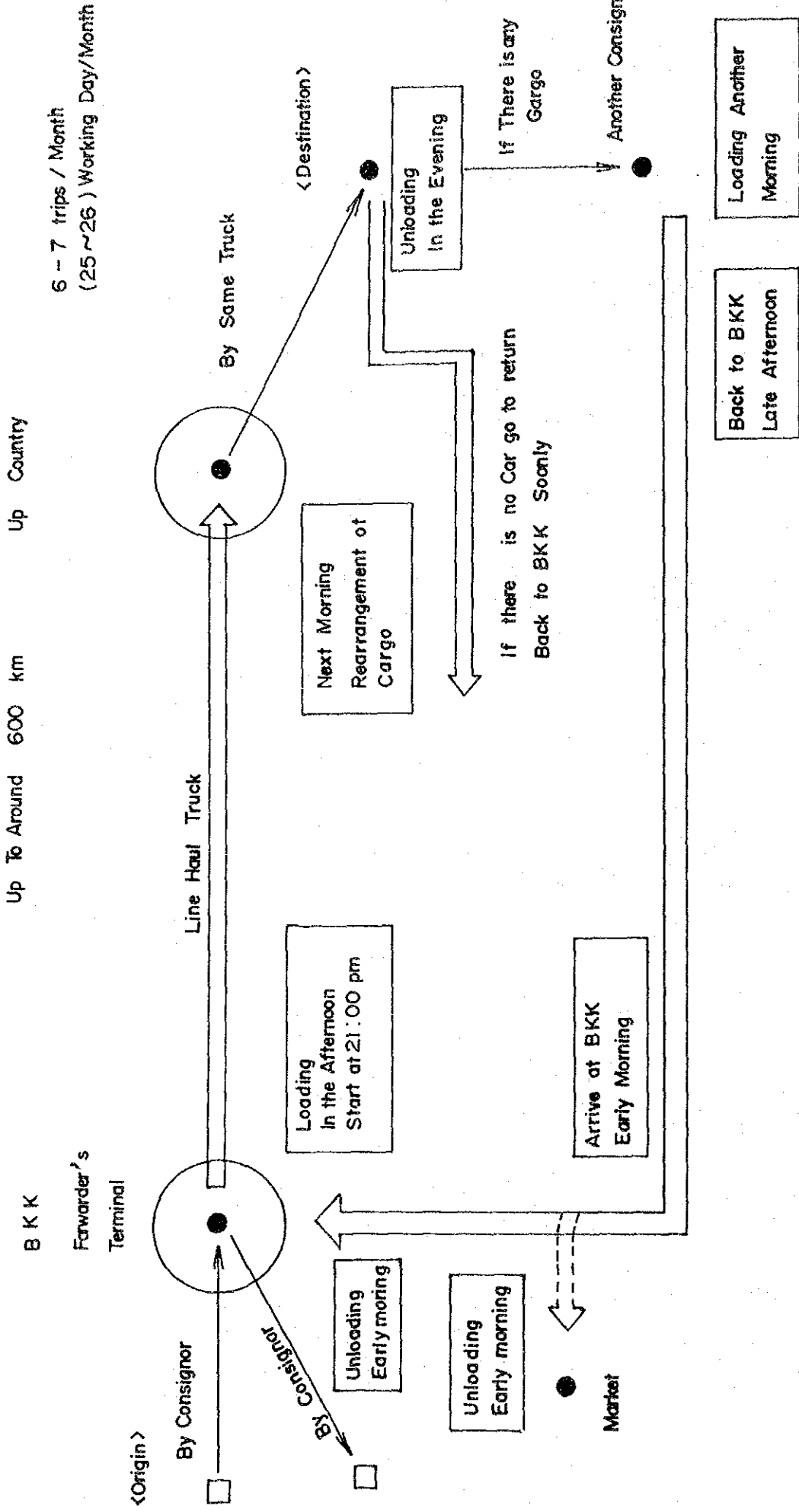


Figure 3.3.8 Transport Circulation

c) Delivery and collection

Delivery and collection of cargo have been mainly operated by consignors themselves by pick-up or 4 wheels truck. Exception is the case of huge volume of cargo such as steel. Another exception is the case that the truck is fully loaded with cargoes of a sole consignor.

Loading and unloading which transmit cargoes to/from large trucks is carried out usually on roadsides in front of forwarder's shop and this manpower handling works take around an hour. However, since difficulty in finding parking space becomes a big problem for this activities, consignors carries their cargo to forwarder's offices with due coordination with the arrival time of line haul trucks.

Figure 3.3.10 shows a typical transportation routine pattern between BMR and rural region far from around 400-600 kilometer distance.

Table 3.3.7 Packaging of Commodity

| Commodity | Packaging | Weight |
|---------------------|------------|------------------|
| Rice, Beans & Maize | jute bag | around 20 kg. |
| Flour | vinyl bag | 20-25 kg. |
| Vegetable, Fruit | bamboo bag | around 20-25 kg. |
| Miscellaneous | carton box | variety |

The transportation of both the governmental cargo and the import cargo have been conducted exclusively by Express Tollway Organization (ETO). ETO has its own trucks and sub-contractors to transport its cargoes.

e) Package

Package of major cargoes is categorized in Table 3.3.7 and major features are summarized below:

- (1) Agricultural products such as rice, maize and beans are transported in package of jute bag with a weight of 20-25 kg without pallet.
- (2) Plastic bag is used for flour transportation with a weight of 20-25 kg.
- (3) Bamboo cargo is used for perishable vegetable and fruit. Its average weight is around 25 kg.
- (4) Miscellaneous and light industry cargoes are packaged in carton box except some special cases since they are transported from factories as manufactured goods.

The sizes of package widely varies, depending on their characteristics of goods.

- (5) In some cases of beverage transportation in vintage, pallet can be observed at present.

f) Freight rate

Although a fixed freight rate is set up by the Express Tollway Organization (ETO), no authorized freight rate is fixed in general private cargo transportation, and it is usually decided through negotiations between forwarder and consignor.

"Trucking Industry" contains outline of average freight rates, which are tabulated again in Table 3.3.8.

According to the interview survey by the JICA Study Team, the average tariff is around 0.5 Baht/kg in case of 800 kilometer distance. The charge by consignor is around 6,000 Baht/trip.

Table 3.3.8 Freight Rate

| | Agricultural Products | | | | | | | |
|---------|-----------------------|------------|------------|-------------|-------------|-------------|---------------|---------------|
| | 1) Paddy | 2) Rice | 3) Rice | 4) Maize | 5) Maize | 6) Maize | 7) Tapioca | 7) Tapioca |
| 780-750 | | 410 | | | | | | |
| 630-600 | | | 250 | | | 400 | | |
| 560-530 | | 400 | | | | | | |
| 530-500 | | 300 | 220 | 350 | | | | |
| 490-460 | | | | | | 280 | | |
| 450-430 | | 330 | 240 | 350 | | | | |
| 430-410 | 200* | | | | | | | |
| 400-370 | | 250 | | 230 | | | | 180 |
| 360-340 | 150 | 200 | 250 | | 270 | 200 | 158 | 165 |
| 330-300 | | | | | 300 | | | |
| 290-260 | | 240 | | 160 | | 160 | 140 | 170 |
| 240-210 | 150 | 180 | | | 290 | | | 150 |
| 200-170 | 80 | | | | | | 125 | 130 |
| 150-120 | | | 100 | | 130 | | | |
| 110-100 | 80 | 110 | | 130 | | | | |
| 90-70 | | | 100 | 120 | | | | |
| 60-50 | 54 | | | | | | | |
| 40-20 | | | | | 50 | | | |
| 20-10 | | | | | 40 | | | |

- Notes
- 1) Paddy in bulk. Overloads are given as 52% above GVW limit of 21 tons, except * which has 29% overload.
 - 2) General rates supplied by an Association. No overload data given.
 - 3) Data from a milling company owning its own trucks, over 50% 6 wheels. No overload data given. Seasonal variation -30% in rainy season.
 - 4) Route from North to BKK.
 - 5) From North-east to Tha Rua.
 - 6) From North-east to Si Racha. No overload given.
 - 7) Seasonal variation -15% in rainy season.

Source : Trucking Industry, 1988, LTD

3.4 Subject To Be Solved

A. Urban structure

As for the economic activities, BMR has played the central role in the Kingdom of Thailand. Although BMR has a share of only 16% in population of the country, it has occupied about 50% of the whole GDP and 33% in number of truck. Such a excessive concentration on metropolitan area cannot be observed anywhere else in the world.

When such concentration can be observed in a country, decentralization and rearrangement of BMR in its land use and function should be policy issues.

With respect to rearrangement land use and function of BMR, it seems inevitable to divide the urbanized area by providing sub-cores like a satellite towns, and to promote redevelopment of CBD to form a highly integrated commercial and business district. Moreover, it is necessary to provide transportation facilities to accomplish these re-arrangements. Therefore it becomes more important to clarify large truck movements inside Bangkok city to solve prevailing traffic congestion qualitatively.

1. Physical Distribution System

The physical distribution activities in BMR is now expanding and an imbalance in transportation volumes of outflow and inflow has been worsened due to excessive concentration in BMR. However, judging from national planning point of view, some emphasis will be put on regional development in future and manufacturing sector in these areas will play an important role.

Although the volume of inflow is more than that of outflow at present, a balance should be improved through a mechanism of these regional developments and high economic growth in the future.

High rate of economic growth stimulates higher production of various industries. It can be forecasted that this results in large cargo volume to be transported. According to these circumstances, it is necessary to provide two types of transportation systems:

The one is line haul transport between up-countries and BMR.

The another is transport of intra-regions, including delivery and collection of cargo.

In sum, proposals to solve problems mentioned above are:

- a) Reallocation of forwarders' facilities to outskirts, which include warehouses and other storing facilities in the center of Bangkok.
- b) Provision of truck terminals to modernize a current physical distribution system where cargo transportation can operate more efficiently, and to relieve traffic congestion qualitatively.
- c) In accordance with provision of truck terminals, establishment of two types of transportation system are necessary. They are a line haul and a transport inside region.
- d) Reinforcing and encouraging the trucking companies to transform their financial and management conditions into more competitive one because present trucking industry consist of small companies in size and its capability to adjust its management style suitable to a dynamic and mega-freight society is vulnerable.

CHAPTER 4

DEMAND FORECAST OF TRUCK TERMINAL

CHAPTER 4 DEMAND FORECAST OF TRUCK TERMINAL

4.1 General

This chapter aims at forecasting the freight demand and providing the basic data for planning the truck terminals.

Forecast of future freight demand proceeds by employing socio-economic data and the results of the interview surveys of heavy-truck drivers and corporations.

In this chapter, three candidate sites for the truck terminal are established for future demand analysis, each of which service areas are set according to their respective cargo line hauls.

Demand was forecasted for the year 2000.

4.1.1 Methodology

A. Procedure

Process of traffic forecast in the year 2000 is illustrated in Figure 4.1.1 and described below:

1. Annual statistical cargo flow figures are gathered and grouped.
2. Elasticity of inbound and outbound cargo flows in Bangkok with respect to gross provincial product at the 1972 price constant are determined.
3. Control totals for the inbound and outbound cargo flows at the year 2000 are determined according to the projected gross regional product of the BMR.
4. O-D matrices of cargo movements by commodity types are determined. They are based on existing production and attraction truck trips in Bangkok and the Regions. And it was adjusted according to the year 2000 socio-economic data by zones.
5. The coefficient of truck terminal utilization, based on possible restrictions on trucking, is used to determine year 2000 cargo volumes by commodity type.

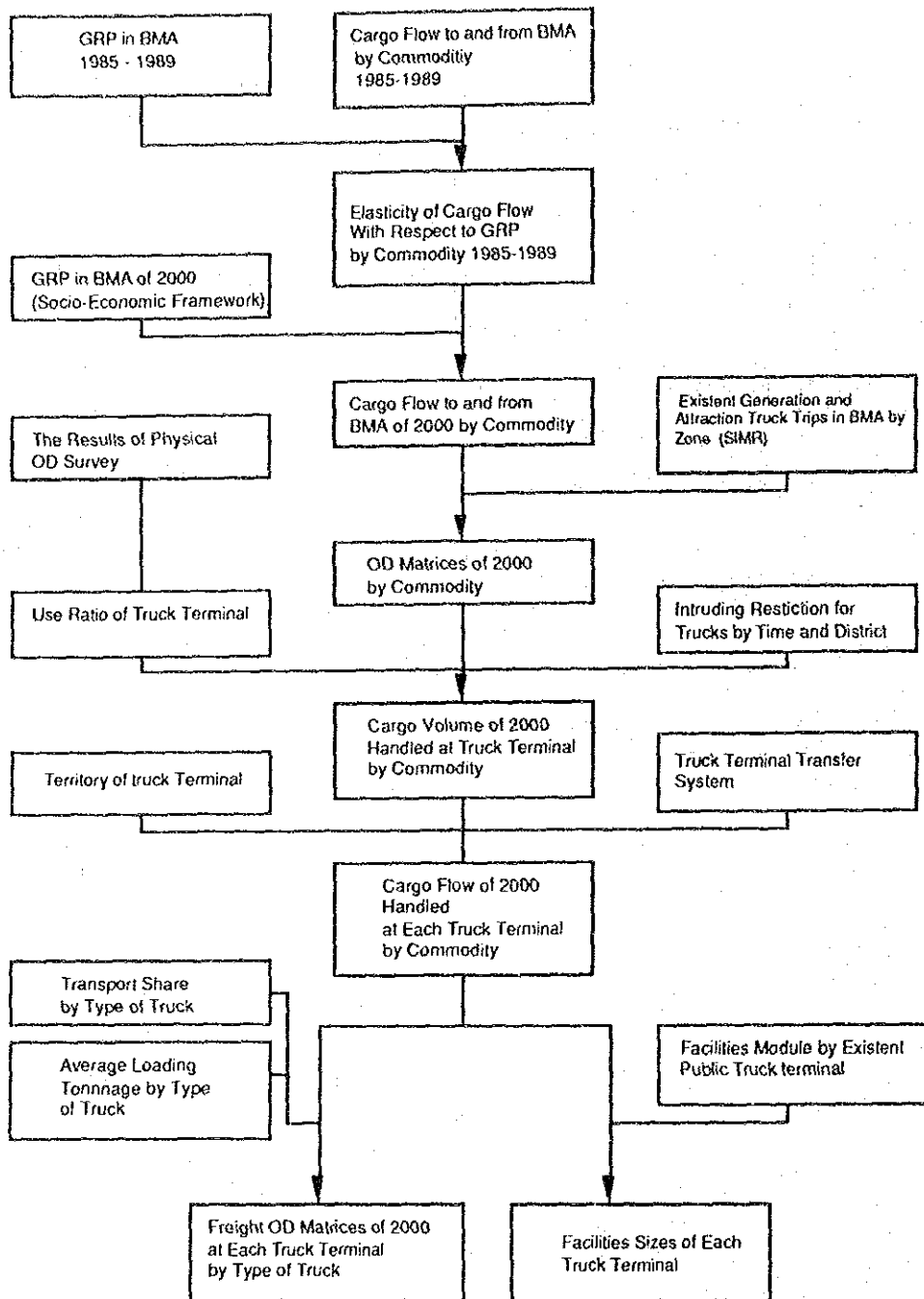


Figure 4.1.1 Work Flow of Demand Forecast for Truck Terminal

6. The year 2000 cargo volumes at each truck terminal by commodity are determined by assuming the assigned area for collection and delivery area.
7. Cargo O-D matrices for the year 2000 by truck type are determined by applying the diversion coefficient to the estimated cargo volumes.
8. The size of each truck terminal facility is determined by using module derived from existing public truck terminals.

B. Commodity Types and Study Area Zones

1. Commodity Types

Wide selection of commodities makes it possible to accurately estimate cargo flows only if such data are available for the whole study area. However, the number of commodities and size of zone trade-off within the limits of available data.

After an inventory of available data, geographical coverage, and consistency with socio-economic data, the following commodity types were selected (Tables 4.1.1 and 4.1.2).

Table 4.1.1 Classified Commodities

| | | |
|------------------------|-----|------------------------------|
| Construction Materials | 1. | Sand & Gravel |
| | 2. | Cement & Products |
| | 3. | Steel |
| | 4. | Other Construction Materials |
| Mining Products | 7. | Petroleum Products |
| | 8. | Minerals |
| Agricultural Products | 5. | Lumber |
| | 6. | Firewood |
| | 9. | Rice |
| | 10. | Vegetables * Fruits |
| | 11. | Tapioca |
| | 12. | Maize |
| | 13. | Sugar |
| | 14. | Beans |
| | 15. | Jute & Products |
| | 16. | Beverages |
| | 17. | Processed Goods |
| | 18. | Animals |
| Manufactured Goods | 19. | Fish |
| | 20. | Fertilizer & Animal Goods |
| | 21. | Personal Effects |
| | 22. | Miscellaneous Goods |
| | 23. | All Others |

a) Construction Materials, b) Mining Products, c) Agricultural, Forestry, Fishery and Related Products, d) Manufactured Goods

(Note: The commodity categories listed above are used throughout this chapter.)

Table 4.1.2 List of Commodities

| Item Number | Commodity | Classification Code for Processing |
|-------------|------------------------------|------------------------------------|
| 1. | Sand & Gravel | 1 |
| 2. | Cement & Products | |
| 3. | Steel | |
| 4. | Other Construction Materials | |
| 5. | Lumber | 2 |
| 6. | Firewood | |
| 7. | Petroleum Products | 3 |
| 8. | Minerals | |
| 9. | Rice | 4 |
| 10. | Vegetables * Fruits | |
| 11. | Tapioca | |
| 12. | Maize | |
| 13. | Sugar | |
| 14. | Beans | |
| 15. | Jute & Products | |
| 16. | Beverages | 6 |
| 17. | Processed Goods | |
| 18. | Animals | 7 |
| 19. | Fish | 8 |
| 20. | Fertilizer & Animal Goods | 9 |
| 21. | Personal Effects | 10 |
| 22. | Miscellaneous Goods | 11 |
| 23. | All Others | 12 |

C. Study Area Zoning

The BMR is divided into twelve zones (Fig. 4.1.2). Zones in the surrounding area of Bangkok are considerably larger than other twelve zones in the BMR, for the purpose of this zonal analysis. It will clarify the in-coming and out-going flows of the freight traffic generated from the terminals. (Fig. 4.1.3)

4.1.2 Development of Forecast Scenarios

The truck restrictions (especially 24-hour bans) and the transfer system are the two major factors to influence the cargo volume and the truck terminal operations. How those two factors are incorporated in to the forecast model are discussed below.

A. Restrictions and Transfer Systems

1. Restrictions

Several restrictions for heavy-truck use in central Bangkok are proposed to relieve traffic congestion (Table 4.1.3).

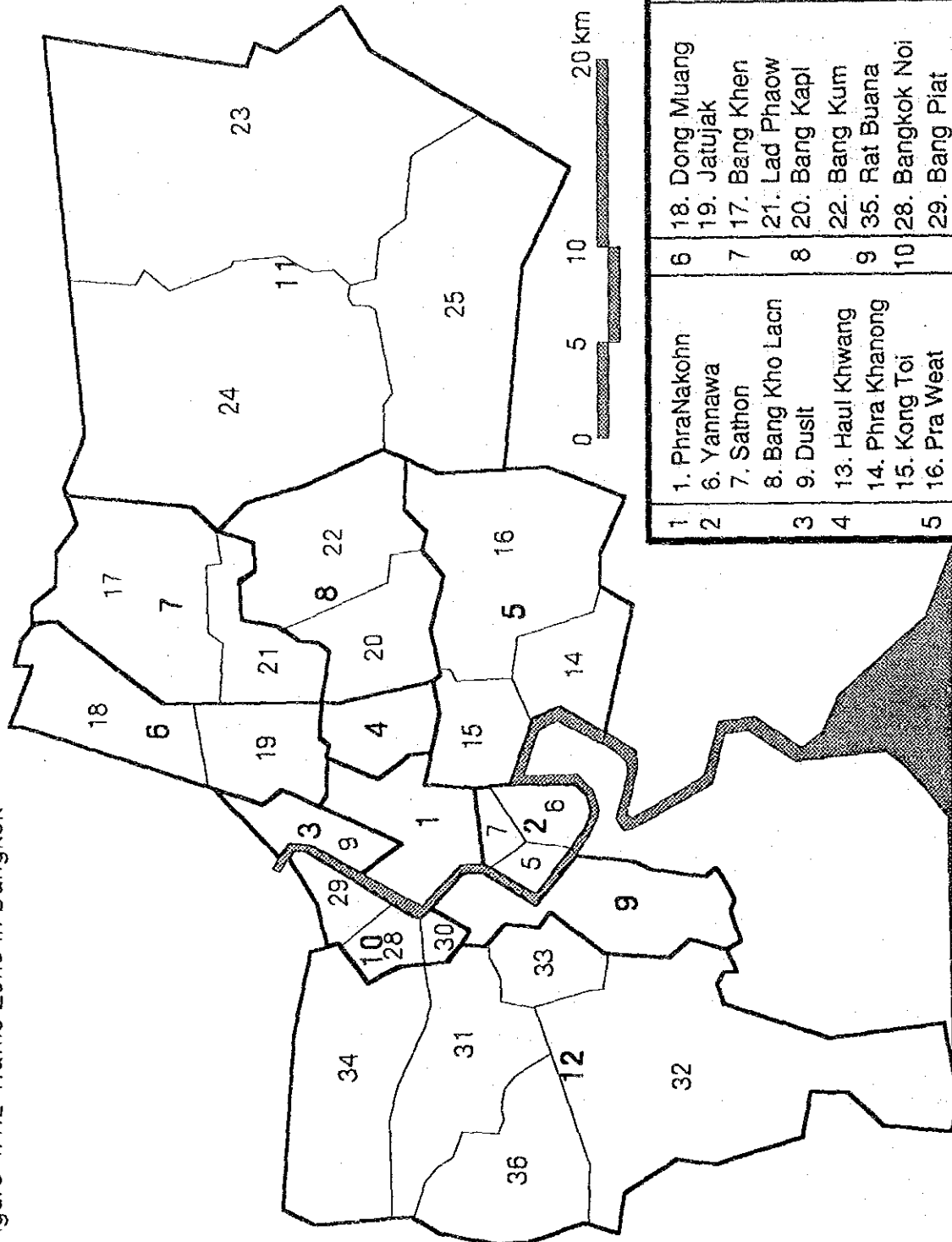
a) SPURT Restriction Area

24-hour restriction for heavy-trucks in central Bangkok in SPURT is shown in Figure 4.1.4. And the details are shown in Figure 4.1.5.

b) LTTPC Restriction Area

The Land Transport Policy Committee proposed the 24-hour restriction area. The proposal has not been approved, but it is suggested that the boundaries will be similar to the existing restriction area boundaries (Figure 4.1.5)

Figure 4.1.2 Traffic Zone in Bangkok



| | | | |
|------------------|----|-----------------|---------------------|
| 1. PhraNakohn | 6 | 18. Dong Muang | 30. Bangkok Yai |
| 2. Yannawa | 7 | 19. Jatujak | 23. Nong Chok |
| 3. Sathon | 8 | 17. Bang Khen | 24. Min Buri |
| 4. Bang Kho Lacn | 9 | 21. Lad Phaow | 25. Lad Kra Bang |
| 5. Dusit | 10 | 20. Bang Kapi | 31. Past Charocn |
| 13. Haul Khwang | 11 | 22. Bang Kum | 32. Bang Khun Thian |
| 14. Phra Khanong | 12 | 35. Rat Buana | 33. Jom Thong |
| 15. Kong Toi | | 28. Bangkok Noi | 34. Thaling Chan |
| 16. Pra Weat | | 29. Bang Piat | 36. Nong Khae |

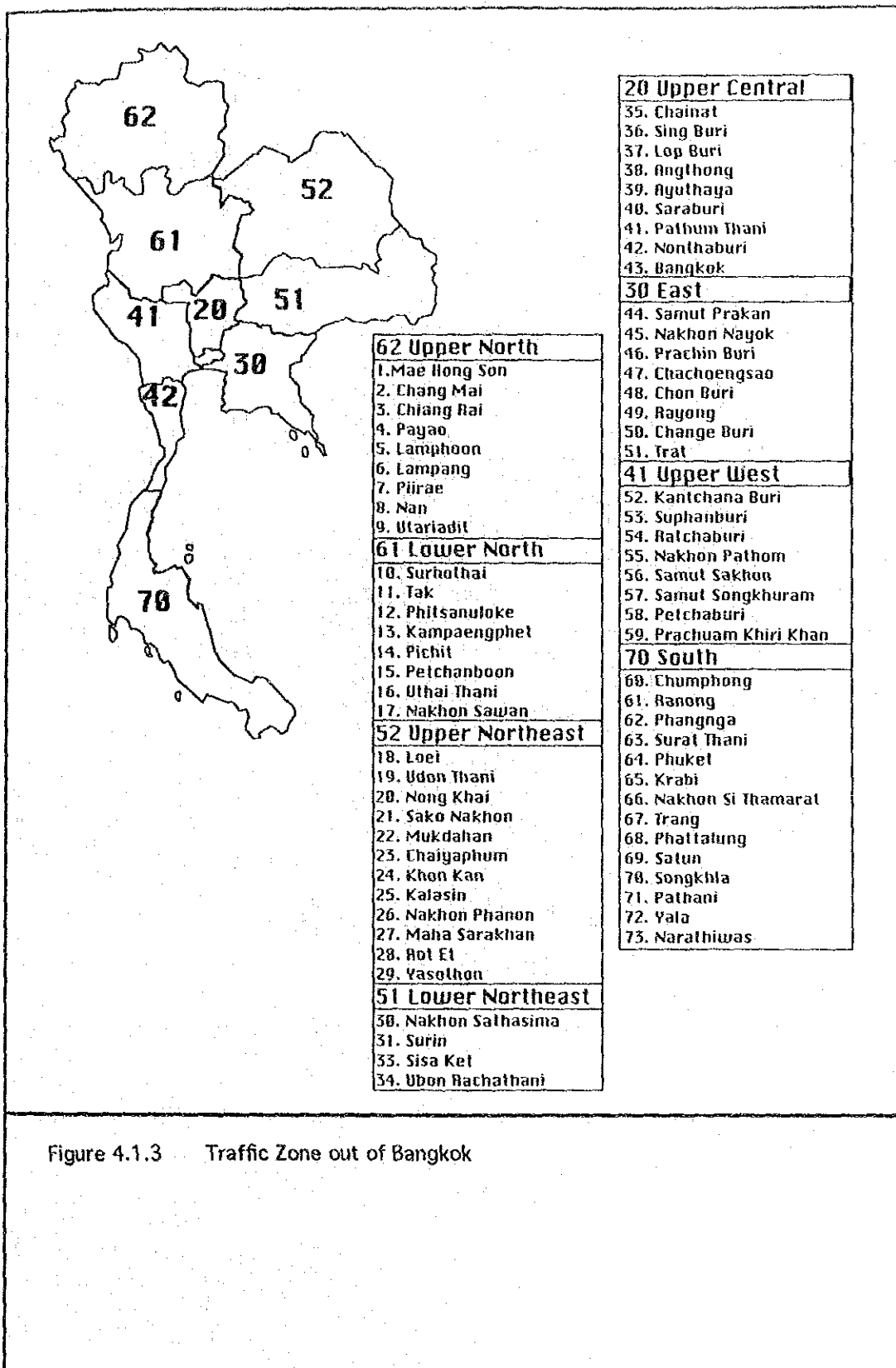


Figure 4.1.3 Traffic Zone out of Bangkok

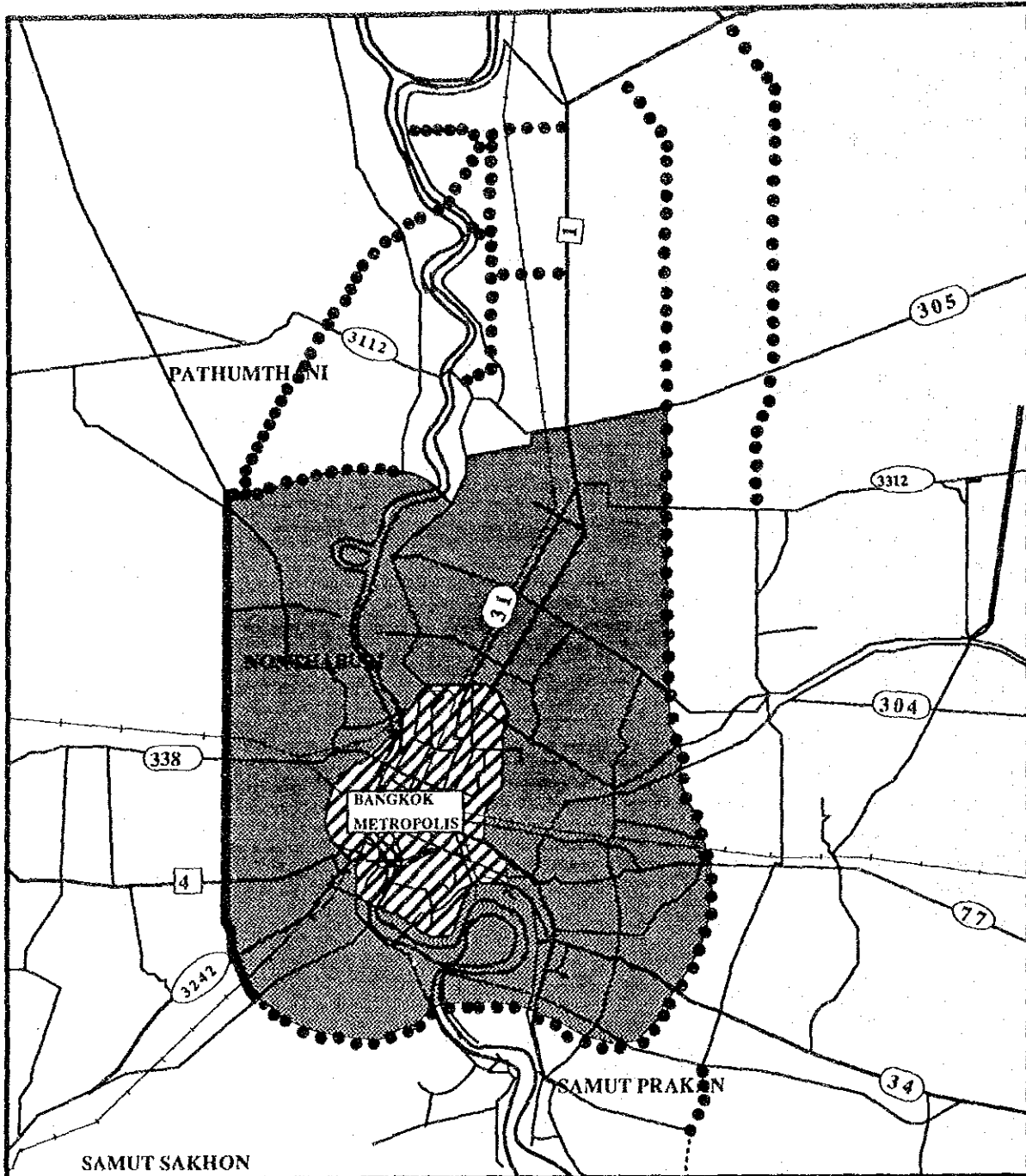


Figure 4.1.4

Whole Restriction Area
Proposed by SPURT and
LTPC

Legend



LTPC
Restriction
Area



SPURT
Restriction
Area

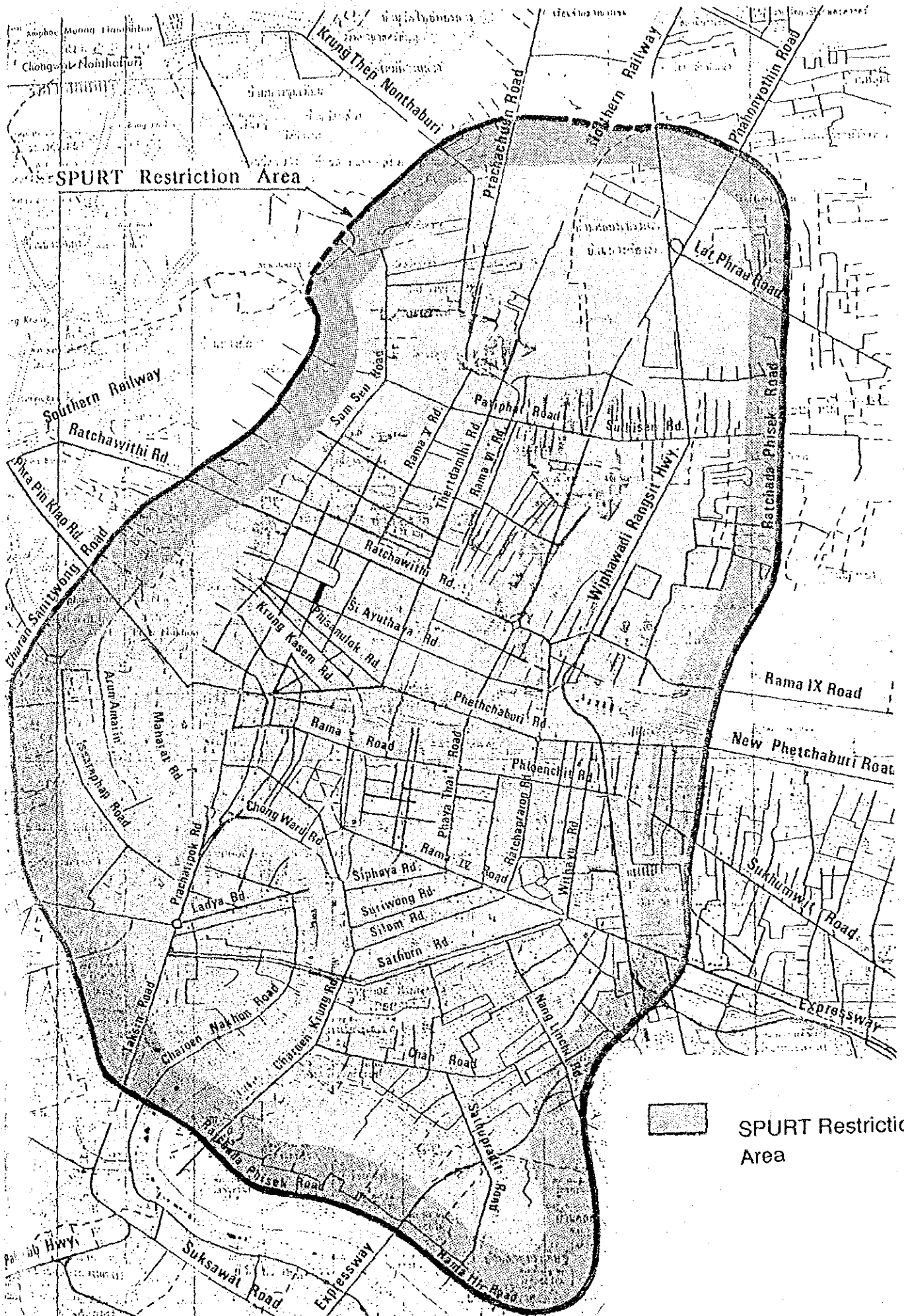


Figure 4.1.5 Whole-day Restriction Area Proposed by SPURT

Table 4.1.1.3 Type of Traffic Restriction to Heavy Truck

| Type of Truck | | Contents of Traffic Restriction | | Characteristics | Evaluation |
|---------------------------------|------------------------------------|--|------------------------|--|--|
| Type | Load | Contents | Time | | |
| 1. Heavy Trucks Heavy Trucks | Bulky Cargo Easy Handling Cargo | Intruding Restriction Intruding Restriction | Rush Hour Rush Hour | Existent Restriction | *not so effective on traffic congestion |
| 2. Heavy Trucks Heavy Trucks | Bulky Cargo Easy Handling Cargo | Intruding Restriction Intruding Restriction | Whole Day Whole Day | LTPC proposal | *impracticable *non-realistic |
| 3. Heavy Trucks Heavy Trucks | Bulky Cargo Easy Handling Cargo | Intruding Restriction Intruding Restriction | Rush Hour Rush Hour | promoting proposal for truck terminal | *recommendable |
| 4. Heavy Trucks Heavy Trucks | Bulky Cargo Easy Handling Cargo | Free of Restriction Free of Restriction | | similar restriction in Japan | *no effect on traffic congestion |
| 5. Heavy Trucks Heavy Trucks | Bulky Cargo Easy Handling Cargo | Intruding Restriction Intruding Restriction | Daytime Daytime | freight trips at night | *unnatural for human activities |

c) Traffic Restriction Proposed by Land Transport Policy Committee (1989)

- (1) This committee has the authority to formulate land and transport policies which are then submitted to the cabinet of the national government for approval. If the proposed policies are approved, the committee or concerned agencies shall administer land transportation policies.
- (2) Policy is proposed by a Land Transport Policy Committee with the Minister of Transport, Communications as chairman, his Deputy Minister as vice-chairman, and Permanent Secretaries of the Ministries as stated in section of Land Transport Act. National Economics and Social Development Board (NESDB), Director Generals of the Budget Bureau, Interior Policy & Planning Department and Department of Highways are also members. The Director General of Department of Land Transport (DLT) is a member, and serves as the committee secretary to the committee (extracted from DLT Sector Paper).

2. Transfer System

Cargo flow and the transportation system in general will improve remarkably with the construction of truck terminals. There are two basic concepts of truck terminal systems. One is a double transfer system, and the other is a single transfer system

The amount of cargo handled within a terminal's "territory" determines whether a double or single transfer system should be used. If cargo volume is large, the single transfer system is more appropriate. Hence, a single transfer system was assumed.

B. Forecast Scenarios

Three scenarios were used according to various heavy-truck restrictions. Those scenarios are as follows:

1. Scenarios 1: Existing restriction
2. Scenarios 2: Restriction proposed by SPURT
3. Scenarios 3: Restriction proposed by LTPC

4.2 Forecast of Commodities Flows

4.2.1 Forecast of Commodity Productions and Attractions

A. GRP Elasticity of Commodities

A trend analysis based on the annual GRP growth rate was used to obtain the elasticity of freight demand with respect to GRP in the Bangkok Metropolitan Area. The inbound and outbound freight demand is prepared by DLT in terms of tonnage, and the GRP in the Bangkok Metropolitan Area is prepared by the NESDB at the 1972 price constant. The results are an average elasticity of 0.763 for inbound flow, and 0.695 for the outbound flow. Details are in Tables 4.2.1 through 4.2.3.

B. Forecast of Inbound and Outbound Cargo Quantities

This forecast takes into account the past patterns by using the demand elasticity of freight volumes with respect to GRP in the BMA. The forecasted GRP growth rate is 12.8% for 1987-1991, 11.4% for 1992-1996, and 8.8% for 1997-2000. These values are used in the following formula to determine future cargo volumes:

$$F_k = F_0 \times (1 + E_k \times G)^n$$

where;

- F_k : Cargo flow in future
- F_0 : Cargo Flow in the base year
- E_k : Elasticity with respect to GRP.
- G : Annual GRP growth rate
- n : Future year minus base year

Forecast figure at the year 2000 is 93.7 million tons for inbound cargoes and 23.9 million tons for outbound cargoes at the BMR (Table 4.2.4 and Figure 4.2.1).

Table 4.2.1 Growth Rate of Gross Regional Product in
BMR/Vicinity at Constant 1972 Prices

| Items | (Unit : 1,000 Baht) | | | | | | | | | |
|---------------------------|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--|
| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | |
| Bangkok Metropolis | 107297828 | 109126526 | 122062094 | 126220243 | 129193902 | 134509643 | 154876858 | 178805100 | 202218704 | |
| Samut Prakan | 12939949 | 13128127 | 13615767 | 14947388 | 14933718 | 16211173 | 19583143 | 24846479 | 28728348 | |
| Pathum Thani | 5924149 | 6051202 | 7892488 | 8749912 | 8712342 | 10034260 | 105663568 | 11286264 | 13395550 | |
| Samut Sakhon | 2820580 | 2642398 | 2950426 | 3216203 | 4612696 | 5820041 | 6726497 | 7068030 | 7720906 | |
| Nakhon Pathom | 4023343 | 4079058 | 4193246 | 4602677 | 5430330 | 5612129 | 5913428 | 6337600 | 6974343 | |
| Nonthaburi | 4452063 | 4615804 | 4880140 | 5339629 | 5454926 | 5840120 | 6616231 | 8784029 | 10656857 | |
| Bangkok/Vicinity | 137457912 | 139643115 | 155494161 | 163078052 | 168337914 | 178027366 | 204279725 | 236927502 | 269696708 | |
| Growth Rate (% p.a.) | | 0.02 | 0.11 | 0.05 | 0.03 | 0.06 | 0.15 | 0.16 | 0.14 | |
| Log(G.R.P.) | 8.14 | 8.15 | 8.19 | 8.21 | 8.23 | 8.25 | 8.31 | 8.37 | 8.43 | |
| Log(GRP(t))-Log(GRP(t-1)) | 0.01 | 0.05 | 0.02 | 0.01 | 0.02 | 0.06 | 0.06 | 0.06 | -0.88 | |

Table 4.2.2 Commodities Flow (1984-1989)

| | | | (Unit : ton/year) | | | | | |
|------------|-----------|------------------------|-------------------|----------|----------|----------|----------|----------|
| Region | Direction | Goods | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
| Central | In | Construction Materials | 3505632 | 3438409 | 3803410 | 4921555 | 8156225 | 6516354 |
| | | Mining Products | 9906 | 9490 | 6708 | 8112 | 10348 | 18746 |
| | | Agricultural Products | 1605604 | 1360320 | 1486719 | 1472026 | 1242364 | 1402178 |
| | | Manufactured Goods | 156468 | 158132 | 152477 | 108317 | 131092 | 141596 |
| | | Total | 5277610 | 4966351 | 5449314 | 6510010 | 9540050 | 8076874 |
| | Out | Construction Materials | 180682 | 160791 | 190359 | 197093 | 117674 | 188162 |
| | | Mining Products | 335361 | 346738 | 410202 | 396227 | 308424 | 470158 |
| | | Agricultural Products | 309582 | 262522 | 298337 | 336557 | 414378 | 387244 |
| | | Manufactured Goods | 380029 | 307658 | 336635 | 257348 | 279474 | 446238 |
| | | Total | 1213654 | 1099709 | 1235533 | 1137225 | 1119950 | 1494602 |
| North | In | Construction Materials | 68198 | 82303 | 66144 | 62335 | 153270 | 140216 |
| | | Mining Products | 93197 | 135486 | 212927 | 161174 | 154336 | 116428 |
| | | Agricultural Products | 2309099 | 2166138 | 2244047 | 1792739 | 1954498 | 1841764 |
| | | Manufactured Goods | 207389 | 212459 | 180544 | 152763 | 181038 | 152022 |
| | | Total | 2677883 | 2596386 | 2703662 | 2169011 | 2443142 | 2250430 |
| | Out | Construction Materials | 168467 | 160082 | 119156 | 124943 | 119782 | 168860 |
| | | Mining Products | 340626 | 453050 | 503360 | 522912 | 546104 | 568958 |
| | | Agricultural Products | 355641 | 326469 | 374374 | 426543 | 489034 | 522976 |
| | | Manufactured Goods | 880009 | 887822 | 891514 | 825942 | 760240 | 1004566 |
| | | Total | 1744743 | 1827423 | 1868406 | 1900340 | 1915160 | 2253460 |
| North-East | In | Construction Materials | 38402 | 32669 | 25909 | 30745 | 47606 | 62036 |
| | | Mining Products | 7267 | 2132 | 6058 | 5395 | 3198 | 2406 |
| | | Agricultural Products | 3020835 | 2855008 | 2866013 | 2543944 | 2448836 | 1746108 |
| | | Manufactured Goods | 185708 | 172535 | 162487 | 147641 | 178438 | 133432 |
| | | Total | 3255213 | 3062345 | 3060467 | 2727725 | 2678078 | 1944982 |
| | Out | Construction Materials | 132847 | 132444 | 153842 | 154167 | 119236 | 129168 |
| | | Mining Products | 423943 | 459838 | 551551 | 566690 | 621712 | 537356 |
| | | Agricultural Products | 2509715 | 576797 | 1484002 | 761644 | 564439 | 618176 |
| | | Manufactured Goods | 108708 | 851682 | 162487 | 780858 | 581863 | 732966 |
| | | Total | 3255213 | 2020759 | 2351882 | 2283359 | 2187250 | 2217366 |
| East | In | Construction Materials | 4036047 | 2714923 | 4033913 | 5024266 | 6868290 | 4371750 |
| | | Mining Products | 258492 | 287417 | 239161 | 270266 | 157144 | 113620 |
| | | Agricultural Products | 1346462 | 1069450 | 1315810 | 1369944 | 1371500 | 1165586 |
| | | Manufactured Goods | 218322 | 227911 | 240563 | 298338 | 286546 | 276566 |
| | | Total | 5861323 | 4299711 | 5829447 | 6963814 | 8683480 | 5927322 |
| | Out | Construction Materials | 157300 | 117629 | 94939 | 172822 | 214266 | 245700 |
| | | Mining Products | 62725 | 83033 | 99437 | 157209 | 181870 | 153678 |
| | | Agricultural Products | 365967 | 531235 | 597675 | 762034 | 793286 | 583752 |
| | | Manufactured Goods | 382278 | 323569 | 337504 | 362492 | 440024 | 613852 |
| | | Total | 998270 | 1055377 | 1179555 | 1454557 | 1629446 | 1601762 |
| South | In | Construction Materials | 34632 | 37635 | 31954 | 38805 | 57278 | 50466 |
| | | Mining Products | 3731 | 2314 | 2340 | 4326 | 3770 | 3224 |
| | | Agricultural Products | 869205 | 865982 | 898365 | 1045260 | 1409920 | 954324 |
| | | Manufactured Goods | 192530 | 286793 | 432237 | 445081 | 418314 | 289374 |
| | | Total | 1100099 | 1192724 | 1364896 | 1533472 | 1689290 | 1266368 |
| | Out | Construction Materials | 45829 | 77561 | 81393 | 116298 | 125242 | 95382 |
| | | Mining Products | 74490 | 102452 | 155402 | 130754 | 130209 | 70524 |
| | | Agricultural Products | 195234 | 250354 | 329537 | 444782 | 605696 | 295450 |
| | | Manufactured Goods | 461448 | 569881 | 648674 | 640848 | 841646 | 634140 |
| | | Total | 781001 | 1000649 | 1215006 | 1332682 | 1702792 | 1095536 |
| West | In | Construction Materials | 9129692 | 10424128 | 10268973 | 12483229 | 12795640 | 16414372 |
| | | Mining Products | 17745 | 46397 | 37570 | 32039 | 47502 | 32552 |
| | | Agricultural Products | 2483702 | 1913709 | 2229045 | 2444534 | 2972560 | 3077698 |
| | | Manufactured Goods | 269620 | 263115 | 284635 | 253162 | 350090 | 398268 |
| | | Total | 11900759 | 12647349 | 12620223 | 15212964 | 16165812 | 19922390 |
| | Out | Construction Materials | 170001 | 136565 | 133143 | 188474 | 247286 | 248820 |
| | | Mining Products | 418899 | 504634 | 549042 | 617526 | 716534 | 622440 |
| | | Agricultural Products | 501124 | 526838 | 605384 | 745862 | 991328 | 692520 |
| | | Manufactured Goods | 461318 | 417163 | 427661 | 446706 | 635076 | 760730 |
| | | Total | 1551342 | 1585220 | 1712230 | 1998568 | 2590224 | 2324920 |

Table 4.2.3 Elasticity of Cargo Flow with Respect to the
G.R.P. in BMR/Vicinity

| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | Average(1985-89) |
|----------------------------|----------|-----------|-----------|-----------|-----------|-----------|------------------|
| Inbound Total | 3007287 | 2876486 | 3122009 | 3511696 | 4109852 | 3942148 | - |
| Outbound Total | 9544223 | 8389737 | 9582612 | 10156731 | 11144822 | 10824866 | - |
| Log(Inbound) | 7.4762 | 7.4589 | 7.4945 | 7.5455 | 7.6170 | 7.5957 | - |
| Log(Outbound) | 6.9797 | 6.9340 | 6.9815 | 7.0068 | 7.0471 | 7.0344 | - |
| Log(ln(t))-Log(ln(t-1)) | -0.0193 | 0.0357 | 0.0510 | 0.0715 | -0.0213 | - | - |
| Log(Out(t))-Log(Out(t-1)) | -0.0453 | 0.0475 | 0.0253 | 0.0403 | -0.0127 | - | - |
| G.R.P. (1000 baht) | 16307052 | 168337914 | 178027366 | 204279725 | 236927502 | 269696708 | - |
| Growth Rate (%) | (1.9%) | (3.2%) | (5.6%) | (14.7%) | (16.0%) | (13.8%) | - |
| Log(G.R.P.) | 8.2124 | 8.2262 | 8.2505 | 8.3102 | 8.3745 | 8.4309 | - |
| Log(GRP(t))-Log(GRP(t-1)) | 0.0138 | 0.0243 | 0.0597 | 0.0644 | 0.0563 | - | - |
| Elasticity (Inbound Flow) | -1.4003 | 1.4681 | 0.8533 | 1.1101 | -0.3780 | - | 0.7634 |
| Elasticity (Outbound Flow) | -3.3160 | 1.9545 | 0.4230 | 0.6262 | -0.2249 | - | 0.6947 |

Table 4.2.4 Forecast of Cargo Flow

(Unit : ton/year)

| Year | Inbound | Outbound | Total |
|------|------------|------------|-------------|
| 1989 | 39,421,486 | 10,824,866 | 50,246,352 |
| 1990 | 43,285,488 | 11,790,450 | 55,075,937 |
| 1991 | 47,528,230 | 12,842,164 | 60,370,393 |
| 1992 | 51,678,888 | 13,862,789 | 65,541,677 |
| 1993 | 56,192,024 | 14,964,529 | 71,156,554 |
| 1994 | 61,099,295 | 16,153,829 | 77,253,124 |
| 1995 | 66,435,119 | 17,437,648 | 83,872,767 |
| 1996 | 72,236,923 | 18,823,498 | 91,060,421 |
| 1997 | 77,089,598 | 19,974,260 | 97,063,858 |
| 1998 | 82,268,262 | 21,195,372 | 103,463,634 |
| 1999 | 87,794,814 | 22,491,137 | 110,285,951 |
| 2000 | 93,692,625 | 23,866,117 | 117,558,742 |

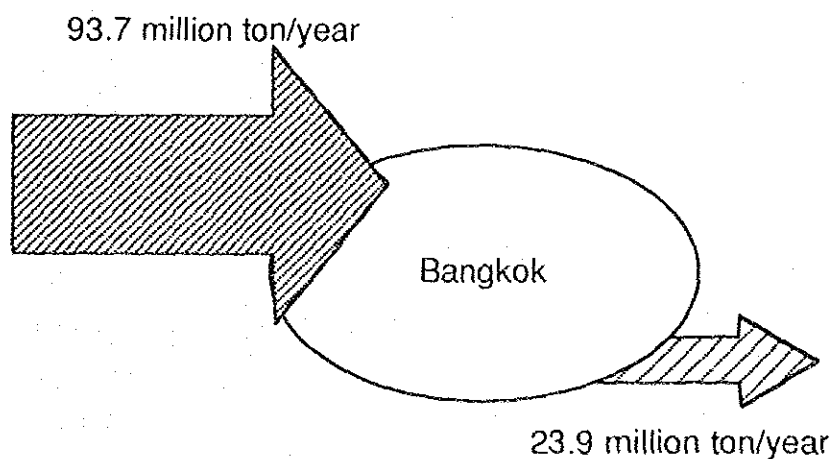


Fig. 4.2.1 Forecast of Freight Volume to and from Bangkok; 2000

4.2.2 Origin and Destination of Commodities

A. Analysis of the Present Conditions

1. Share of Commodity Type

The inbound and outbound cargo volumes by commodity type shown in Table 4.2.5 are based on the O-D results in the DLT survey.

Table 4.2.5 Commodity Shares in Cargo Flow

| | (unit: %) | | | | | |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
| Inbound | | | | | | |
| Construction Materials | 55.9 | 58.2 | 58.4 | 64.2 | 67.8 | 69.9 |
| Mining Products | 1.3 | 1.7 | 1.6 | 1.4 | 0.9 | 0.7 |
| Agricultural Products | 38.7 | 35.6 | 35.4 | 30.4 | 27.5 | 25.8 |
| Manufactured Goods | 4.1 | 4.6 | 4.7 | 4.0 | 3.7 | 3.5 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Outbound | | | | | | |
| Construction Materials | 9.1 | 9.4 | 8.0 | 9.4 | 8.5 | 10.1 |
| Mining Products | 17.4 | 22.7 | 23.7 | 23.7 | 22.5 | 22.4 |
| Agricultural Products | 44.7 | 28.8 | 38.5 | 34.2 | 34.6 | 28.7 |
| Manufactured Goods | 28.9 | 39.1 | 29.8 | 32.6 | 34.4 | 38.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

The commodity type shares shown closely correlate to the survey results in this study. The majority of inbound cargo are construction materials, and the majority of outbound cargo are manufactured goods which are well suited for truck terminal operations. The volume of inbound agriculture and agriculture-related cargo for Bangkok has been stable in recent years although its market share has been decreasing. On the other hand, the freight volume of outbound manufactured goods from Bangkok has risen dramatically. Real annual industrial growth rates prepared by NESDB for the Seventh Five Year Plan (1992-1996) were used as the basis for forecasting commodity type shares. First, the share of each commodity type for the year 2000 was estimated by trend analysis. Then these share were adjusted so that the total of all shares added up to 100%. These

forecasted commodity type shares are shown in Table 4.2.6 and Figure 4.2.2.

Table 4.2.6 Estimated Commodity Shares in Cargo Flow; 2000

| | Growth Rate | | | Shares of Cargo Flow (-2000) |
|------------------------|----------------------|----------------------|-------------|------------------------------|
| | 6th Plan (1987-1991) | 7th Plan (1992-1996) | (1997-2000) | |
| Inbound Total | | | | |
| Construction Materials | 0.187 | 0.094 | 0.072 | 80.7% |
| Mining Products | 0.110 | 0.089 | 0.072 | 0.7% |
| Agricultural Products | 0.035 | 0.034 | 0.034 | 14.8% |
| Manufactured Goods | 0.137 | 0.099 | 0.072 | 3.8% |
| Total | | | | 100.0% |
| Outbound Total | | | | |
| Construction Materials | 0.187 | 0.094 | 0.072 | 12.6% |
| Mining Products | 0.110 | 0.089 | 0.072 | 24.0% |
| Agricultural Products | 0.035 | 0.034 | 0.034 | 17.9% |
| Manufactured Goods | 0.137 | 0.099 | 0.072 | 45.5% |
| Total | | | | 100.0% |

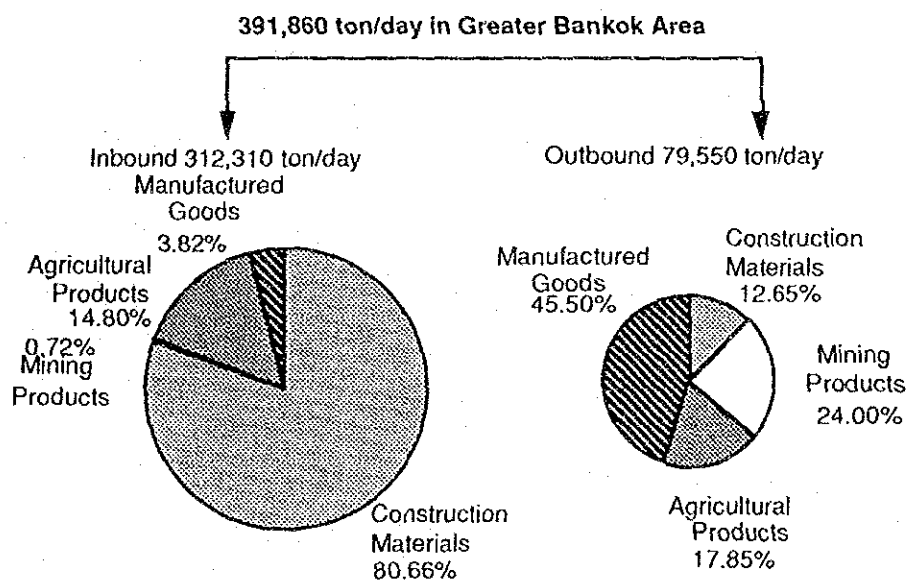


Fig. 4.2.2 Commodity Shares in Cargo Flow; 2000

2. Cargo Volumes between Bangkok and the Outside Region

Existing cargo volumes by commodity type (based on the DLT O-D survey results) between Bangkok and the outside region (external zone) are shown in Table 4.2.7. These existing volumes for each distribution pattern were adjusted to estimate future cargo volumes by commodity type. First, inter-regional inbound and outbound cargo volumes by commodity type were multiplied by the 1989 to the year 2000 regional growth rate calculated in Chapter 3, then the shares were adjusted so that the totals of all shares matched the estimated inter-regional cargo volumes by commodity type (Table 4.2.8).

3. Production and Attraction Cargo Trips by Zone

The ratio of 1989 inbound and outbound freight volumes corresponding to Bangkok's inter-zonal generation and attraction cargo trips (based on JICA's 1989 SMIR study results) are shown in Tables 4.2.9 through 4.2.11 and also show in Figures 4.2.3 and 4.2.4. It was assumed that the composition ratio for each zone was representative of the production and attraction freight trips. Therefore, this composition ratio was used.

B. Origin and Destination of Commodities

Estimated future cargo O-D matrices by commodities type are shown in Tables 4.2.12 through 4.2.16.

4.3 Future Demand for Each Truck Terminal

4.3.1 Cargo Volume Handled at Each Truck Terminal

A. Coefficients for the Truck Terminal Utilization

1. Use ratio of Truck Terminals

The sources of information for determining commodity suitability for a given truck terminal are based on the 1980 JICA study results, statistical data of Japanese truck terminals, and results of the heavy-

Figure 4.2.3 Zonal Share of Cargo Flow (Manufactured Goods)

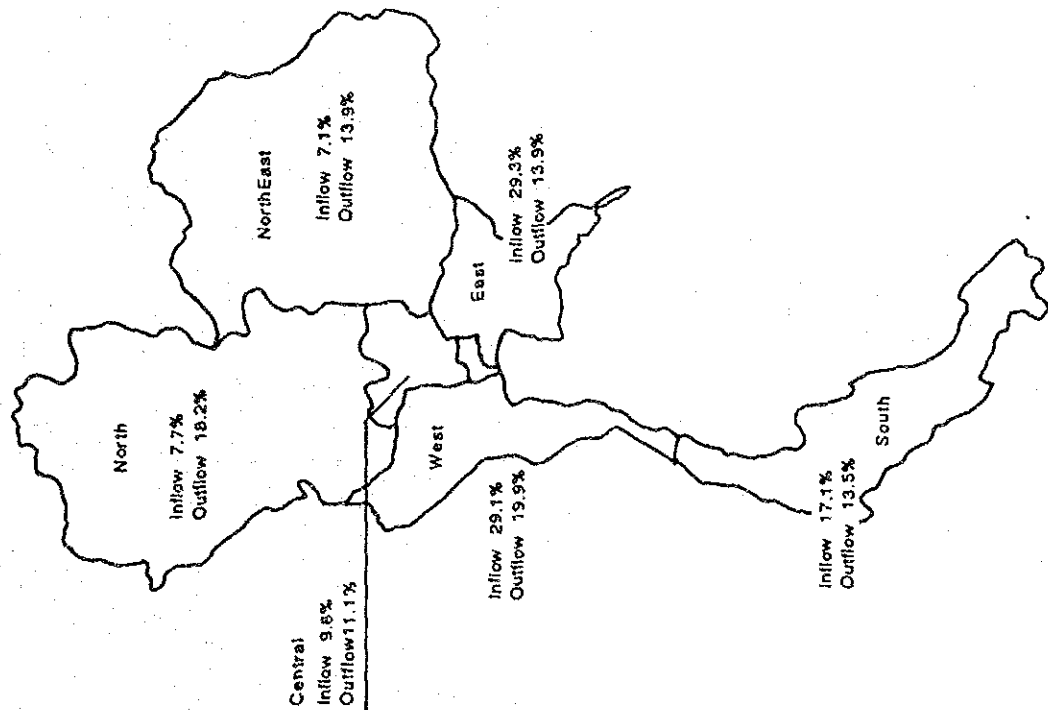


Figure 4.2.4 Zonal Share of Cargo Flow

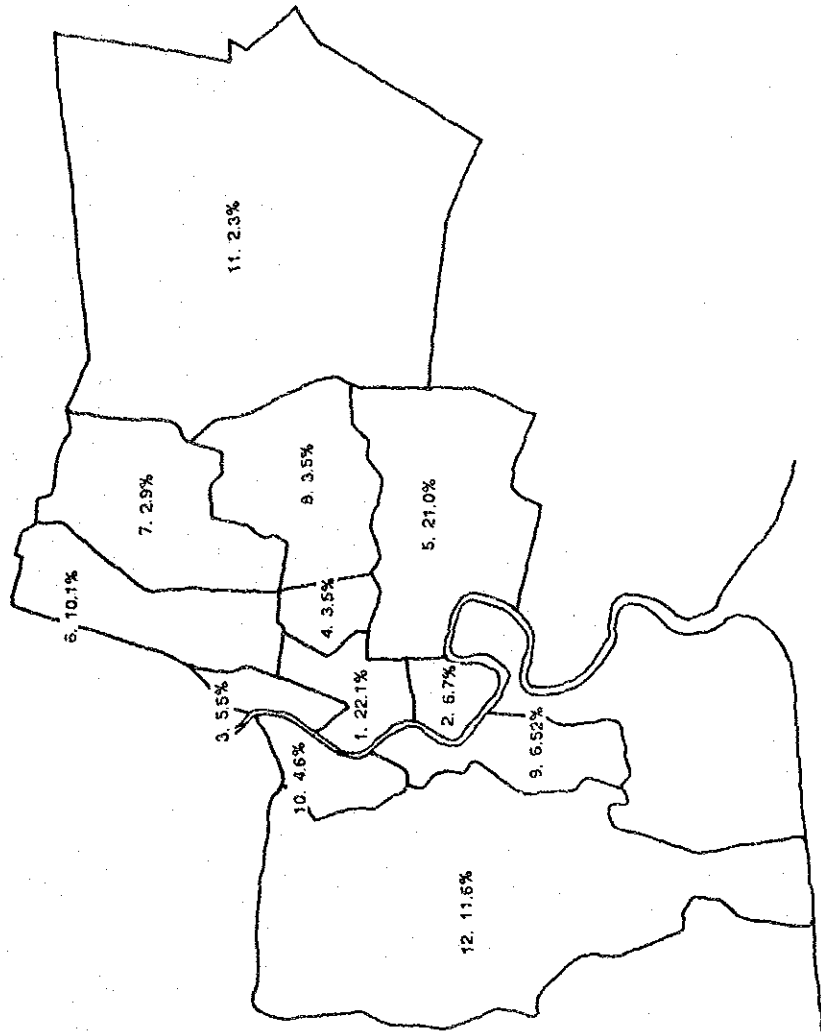


Table 4.2.7

Inter-regional Shares of Cargo Flow by
Commodities and Direction

| Goods | Direction | Region | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|-----------|------------|--------|--------|--------|--------|--------|--------|
| Construction Materials | Inbound | Central | 20.8% | 20.6% | 20.9% | 21.8% | 29.0% | 23.8% |
| | | North | 0.4% | 0.5% | 0.4% | 0.3% | 0.5% | 0.5% |
| | | North-East | 0.2% | 0.2% | 0.1% | 0.1% | 0.2% | 0.2% |
| | | East | 24.0% | 16.2% | 22.1% | 22.3% | 24.5% | 15.9% |
| | | South | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| | | West | 54.3% | 62.3% | 56.3% | 55.3% | 45.6% | 59.6% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| | Outbound | Central | 21.8% | 22.4% | 24.7% | 20.7% | 12.5% | 17.2% |
| | | North | 19.4% | 19.9% | 15.5% | 13.1% | 12.7% | 17.1% |
| | | North-East | 15.3% | 16.4% | 20.0% | 16.2% | 12.6% | 11.6% |
| | | East | 18.1% | 14.6% | 12.3% | 18.1% | 22.7% | 22.5% |
| | | South | 5.7% | 9.7% | 10.6% | 12.2% | 13.3% | 8.7% |
| | | West | 19.6% | 17.0% | 16.9% | 19.6% | 26.2% | 22.7% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Mining Products | Inbound | Central | 2.5% | 2.0% | 1.3% | 1.7% | 2.7% | 6.5% |
| | | North | 23.9% | 28.0% | 42.2% | 33.5% | 41.0% | 40.4% |
| | | North-East | 1.9% | 0.4% | 1.2% | 1.1% | 0.8% | 1.2% |
| | | East | 66.2% | 59.5% | 47.4% | 56.2% | 41.8% | 39.5% |
| | | South | 1.0% | 0.5% | 0.5% | 0.9% | 1.0% | 1.1% |
| | | West | 4.5% | 9.6% | 7.4% | 6.7% | 12.6% | 11.3% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| | Outbound | Central | 2.5% | 2.0% | 1.3% | 1.7% | 2.7% | 6.5% |
| | | North | 23.9% | 28.0% | 42.2% | 33.5% | 41.0% | 40.4% |
| | | North-East | 1.9% | 0.4% | 1.2% | 1.1% | 0.8% | 1.2% |
| | | East | 66.2% | 59.5% | 47.4% | 56.2% | 41.8% | 39.5% |
| | | South | 1.0% | 0.5% | 0.5% | 0.9% | 1.0% | 1.1% |
| | | West | 4.5% | 9.6% | 7.4% | 6.7% | 12.6% | 11.3% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Agricultural, fishery, and Forestry Products | Inbound | Central | 13.6% | 13.3% | 13.5% | 13.6% | 10.9% | 13.7% |
| | | North | 19.5% | 21.2% | 20.3% | 16.8% | 17.1% | 18.1% |
| | | North-East | 26.0% | 27.9% | 26.0% | 23.6% | 21.5% | 17.1% |
| | | East | 11.6% | 10.5% | 11.9% | 12.6% | 12.0% | 11.4% |
| | | South | 7.5% | 8.5% | 8.1% | 9.8% | 12.4% | 9.4% |
| | | West | 21.3% | 18.7% | 20.2% | 22.9% | 26.1% | 30.2% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| | Outbound | Central | 7.3% | 10.6% | 8.1% | 9.7% | 10.7% | 12.4% |
| | | North | 8.3% | 13.2% | 10.1% | 12.3% | 12.7% | 17.1% |
| | | North-East | 50.6% | 23.3% | 40.2% | 21.9% | 14.6% | 19.9% |
| | | East | 9.3% | 21.5% | 16.2% | 21.9% | 20.6% | 18.6% |
| | | South | 4.6% | 10.1% | 8.9% | 12.6% | 15.7% | 9.5% |
| | | West | 11.7% | 21.3% | 16.4% | 21.4% | 25.7% | 22.3% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Manufactured Goods | Inbound | Central | 12.7% | 12.0% | 10.5% | 7.7% | 8.5% | 10.2% |
| | | North | 16.8% | 16.1% | 12.4% | 10.9% | 11.7% | 10.9% |
| | | North-East | 15.3% | 13.1% | 11.2% | 10.5% | 11.5% | 9.6% |
| | | East | 17.7% | 17.3% | 16.6% | 21.3% | 18.5% | 19.9% |
| | | South | 15.6% | 21.7% | 23.7% | 31.6% | 27.1% | 20.3% |
| | | West | 21.5% | 15.9% | 19.6% | 18.6% | 22.7% | 23.6% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| | Outbound | Central | 13.8% | 9.2% | 11.8% | 7.6% | 7.3% | 10.6% |
| | | North | 32.0% | 26.4% | 31.2% | 24.9% | 19.8% | 24.0% |
| | | North-East | 6.9% | 25.4% | 5.7% | 23.6% | 23.0% | 17.5% |
| | | East | 13.5% | 9.6% | 13.6% | 10.8% | 11.5% | 14.6% |
| | | South | 16.6% | 17.0% | 22.7% | 19.3% | 21.0% | 15.1% |
| | | West | 16.6% | 12.4% | 15.0% | 13.5% | 16.5% | 18.1% |
| | | Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

Table 4.2.8

Estimated Inter-regional Shares of Cargo Flow
by Commodities and Direction of 2000

| Commodity | Direction | Region | Cargo Flow 2000 ton/year | Share of Cargo Flow in 2000 | Share of Cargo Flow in 1989 |
|---------------------------|------------|------------|--------------------------------|-----------------------------------|-----------------------------------|
| Construction Materials | Inbound | Central | 16028137 | 21.2% | 23.6% |
| | | North | 251652 | 0.3% | 0.5% |
| | | North-East | 116647 | 0.2% | 0.2% |
| | | East | 16470899 | 21.8% | 15.9% |
| | | South | 106097 | 0.1% | 0.2% |
| | | West | 42594941 | 56.4% | 59.6% |
| | | Total | 75568374 | 100.0% | 100.0% |
| | Outbound | Central | 496737 | 16.5% | 17.2% |
| | | North | 359944 | 11.9% | 17.1% |
| | | North-East | 260677 | 8.6% | 11.8% |
| | | East | 993536 | 32.9% | 22.5% |
| | | South | 214546 | 7.1% | 8.7% |
| | | West | 693004 | 23.0% | 22.7% |
| | | | Total | 3018444 | 100.0% |
| Mining Products | | Inbound | Central | 39860 | 5.9% |
| | North | | 180640 | 26.8% | 40.4% |
| | North-East | | 5536 | 0.8% | 1.2% |
| | East | | 370059 | 54.8% | 39.5% |
| | South | | 5859 | 0.9% | 1.1% |
| | West | | 73024 | 10.8% | 11.3% |
| | | Total | 674979 | 100.0% | 100.0% |
| | Outbound | Central | 338194 | 5.9% | 6.5% |
| | | North | 1532634 | 26.8% | 40.4% |
| | | North-East | 46974 | 0.8% | 1.2% |
| | | East | 3139751 | 54.8% | 39.5% |
| | | South | 49714 | 0.9% | 1.1% |
| | | West | 619569 | 10.8% | 11.3% |
| | | | Total | 5726837 | 100.0% |
| Agricultural Products | | Inbound | Central | 1955636 | 14.1% |
| | North | | 1876994 | 13.5% | 18.1% |
| | North-East | | 1864356 | 13.4% | 17.1% |
| | East | | 2494276 | 18.0% | 11.4% |
| | South | | 1139660 | 8.2% | 9.4% |
| | West | | 4535092 | 32.7% | 30.2% |
| | | Total | 13856222 | 100.0% | 100.0% |
| | Outbound | Central | 527737 | 12.4% | 12.4% |
| | | North | 523986 | 12.4% | 17.1% |
| | | North-East | 644017 | 15.1% | 19.9% |
| | | East | 1218553 | 28.6% | 18.8% |
| | | South | 344193 | 8.1% | 9.5% |
| | | West | 996227 | 23.4% | 22.3% |
| | | | Total | 4260713 | 100.0% |
| Manufactured Products | | Inbound | Central | 350903 | 9.8% |
| | North | | 274816 | 7.7% | 10.9% |
| | North-East | | 252712 | 7.1% | 9.6% |
| | East | | 1049909 | 29.3% | 19.9% |
| | South | | 613829 | 17.1% | 20.8% |
| | West | | 1040931 | 29.1% | 28.6% |
| | | Total | 3583050 | 100.0% | 100.0% |
| | Outbound | Central | 1204263 | 11.1% | 10.6% |
| | | North | 1978539 | 16.2% | 24.0% |
| | | North-East | 1512139 | 13.9% | 17.5% |
| | | East | 2536649 | 23.4% | 14.6% |
| | | South | 1462737 | 13.5% | 15.1% |
| | | West | 2165996 | 19.9% | 18.1% |
| | | | Total | 10860123 | 100.0% |
| Total | | Inbound | Central | 18374437 | 19.6% |
| | North | | 2584103 | 2.8% | 3.7% |
| | North-East | | 2239252 | 2.4% | 3.0% |
| | East | | 20385142 | 21.8% | 15.6% |
| | South | | 1685654 | 2.0% | 2.3% |
| | West | | 48244039 | 51.5% | 53.8% |
| | | Total | 93692625 | 100.0% | 100.0% |
| | Outbound | Central | 2566930 | 10.8% | 10.8% |
| | | North | 4409903 | 18.4% | 25.7% |
| | | North-East | 2463807 | 10.3% | 13.4% |
| | | East | 7888490 | 33.1% | 22.0% |
| | | South | 2071189 | 8.7% | 10.1% |
| | | West | 4474797 | 18.7% | 17.9% |
| | | | Total | 23866117 | 100.0% |

Table 4.2.9 Zonal Shares of Generation and Attraction
Freight Trips in Each Restriction Area

| Zone | (unit: %) | | | | | | | | | | | | |
|------------|-----------|-----|-----|-----|------|------|-----|-----|-----|-----|-----|------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Generation | 21.5 | 6.6 | 5.7 | 3.5 | 21.2 | 10.3 | 2.9 | 3.4 | 6.1 | 4.9 | 2.7 | 11.3 | 100.0 |
| Attraction | 22.5 | 6.7 | 5.2 | 3.4 | 20.9 | 9.9 | 3.0 | 3.6 | 7.0 | 4.3 | 1.8 | 11.8 | 100.0 |
| Total | 22.0 | 6.7 | 5.5 | 3.4 | 21.0 | 10.1 | 2.9 | 3.5 | 6.5 | 4.6 | 2.3 | 11.6 | 100.0 |

Table 4.2.10 Zonal Shares of Generation and Attraction
Freight Trips in Each Restriction Area
(Case 2)

| Zone | | | | | | | | | | | | | |
|-------------------------|-------|------|------|------|-------|-------|------|------|------|------|------|-------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Restriction Area | 22.0% | 6.7% | 5.0% | 2.3% | 5.6% | 3.7% | 0.0% | 0.0% | 3.2% | 2.3% | 0.0% | 0.0% | 50.7% |
| Out of Restriction Area | 0.0% | 0.0% | 0.5% | 1.2% | 15.4% | 6.4% | 2.9% | 3.5% | 3.4% | 2.3% | 2.3% | 11.6% | 49.3% |
| Total | 22.0% | 6.7% | 5.5% | 3.4% | 21.0% | 10.1% | 2.9% | 3.5% | 6.5% | 4.6% | 2.3% | 11.6% | 100.0% |

Table 4.2.11 Zonal Shares of Generation and Attraction
Freight Trips in Each Restriction Area
(Case 3)

| Zone | | | | | | | | | | | | | |
|-------------------------|-------|------|------|------|-------|-------|------|------|------|------|------|-------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Restriction Area | 22.0% | 6.7% | 5.5% | 3.4% | 21.0% | 10.1% | 2.9% | 3.5% | 6.5% | 4.6% | 0.0% | 8.9% | 95.0% |
| Out of Restriction Area | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 2.3% | 2.7% | 5.0% |
| Total | 22.0% | 6.7% | 5.5% | 3.4% | 21.0% | 10.1% | 2.9% | 3.5% | 6.5% | 4.6% | 2.3% | 11.6% | 100.0% |

Table 4.2.12 Cargo O-D Matrix of 2000 (Construction Materials)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | | |
|------------------------|------------|-----------|-----------------|---------|----------|---------|----------|---------|---------|---------|---------|---------|----------|---------|----------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Construction Materials | Central | Inbound | 22.01% | 5.65% | 5.45% | 3.45% | 21.03% | 10.08% | 2.91% | 3.48% | 6.52% | 4.58% | 2.26% | 11.56% | 100.00% |
| | | Outbound | 3527013 | 1068131 | 874823 | 552615 | 5370474 | 1615811 | 466079 | 558209 | 1045675 | 734325 | 362268 | 1852716 | 16028137 |
| | | Total | 109358 | 33103 | 27112 | 17126 | 104456 | 50077 | 14445 | 17300 | 32407 | 22758 | 11227 | 57419 | 496737 |
| | | Total | 3636321 | 1101234 | 901935 | 569741 | 3474931 | 1665887 | 480523 | 578508 | 1078082 | 757083 | 373495 | 1910735 | 16524875 |
| | North | Inbound | 55376 | 16770 | 13735 | 8676 | 52919 | 25369 | 7318 | 8764 | 18418 | 11529 | 5688 | 29089 | 251652 |
| | | Outbound | 75206 | 23987 | 19645 | 12410 | 75591 | 38286 | 10467 | 12536 | 23483 | 16491 | 8135 | 41607 | 359944 |
| | | Total | 134583 | 40757 | 33381 | 21086 | 128609 | 61656 | 17784 | 21300 | 39900 | 28020 | 13823 | 70895 | 611596 |
| | | Total | 25638 | 7774 | 6367 | 4022 | 24529 | 11759 | 3392 | 4062 | 7610 | 5344 | 2636 | 13483 | 116547 |
| | North-East | Inbound | 57362 | 17372 | 14228 | 8988 | 54816 | 28279 | 7590 | 9079 | 17007 | 11943 | 8892 | 30132 | 260877 |
| | | Outbound | 63031 | 25145 | 20595 | 13009 | 79346 | 38038 | 10972 | 13141 | 24617 | 17287 | 8528 | 43616 | 377925 |
| | | Total | 120393 | 42517 | 34823 | 21997 | 134202 | 66317 | 18567 | 23217 | 41724 | 35224 | 17420 | 73748 | 644802 |
| | | Total | 3624443 | 1097637 | 898939 | 567860 | 3463580 | 1660446 | 478954 | 573629 | 1074560 | 754610 | 372275 | 1903896 | 16470959 |
| | East | Inbound | 218628 | 66210 | 54228 | 34255 | 288926 | 100159 | 28891 | 34602 | 54818 | 45519 | 22456 | 114844 | 993536 |
| | | Outbound | 3843072 | 1163848 | 953217 | 602135 | 3672506 | 1760605 | 507844 | 608230 | 1139378 | 800128 | 394731 | 2018740 | 17464435 |
| | | Total | 4039700 | 1230658 | 1001545 | 904270 | 5538812 | 2421211 | 796733 | 1155032 | 1752604 | 1645838 | 619207 | 2127580 | 18230871 |
| | | Total | 23347 | 7070 | 5791 | 3658 | 22311 | 10696 | 3085 | 3695 | 6922 | 4861 | 2398 | 12264 | 106097 |
| | South | Inbound | 47211 | 14298 | 11710 | 7397 | 45116 | 21629 | 6239 | 7472 | 13997 | 9829 | 4849 | 24800 | 214546 |
| | | Outbound | 70558 | 21568 | 17501 | 11055 | 67426 | 32324 | 9324 | 11167 | 20919 | 14690 | 7247 | 37064 | 320843 |
| | | Total | 117769 | 35866 | 29211 | 18110 | 112542 | 63953 | 18653 | 18641 | 31916 | 25609 | 12096 | 61964 | 535489 |
| | | Total | 9373073 | 2838570 | 2324851 | 1488580 | 8957070 | 4294034 | 1238609 | 1483445 | 2778891 | 1951476 | 962731 | 4923812 | 42594941 |
| | West | Inbound | 152495 | 46182 | 37824 | 23893 | 145728 | 69862 | 20152 | 24135 | 45212 | 31750 | 15663 | 80105 | 693004 |
| | | Outbound | 9525539 | 2884752 | 2362675 | 1482473 | 9102798 | 4363896 | 1258761 | 1507580 | 2824102 | 1983225 | 978394 | 5003718 | 43287845 |
| | | Total | 9678034 | 3346634 | 2741500 | 1621366 | 10060026 | 4800792 | 1466637 | 1755368 | 3309702 | 2081327 | 1034944 | 5504433 | 47617849 |
| | | Total | 664213 | 201152 | 164748 | 104069 | 634733 | 304232 | 87773 | 105123 | 196923 | 138289 | 68223 | 348906 | 3018444 |
| Total | 17293133 | 5237105 | 4289304 | 2709501 | 16575616 | 7923405 | 2285209 | 2736927 | 5126008 | 3600434 | 1776219 | 9889367 | 78586818 | | |

(Unit : ton/year)

Table 4.2.13 Cargo O-D Matrix of 2000 (Mining Products)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | | |
|-----------------|------------|-----------|-----------------|--------|--------|--------|---------|---------|--------|--------|--------|--------|--------|---------|----------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Mining Products | Central | Inbound | 22.01% | 6.65% | 5.45% | 3.45% | 21.03% | 10.08% | 2.91% | 3.48% | 6.52% | 4.58% | 2.26% | 11.56% | 100.00% |
| | | Outbound | 8771 | 2656 | 2176 | 1374 | 8382 | 4018 | 1159 | 1388 | 2600 | 1826 | 901 | 4608 | 39660 |
| | | Total | 74420 | 28938 | 18459 | 11660 | 71117 | 34094 | 9834 | 11778 | 22064 | 15494 | 7644 | 39092 | 328194 |
| | | Total | 83191 | 25194 | 20634 | 13034 | 79499 | 38112 | 10993 | 13166 | 24864 | 17320 | 8545 | 43700 | 378084 |
| | North | Inbound | 39750 | 12038 | 9850 | 6228 | 37986 | 18210 | 5253 | 6291 | 11765 | 8276 | 4083 | 20800 | 180640 |
| | | Outbound | 337258 | 102136 | 83652 | 53842 | 322290 | 154506 | 44567 | 53377 | 99989 | 70217 | 34641 | 177159 | 1532634 |
| | | Total | 377008 | 114174 | 93511 | 59070 | 360276 | 172717 | 49320 | 59668 | 111774 | 78493 | 38723 | 198030 | 1713274 |
| | | Total | 1218 | 369 | 302 | 191 | 1164 | 558 | 161 | 193 | 361 | 254 | 125 | 640 | 5536 |
| | North-East | Inbound | 10337 | 3130 | 2564 | 1620 | 9878 | 4735 | 1366 | 1636 | 3065 | 2152 | 1062 | 5430 | 46974 |
| | | Outbound | 11555 | 3499 | 2866 | 1810 | 11042 | 5294 | 1629 | 1829 | 3426 | 2406 | 1187 | 6070 | 52510 |
| | | Total | 81432 | 24661 | 20198 | 12759 | 77818 | 37306 | 10761 | 12388 | 24143 | 16954 | 8364 | 42776 | 370039 |
| | | Total | 680906 | 203236 | 171369 | 108252 | 660242 | 316321 | 91300 | 109347 | 204837 | 143847 | 70955 | 362929 | 3139751 |
| | South | Inbound | 772338 | 230897 | 191567 | 121011 | 738060 | 353827 | 102661 | 122235 | 228960 | 160801 | 79329 | 405704 | 3509810 |
| | | Outbound | 1289 | 390 | 320 | 202 | 1232 | 591 | 170 | 204 | 382 | 268 | 132 | 577 | 5859 |
| | | Total | 10940 | 3313 | 2713 | 1714 | 10454 | 5012 | 1446 | 1731 | 3243 | 2278 | 1124 | 5747 | 49714 |
| | | Total | 12229 | 3703 | 3033 | 1916 | 11686 | 5502 | 1618 | 1935 | 3626 | 2546 | 1266 | 6424 | 55573 |
| | West | Inbound | 16060 | 4966 | 2518 | 15356 | 7362 | 2123 | 2543 | 4764 | 3346 | 1650 | 841 | 75024 | 619569 |
| | | Outbound | 135337 | 41289 | 33816 | 21301 | 130286 | 62459 | 18016 | 21578 | 40421 | 28385 | 14004 | 71617 | 619569 |
| | | Total | 152406 | 46155 | 37802 | 23879 | 148542 | 69821 | 20140 | 24121 | 45185 | 31791 | 15654 | 80058 | 692593 |
| | | Total | 148500 | 44981 | 36641 | 23272 | 141938 | 68045 | 19628 | 24056 | 30324 | 15256 | 78022 | 674979 | 574979 |
| | Total | Inbound | 1260198 | 381642 | 312570 | 197449 | 1204267 | 577927 | 166529 | 199447 | 373618 | 262373 | 129438 | 661974 | 5766637 |
| | | Outbound | 1408782 | 426623 | 349414 | 220721 | 1346395 | 645373 | 186157 | 222955 | 417854 | 293297 | 144654 | 730995 | 6401815 |
| | | Total | 2668980 | 808265 | 661984 | 418170 | 2550662 | 1223300 | 352686 | 422402 | 791572 | 561670 | 274092 | 1392969 | 12168452 |
| | | Total | 148500 | 44981 | 36641 | 23272 | 141938 | 68045 | 19628 | 24056 | 30324 | 15256 | 78022 | 674979 | 574979 |

Table 4.2.16 Cargo O-D Matrix of 2000 (Total)

(Unit : ton/year)

| Commodity | Region | Direction | Zone in District | | | | | | | | | | | | |
|------------|----------|-----------|------------------|---------|---------|---------|----------|----------|---------|---------|---------|---------|---------|----------|-----------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| | | | 22.01% | 6.89% | 5.46% | 3.45% | 21.93% | 10.08% | 2.31% | 3.49% | 6.52% | 4.58% | 2.28% | 11.56% | 100.00% |
| Total | Inbound | | 4043319 | 1224491 | 1002885 | 603510 | 305385 | 1822343 | 53406 | 639923 | 1198747 | 841820 | 415299 | 2123928 | 13374437 |
| | Outbound | | 564856 | 171063 | 140104 | 80502 | 599787 | 258775 | 74643 | 89398 | 167466 | 117603 | 58018 | 296715 | 2566930 |
| | Total | | 4608175 | 1395554 | 1142989 | 722012 | 440302 | 2111118 | 608949 | 793021 | 1366213 | 959423 | 191783 | 473317 | 2420644 |
| North | Inbound | | 568635 | 172207 | 141041 | 99094 | 543398 | 260506 | 75143 | 89996 | 168587 | 118390 | 58406 | 298700 | 2584103 |
| | Outbound | | 968425 | 293281 | 240203 | 151733 | 925443 | 443559 | 127973 | 153269 | 287115 | 201626 | 99469 | 508707 | 4400903 |
| | Total | | 1537060 | 465488 | 381245 | 240828 | 146841 | 704165 | 203115 | 243265 | 455701 | 320016 | 157875 | 807407 | 6985006 |
| North-East | Inbound | | 492750 | 149226 | 122413 | 77204 | 470881 | 225741 | 55115 | 77986 | 146089 | 102591 | 50612 | 258838 | 2239252 |
| | Outbound | | 542164 | 164191 | 134476 | 84947 | 518101 | 248379 | 71644 | 85806 | 160739 | 112879 | 55687 | 284795 | 2463807 |
| | Total | | 1034914 | 313417 | 256895 | 162151 | 989282 | 474119 | 136759 | 136759 | 306827 | 215469 | 106299 | 543534 | 4703059 |
| East | Inbound | | 448577 | 1358406 | 1112630 | 702835 | 426686 | 2055044 | 592775 | 703949 | 1329925 | 933940 | 460745 | 2356349 | 20385142 |
| | Outbound | | 1735879 | 525697 | 430557 | 271978 | 1648840 | 795246 | 229308 | 274731 | 514645 | 361409 | 178256 | 911842 | 7888490 |
| | Total | | 6221650 | 1884183 | 1543187 | 974813 | 5925516 | 2850290 | 822163 | 984680 | 1844570 | 1295349 | 639041 | 3268191 | 28273632 |
| South | Inbound | | 410540 | 124329 | 101828 | 64324 | 392319 | 193073 | 54251 | 64975 | 121715 | 85474 | 42168 | 215654 | 1865654 |
| | Outbound | | 455768 | 130026 | 113066 | 71410 | 435540 | 202738 | 60288 | 72193 | 185124 | 94891 | 46813 | 239412 | 2071189 |
| | Total | | 866308 | 254355 | 214894 | 135734 | 827858 | 396811 | 114479 | 137108 | 256839 | 180365 | 89981 | 455066 | 3936843 |
| West | Inbound | | 10616164 | 3215031 | 2630181 | 1663348 | 10144980 | 4863524 | 1402878 | 1580165 | 3147438 | 2210288 | 1050412 | 5578600 | 48244039 |
| | Outbound | | 984685 | 298205 | 244236 | 154281 | 940982 | 451108 | 130122 | 155843 | 291935 | 205012 | 101139 | 517248 | 4474797 |
| | Total | | 11600849 | 3513236 | 2872418 | 1817630 | 11055972 | 5314632 | 1522999 | 1838008 | 3439373 | 2415299 | 1191551 | 6093843 | 52718835 |
| Total | Inbound | | 20517186 | 6243771 | 5113785 | 3200116 | 19702108 | 9445236 | 2724487 | 3283013 | 6112500 | 4292502 | 2117641 | 10833069 | 93692625 |
| | Outbound | | 92511770 | 1500462 | 1302823 | 822851 | 5018662 | 2405964 | 693996 | 831180 | 1557024 | 1093420 | 539422 | 2758720 | 23866117 |
| | Total | | 25568956 | 7014233 | 6416409 | 4053167 | 24720921 | 11851200 | 3418465 | 4094194 | 7669524 | 5085022 | 2657063 | 13589789 | 117559742 |

truck driver interview surveys and corporation interviews conducted during the course of this study. The use ratio of public truck terminals in the Tokyo metropolis is shown in Table 4.3.1.

Table 4.3.1 Use Ratio of Public Truck Terminal in Tokyo Metropolis; 1989

| Commodity | Cargo Volume handled at Public Truck Terminal (ton/day) | Cargo Volume handled at Tokyo Metropolis by Truck (ton/day) | Use Ratio of Public Truck Terminal |
|-------------------------|---|---|------------------------------------|
| Miscellaneous | 14,606 | 61,000 | 0.239 |
| Manufactured Goods | | | |
| - Daily necessities | 7,320 | | |
| - Miscellaneous Goods | 4,090 | | |
| - Textile Goods | 3,196 | | |
| Light Industry Products | 4,708 | 82,000 | 0.057 |
| Chemical Products | 3,540 | 74,000 | 0.048 |
| Others | 11,514 | 412,000 | 0.028 |
| Total | 34,368 | 629,000 | 0.055 |

a) Construction Materials :

Based on the O-D survey results conducted in this study the detailed construction materials are sand, laterite, stone, gravel, soil, piling, steel, cement, brick, rock, tile, etc. Among those commodities some kinds of steel and cement products are considered to be suitable for the truck terminal.

b) Mining Products :

Not suitable

c) Agricultural, Forestry, Fishery and Relevant Products :

Some of foodstuffs like processed food and beverages are suitable for truck terminal. Also, jute products and charcoal will make a use of the truck terminals.

d) Manufactured Goods :

Manufactured goods are usually considered suitable for truck terminal because they consist of packaged types of cargo. Using the same ratio as in Tokyo Metropolis, the use ratio of truck terminals for manufactured goods was determined.

2. Considerations of Traffic Restriction for Heavy Trucks

The time of freight trips of heavy-trucks are adjusted spontaneously under the existent periodic restriction for heavy-trucks by a consignee and a driver. In the case of existent restriction, above coefficients were adopted as the use ratio of truck terminals. In the case of whole day restriction, the accurate use ratio of truck terminals is difficult to obtain because the appropriate data is not available. The data corporation interview surveys is used to substitute the data necessary to determine the use ratio of truck terminal (Table 4.3.2 and Figures 4.3.1 through 4.3.3. Even though the interview gives the use ratio, it is unreasonable to consider that all heavy-trucks make use of truck terminals. Therefore, some exceptions out of suitable commodities for truck terminals such as steel, cement product and fertilizer are determined. Manufactured goods are suitable commodities for the use of the truck terminals. Cargoes for Manufactured goods make 100% use of the truck terminals.

Figure 4.3.1 Forecast Cases and Application of Ratio for Usage of Truck Terminal

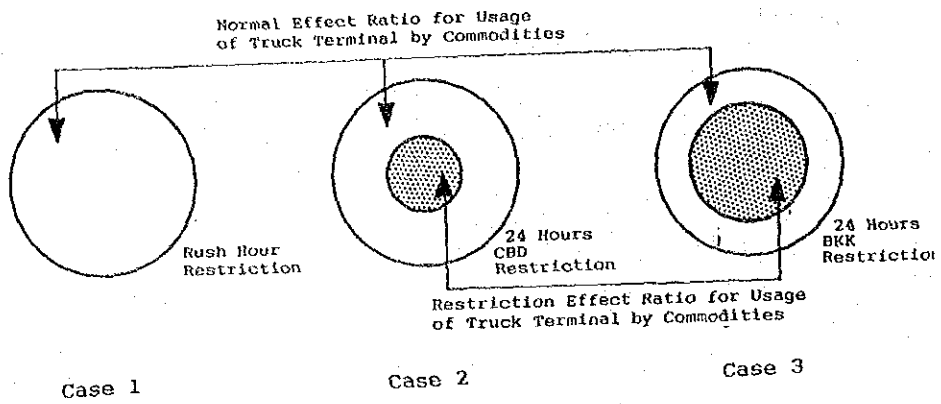


Figure 4.3.2 Use Ratio of Public Truck Terminal (24-Hour Restriction Area Case 2-b, 3-b)

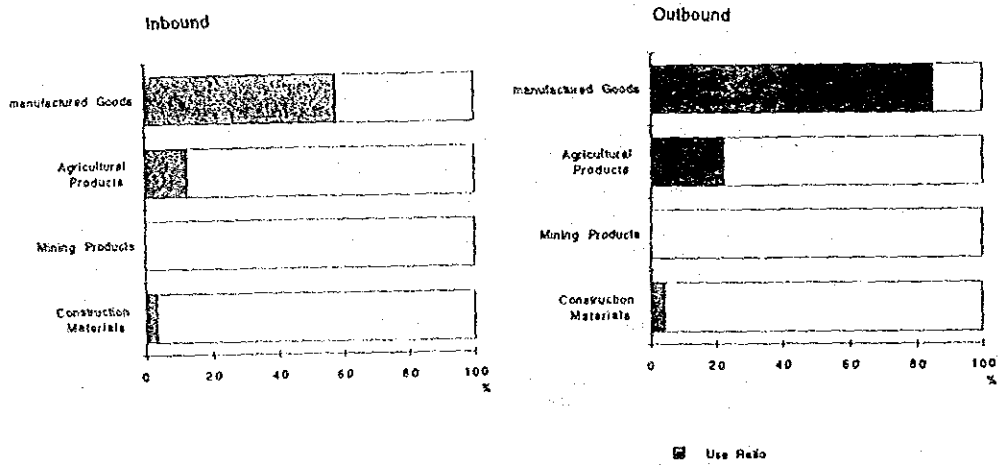


Figure 4.3.3 Use Ratio of Public Truck Terminal for Existing Restriction Area

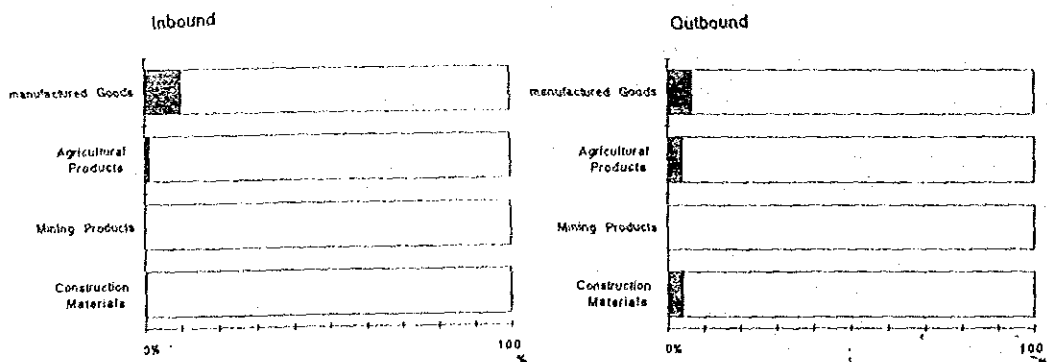


Table 4.3.2 Forecast Cases

| Forecast Case | Restriction | Use Ratio of Truck Terminal |
|---------------|-------------------------------|---|
| 1 | Existing Restriction | Use Ratio of 2.8% to All, Others |
| 2-a | Restriction Proposed by SPURT | Use Ratio of 100% to All, Others in 24 hours Restriction Area |
| 2-b | Restriction Proposed by SPURT | Use Ratio of 2.8% to All, Others in 24 hours Restriction Area |
| 3-a | Restriction Proposed by LTPC | Use Ratio of 100% to All, Others in 24 hours Restriction Area |
| 3-b | Restriction Proposed by LTPC | Use Ratio of 2.8% to All, Others in 24 hours Restriction Area |

The use ratio for the category Others (DLT O-D survey) cannot be determined easily, since it includes miscellaneous goods. To cope with this uncertainty, two different use ratio of 100% (a) and 2.8% (b) were used. So five (5) forecast cases were set in this study (Tables 4.3.3 through 4.3.8 and Figures 4.3.4 and 4.3.5).

3. Collection and Delivery Area

A truck terminal shall serve certain territories. The feeder freight trip length to and from truck terminals range from 10 km to 20 km in Japanese truck terminals. In this study, radius of 20 km was set as the truck terminal collection and delivery area (Figure 4.3.6).

Considering standard stretch of area, geographical condition, presumed generation and attraction volume and future network, the approximate zones for collection and delivery of freight for each truck terminal the territory of each truck terminal was determined (Figure 4.3.7).

Figure 4.3.4 Cargo Volume Handled at Public Truck Terminal in Each Forecast Case; 2000

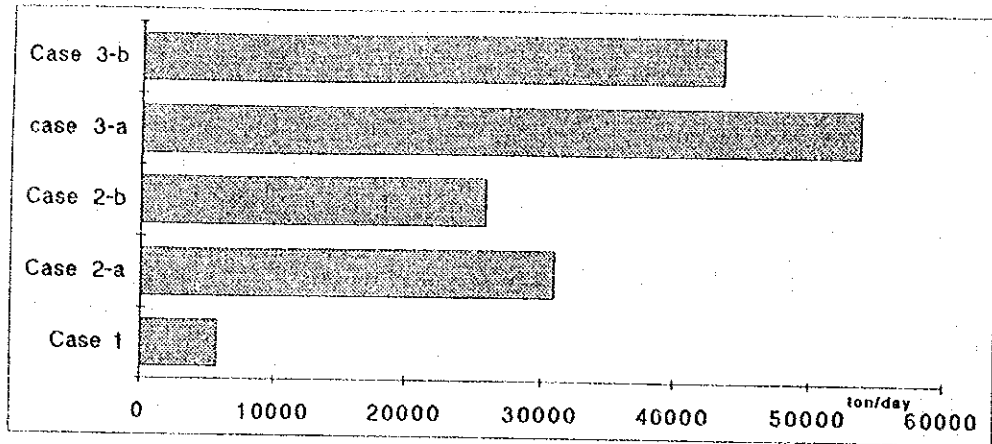
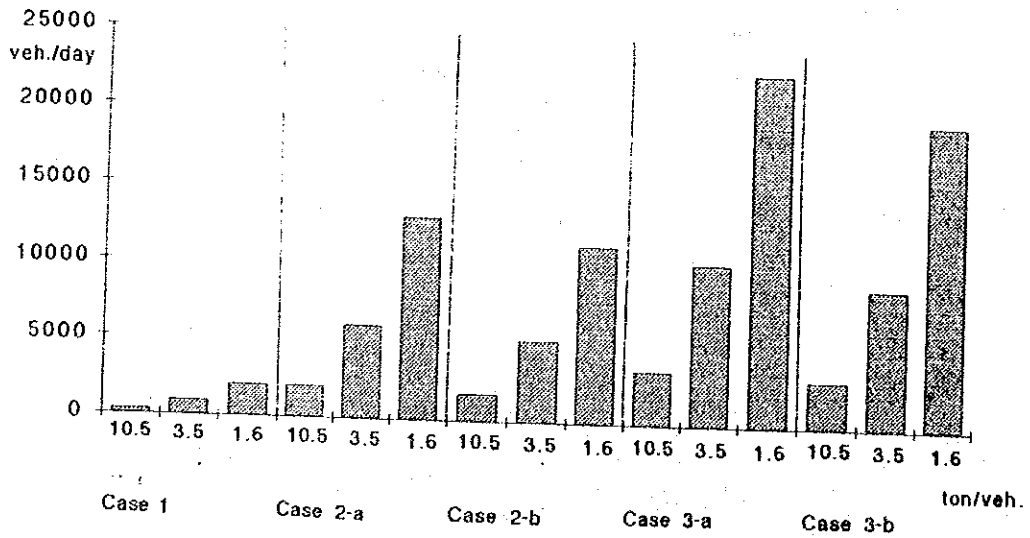


Figure 4.3.5 Truck Vehicles Using Public Truck Terminal in Each Forecast Case



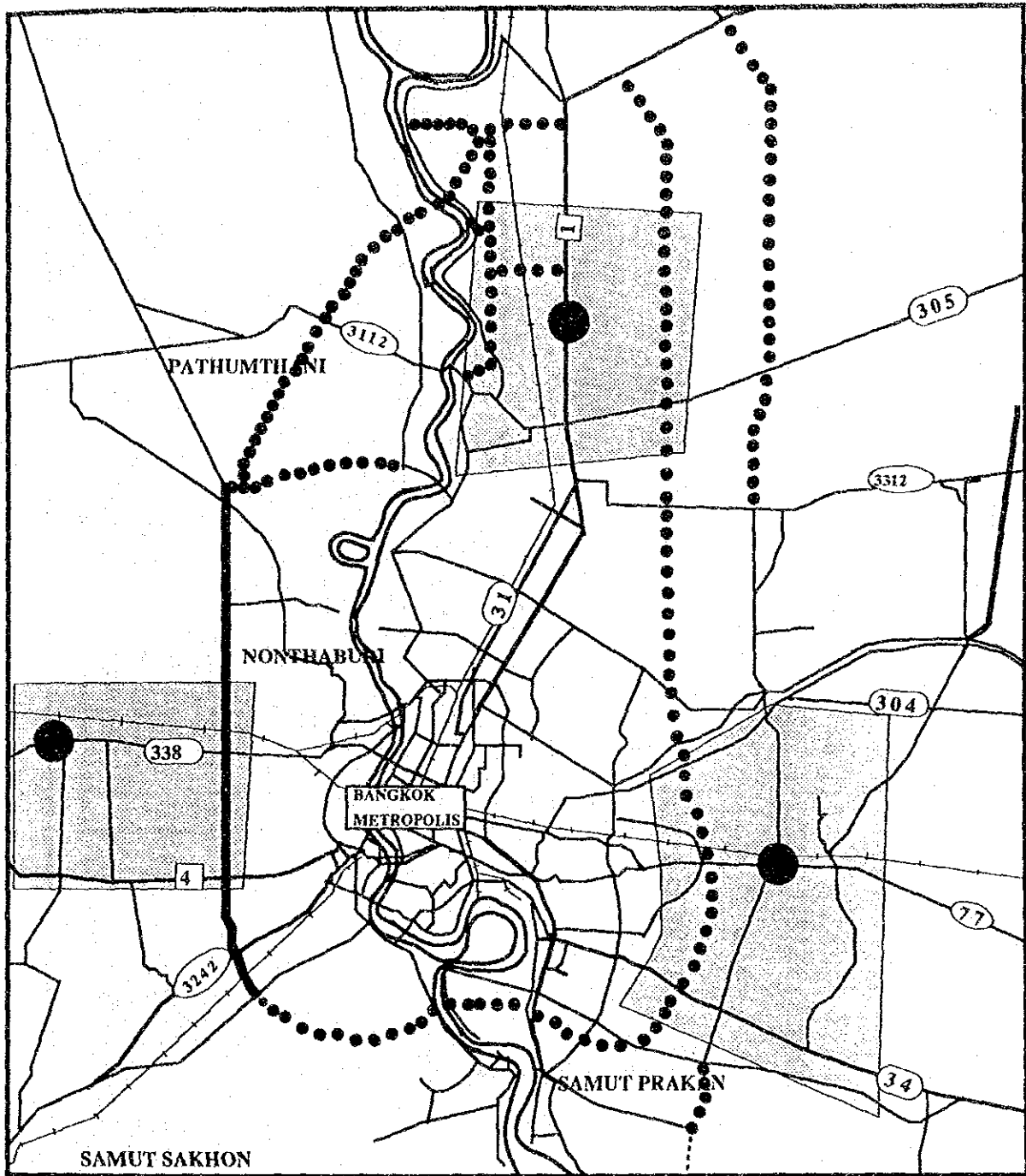


Figure 4.3.6

Desired Area for
Truck Terminal

Legend



Desired Area

Figure 4.3.7 Territory of Each Truck Terminal

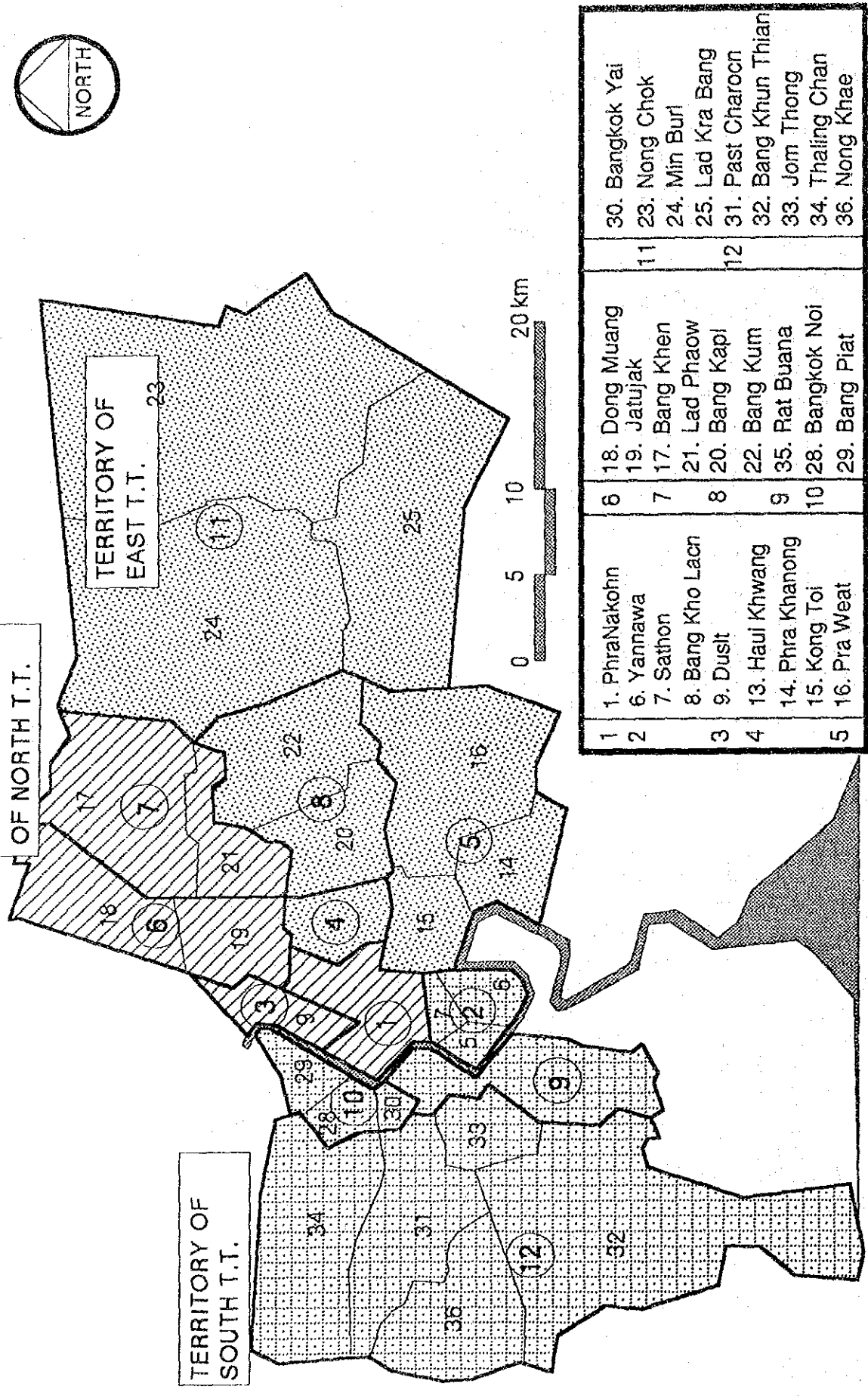


Table 4.3.3 Use Ratio of Truck Terminals by Commodity (Inbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 0.34% |
| 2) SAND & GRAVEL | 90.7% | NO | | |
| 3) CEMENT & PRODUCT | 6.7% | YES(4.8%) | Terminal | |
| 4) STEEL | 0.8% | YES(2.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 1.9% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 26.1% | NO | | |
| 9) MINERALS | 73.9% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 1.36% |
| 1) RICE | 37.7% | NO | | |
| 6) TIMBER | 9.1% | NO | | |
| 7) FIREWOOD | 2.0% | YES(25.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 3.9% | NO | | |
| 11) TAPIOCA | 5.6% | NO | | |
| 12) MAIZE | 4.1% | NO | | |
| 13) SUGAR | 13.7% | NO | | |
| 14) BEANS | 1.6% | NO | | |
| 15) JUTE & PRODUCTS | 0.7% | YES(5.7%) | Terminal | |
| 16) BEVERAGES | 1.0% | YES(5.7%) | Terminal | |
| 17) PROCESSED FOODS | 8.8% | YES(5.7%) | Terminal | |
| 18) ANIMALS | 2.0% | NO | | |
| 19) FISH | 4.5% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 5.4% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 10.01% |
| 21) PERSONAL EFFECTS | 30.6% | YES(23.9%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 26.1% | YES(5.7%) | Terminal | |
| 23) ALL OTHERS | 43.4% | YES(2.8%) | Terminal | |

Table 4.3.4 Use Ratio of Truck Terminals by Commodity (Outbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 4.18% |
| 2) SAND & GRAVEL | 4.7% | NO | | |
| 3) CEMENT & PRODUCT | 44.6% | YES(4.8%) | Terminal | |
| 4) STEEL | 42.5% | YES(4.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 8.2% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 98.3% | NO | | |
| 9) MINERALS | 1.7% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 4.00% |
| 1) RICE | 4.5% | NO | | |
| 6) TIMBER | 11.3% | NO | | |
| 7) FIREWOOD | 1.0% | YES(25.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 4.7% | NO | | |
| 11) TAPIOCA | 0.6% | NO | | |
| 12) MAIZE | 0.5% | NO | | |
| 13) SUGAR | 0.4% | NO | | |
| 14) BEANS | 0.3% | NO | | |
| 15) JUTE & PRODUCTS | 0.6% | YES(5.7%) | Terminal | |
| 16) BEVERAGES | 13.8% | YES(5.7%) | Terminal | |
| 17) PROCESSED FOODS | 4.1% | YES(5.7%) | Terminal | |
| 18) ANIMALS | 0.7% | NO | | |
| 19) FISH | 1.4% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 56.0% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 6.57% |
| 21) PERSONAL EFFECTS | 7.2% | YES(23.9%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 77.2% | YES(5.7%) | Terminal | |
| 23) ALL OTHERS | 15.5% | YES(2.8%) | Terminal | |

Table 4.3.5 Use Ratio of Truck Terminals by Commodity (Case 2.3-a: Inbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 0.34% |
| 2) SAND & GRAVEL | 90.7% | NO | | |
| 3) CEMENT & PRODUCT | 6.7% | YES(4.8%) | Terminal | |
| 4) STEEL | 0.8% | YES(2.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 1.9% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 26.1% | NO | | |
| 9) MINERALS | 73.9% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 12.79% |
| 1) RICE | 37.7% | NO | | |
| 6) TIMBER | 9.1% | NO | | |
| 7) FIREWOOD | 2.0% | YES(100.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 3.9% | NO | | |
| 11) TAPIOCA | 5.6% | NO | | |
| 12) MAIZE | 4.1% | NO | | |
| 13) SUGAR | 13.7% | NO | | |
| 14) BEANS | 1.6% | NO | | |
| 15) JUTE & PRODUCTS | 0.7% | YES(100.0%) | Terminal | |
| 16) BEVERAGES | 1.0% | YES(100.0%) | Terminal | |
| 17) PROCESSED FOODS | 8.8% | YES(100.0%) | Terminal | |
| 18) ANIMALS | 2.0% | NO | | |
| 19) FISH | 4.5% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 5.4% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 100.00% |
| 21) PERSONAL EFFECTS | 30.6% | YES(100.0%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 26.1% | YES(100.0%) | Terminal | |
| 23) ALL OTHERS | 43.4% | YES(100.0%) | Terminal | |

Table 4.3.6 Use Ratio of Truck Terminals by Commodity (Case 2.3-a: Outbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 4.18% |
| 2) SAND & GRAVEL | 4.7% | NO | | |
| 3) CEMENT & PRODUCT | 44.6% | YES(4.8%) | Terminal | |
| 4) STEEL | 42.5% | YES(4.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 8.2% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 98.3% | NO | | |
| 9) MINERALS | 1.7% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 22.21% |
| 1) RICE | 4.5% | NO | | |
| 6) TIMBER | 11.3% | NO | | |
| 7) FIREWOOD | 1.0% | YES(100.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 4.7% | NO | | |
| 11) TAPIOCA | 0.6% | NO | | |
| 12) MAIZE | 0.5% | NO | | |
| 13) SUGAR | 0.4% | NO | | |
| 14) BEANS | 0.3% | NO | | |
| 15) JUTE & PRODUCTS | 0.6% | YES(100.0%) | Terminal | |
| 16) BEVERAGES | 13.8% | YES(100.0%) | Terminal | |
| 17) PROCESSED FOODS | 4.1% | YES(100.0%) | Terminal | |
| 18) ANIMALS | 0.7% | NO | | |
| 19) FISH | 1.4% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 56.0% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 100.00% |
| 21) PERSONAL EFFECTS | 7.2% | YES(100.0%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 77.2% | YES(100.0%) | Terminal | |
| 23) ALL OTHERS | 15.5% | YES(100.0%) | Terminal | |

Table 4.3.7 Use Ratio of Truck Terminals by Commodity (Case 2.3-b: Inbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 0.34% |
| 2) SAND & GRAVEL | 90.7% | NO | | |
| 3) CEMENT & PRODUCT | 6.7% | YES(4.8%) | Terminal | |
| 4) STEEL | 0.8% | YES(2.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 1.9% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 26.1% | NO | | |
| 9) MINERALS | 73.9% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 12.79% |
| 1) RICE | 37.7% | NO | | |
| 6) TIMBER | 9.1% | NO | | |
| 7) FIREWOOD | 2.0% | YES(100.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 3.9% | NO | | |
| 11) TAPIOCA | 5.6% | NO | | |
| 12) MAIZE | 4.1% | NO | | |
| 13) SUGAR | 13.7% | NO | | |
| 14) BEANS | 1.6% | NO | | |
| 15) JUTE & PRODUCTS | 0.7% | YES(100.0%) | Terminal | |
| 16) BEVERAGES | 1.0% | YES(100.0%) | Terminal | |
| 17) PROCESSED FOODS | 8.8% | YES(100.0%) | Terminal | |
| 18) ANIMALS | 2.0% | NO | | |
| 19) FISH | 4.5% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 5.4% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 57.86% |
| 21) PERSONAL EFFECTS | 30.6% | YES(100.0%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 26.1% | YES(100.0%) | Terminal | |
| 23) ALL OTHERS | 43.4% | YES(2.8%) | Terminal | |

Table 4.3.8 Use Ratio of Truck Terminals by Commodity (Case 2.3-b: Outbound)

| Type of Commodity | Composition ratio (%) 1989 | Suitability | Suitable Facilities | Use Ratio of the Truck Terminals |
|------------------------------|----------------------------|-------------|---------------------|----------------------------------|
| 1. CONSTRUCTION MATERIALS | 100.0% | | | 4.18% |
| 2) SAND & GRAVEL | 4.7% | NO | | |
| 3) CEMENT & PRODUCT | 44.6% | YES(4.8%) | Terminal | |
| 4) STEEL | 42.5% | YES(4.8%) | Terminal | |
| 5) OTHER CONSTRUCTION | 8.2% | NO | | |
| 2. MINING PRODUCTS | 100.0% | NO | | 0.00% |
| 8) PETROLEUM PRODUCTS | 98.3% | NO | | |
| 9) MINERALS | 1.7% | NO | | |
| 3. AGRICULTURAL PRODUCTS | 100.0% | | | 22.21% |
| 1) RICE | 4.5% | NO | | |
| 6) TIMBER | 11.3% | NO | | |
| 7) FIREWOOD | 1.0% | YES(100.0%) | Terminal | |
| 10) VEGETABLE & FRUIT | 4.7% | NO | | |
| 11) TAPIOCA | 0.6% | NO | | |
| 12) MAIZE | 0.5% | NO | | |
| 13) SUGAR | 0.4% | NO | | |
| 14) BEANS | 0.3% | NO | | |
| 15) JUTE & PRODUCTS | 0.6% | YES(100.0%) | Terminal | |
| 16) BEVERAGES | 13.8% | YES(100.0%) | Terminal | |
| 17) PROCESSED FOODS | 4.1% | YES(100.0%) | Terminal | |
| 18) ANIMALS | 0.7% | NO | | |
| 19) FISH | 1.4% | NO | | |
| 20) FERTILIZER & ANIMAL FEED | 56.0% | YES(4.8%) | | |
| 4. MANUFACTURED GOODS | 100.0% | | | 84.92% |
| 21) PERSONAL EFFECTS | 7.2% | YES(100.0%) | Terminal | |
| 22) MISCELLANEOUS GOODS | 77.2% | YES(100.0%) | Terminal | |
| 23) ALL OTHERS | 15.5% | YES(2.8%) | Terminal | |

4. Proportion of marine transportation

Approximately 96.9% of cargo flows is by the freight transport (Table 4.3.9), according to the marine-freight cargo tonnage of 1988.

Table 4.3.9 Cargo Tonnage by Mode, 1988

| | (Unit : ton/year) | | |
|-------------------|-------------------|--------|----------|
| | Truck | Ship | Total |
| Cargo Tonnage | 50.1 | 1.6 | 51.7 |
| Composition Ratio | (96.9%) | (3.1%) | (100.0%) |

5. Potential Workdays

Since the results indicate the Bangkok control total for trucks and in tons/year, it is necessary to convert them to daily traffic volumes.

In this study, the following formula was used to convert yearly into daily cargo volumes.

$$D = Y / 300$$

where:

- D : Daily cargo volume into and out of Bangkok carried by truck
- Y : Yearly cargo volume inbound and outbound the Bangkok
- 300 : Potential workdays(days/year) based on the following assumptions :

- Sundays ; 52 days/year
- National holidays ; 15 days/year
- Total holidays ; 67 days/year

Therefore,

$$\begin{aligned} \text{Potential workdays} &= 365 - 67 \\ &= \text{about } 300 \text{ (days/year)} \end{aligned}$$

The daily volumes for truck terminals were calculated according to this formula.

B. Cargo Volume Handled at Each Truck Terminal

Using the established O-D matrices, the relative cargo volumes to be handled at proposed terminals were estimated and are shown in Tables 4.3.10 through 4.3.14 and Figure 4.3.8. In Case 2, territory of north and east truck terminals were adjusted, because volume handled at North truck terminal was partially large. The largest cargo volumes generated and attracted can be seen at the north truck terminal; the generated and attracted cargo volume was divided equally to the east and west truck terminals. Since the total cargo volume into and out of the Bangkok was the same for all of the alternatives, the difference in cargo tonnage could be attributed to the territories served and the use ratio of the truck terminals.

The total handling freight volume of Case 2-b is about 4.5 times that of Case 1. And the total handling freight volume of Case 3-b is about 1.7 times that of Case 2-b.

Table 4.3.10 Estimated Commodity Volume Handled at Truck Terminals; 2000 (Case 1)

| | | (Unit : ton/year) | | | |
|-------------------------|----------|-------------------|--------------|--------------|--------------|
| | | Total | Construction | Agricultural | Manufactured |
| | | | Materials | Products | Goods |
| North Truck Terminal | Inbound | 309,529 | 99,319 | 72,364 | 137,846 |
| | Outbound | 388,558 | 48,464 | 65,479 | 274,616 |
| | Total | 698,087 | 147,782 | 137,843 | 412,462 |
| West Truck Terminal | Inbound | 224,416 | 72,008 | 52,466 | 99,942 |
| | Outbound | 281,713 | 35,137 | 47,473 | 199,103 |
| | Total | 506,129 | 107,146 | 99,939 | 299,045 |
| East Truck Terminal | Inbound | 231,229 | 74,195 | 54,058 | 102,976 |
| | Outbound | 290,266 | 36,204 | 48,915 | 205,148 |
| | Total | 521,495 | 110,399 | 102,973 | 308,124 |

| | | (Unit : ton/day) | | | |
|-------------------------|----------|------------------|--------------|--------------|--------------|
| | | Total | Construction | Agricultural | Manufactured |
| | | | Materials | Products | Goods |
| North Truck Terminal | Inbound | 1,032 | 331 | 241 | 459 |
| | Outbound | 1,295 | 162 | 218 | 915 |
| | Total | 2,327 | 493 | 459 | 1,375 |
| West Truck Terminal | Inbound | 748 | 240 | 175 | 333 |
| | Outbound | 939 | 117 | 158 | 664 |
| | Total | 1,687 | 357 | 333 | 997 |
| East Truck Terminal | Inbound | 771 | 247 | 180 | 343 |
| | Outbound | 968 | 121 | 163 | 684 |
| | Total | 1,738 | 368 | 343 | 1,027 |

Table 4.3.11 Estimated Commodity Volume Handled at Truck Terminals; 2000 (Case 2-a)

| | | (Unit : ton/year) | | | |
|----------------|----------|-------------------|------------------------|-----------------------|--------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North | Inbound | 1,123,824 | 72,306 | 348,780 | 702,738 |
| Truck Terminal | Outbound | 2,323,274 | 35,282 | 192,645 | 2,095,347 |
| | Total | 3,447,098 | 107,588 | 541,425 | 2,798,085 |
| West | Inbound | 778,212 | 72,008 | 234,971 | 471,232 |
| Truck Terminal | Outbound | 1,539,350 | 35,137 | 136,832 | 1,367,381 |
| | Total | 2,317,562 | 107,146 | 371,803 | 1,838,613 |
| East | Inbound | 1,177,597 | 101,208 | 357,875 | 718,514 |
| Truck Terminal | Outbound | 2,353,904 | 49,385 | 205,842 | 2,098,677 |
| | Total | 3,531,501 | 150,593 | 563,717 | 2,817,191 |

| | | (Unit : ton/day) | | | |
|----------------|----------|------------------|------------------------|-----------------------|--------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North | Inbound | 3,746 | 241 | 1,163 | 2,342 |
| Truck Terminal | Outbound | 7,744 | 118 | 642 | 6,984 |
| | Total | 11,490 | 359 | 1,805 | 9,327 |
| West | Inbound | 2,594 | 240 | 783 | 1,571 |
| Truck Terminal | Outbound | 5,131 | 117 | 456 | 4,558 |
| | Total | 7,725 | 357 | 1,239 | 6,129 |
| East | Inbound | 3,925 | 337 | 1,193 | 2,395 |
| Truck Terminal | Outbound | 7,846 | 165 | 686 | 6,996 |
| | Total | 11,772 | 502 | 1,879 | 9,391 |

Table 4.3.12 Estimated Commodity Volume Handled at Truck Terminals; 2000 (Case 2-b)

| | | (Unit : ton/year) | | | |
|----------------|----------|-------------------|------------------------|-----------------------|--------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North | Inbound | 841,747 | 72,306 | 348,780 | 420,661 |
| Truck Terminal | Outbound | 2,017,312 | 35,282 | 192,645 | 1,789,385 |
| | Total | 2,859,059 | 107,588 | 541,425 | 2,210,046 |
| West | Inbound | 604,348 | 72,008 | 234,971 | 297,369 |
| Truck Terminal | Outbound | 1,350,765 | 35,137 | 136,832 | 1,178,796 |
| | Total | 1,955,113 | 107,146 | 371,803 | 1,476,164 |
| East | Inbound | 906,916 | 101,208 | 357,875 | 447,833 |
| Truck Terminal | Outbound | 2,060,305 | 49,385 | 205,842 | 1,805,078 |
| | Total | 2,967,221 | 150,593 | 563,717 | 2,252,911 |

| | | (Unit : ton/day) | | | |
|----------------|----------|------------------|------------------------|-----------------------|--------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North | Inbound | 2,806 | 241 | 1,163 | 1,402 |
| Truck Terminal | Outbound | 6,724 | 118 | 642 | 5,965 |
| | Total | 9,530 | 359 | 1,805 | 7,367 |
| West | Inbound | 2,014 | 240 | 783 | 991 |
| Truck Terminal | Outbound | 4,503 | 117 | 456 | 3,929 |
| | Total | 6,517 | 357 | 1,239 | 4,921 |
| East | Inbound | 3,023 | 337 | 1,193 | 1,493 |
| Truck Terminal | Outbound | 6,868 | 165 | 686 | 6,017 |
| | Total | 9,891 | 502 | 1,879 | 7,510 |

Table 4.3.13 Estimated Commodity Volume Handled at Truck Terminals; 2000 (Case 3-a)

| | | (Unit : ton/year) | | | |
|-------------------------|----------|-------------------|---------------------------|--------------------------|-----------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North Truck Terminal | Inbound | 2,157,706 | 99,319 | 681,437 | 1,376,949 |
| | Outbound | 4,585,652 | 48,464 | 363,693 | 4,173,495 |
| | Total | 6,743,357 | 147,782 | 1,045,130 | 5,550,444 |
| West Truck Terminal | Inbound | 1,439,807 | 72,008 | 453,002 | 914,797 |
| | Outbound | 3,041,792 | 35,137 | 243,584 | 2,763,070 |
| | Total | 4,481,599 | 107,146 | 696,587 | 3,677,867 |
| East Truck Terminal | Inbound | 1,508,616 | 74,195 | 475,026 | 959,396 |
| | Outbound | 3,191,134 | 36,204 | 255,029 | 2,899,901 |
| | Total | 4,699,750 | 110,399 | 730,055 | 3,859,296 |

| | | (Unit : ton/day) | | | |
|-------------------------|----------|------------------|---------------------------|--------------------------|-----------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North Truck Terminal | Inbound | 7,192 | 331 | 2,271 | 4,590 |
| | Outbound | 15,286 | 162 | 1,212 | 13,912 |
| | Total | 22,478 | 493 | 3,484 | 18,501 |
| West Truck Terminal | Inbound | 4,799 | 240 | 1,510 | 3,049 |
| | Outbound | 10,139 | 117 | 812 | 9,210 |
| | Total | 14,939 | 357 | 2,322 | 12,260 |
| East Truck Terminal | Inbound | 5,029 | 247 | 1,583 | 3,198 |
| | Outbound | 10,637 | 121 | 850 | 9,666 |
| | Total | 15,666 | 368 | 2,434 | 12,864 |

Table 4.3.14 Estimated Commodity Volume Handled at Truck Terminals; 2000 (Case 3-b)

| | | (Unit : ton/year) | | | |
|-------------------------|----------|-------------------|---------------------------|--------------------------|-----------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North Truck Terminal | Inbound | 1,577,473 | 99,319 | 681,437 | 796,717 |
| | Outbound | 3,956,289 | 48,464 | 363,693 | 3,544,132 |
| | Total | 5,533,761 | 147,782 | 1,045,130 | 4,340,849 |
| West Truck Terminal | Inbound | 1,058,236 | 72,008 | 453,002 | 533,226 |
| | Outbound | 2,627,912 | 35,137 | 243,584 | 2,349,191 |
| | Total | 3,686,149 | 107,146 | 696,587 | 2,882,417 |
| East Truck Terminal | Inbound | 1,107,582 | 74,195 | 475,026 | 558,361 |
| | Outbound | 2,756,142 | 36,204 | 255,029 | 2,464,909 |
| | Total | 3,863,725 | 110,399 | 730,055 | 3,023,271 |

| | | (Unit : ton/day) | | | |
|-------------------------|----------|------------------|---------------------------|--------------------------|-----------------------|
| | | Total | Construction Materials | Agricultural Products | Manufactured Goods |
| North Truck Terminal | Inbound | 5,258 | 331 | 2,271 | 2,656 |
| | Outbound | 13,188 | 162 | 1,212 | 11,814 |
| | Total | 18,446 | 493 | 3,484 | 14,469 |
| West Truck Terminal | Inbound | 3,527 | 240 | 1,510 | 1,777 |
| | Outbound | 8,760 | 117 | 812 | 7,831 |
| | Total | 12,287 | 357 | 2,322 | 9,608 |
| East Truck Terminal | Inbound | 3,692 | 247 | 1,583 | 1,861 |
| | Outbound | 9,187 | 121 | 850 | 8,216 |
| | Total | 12,879 | 368 | 2,434 | 10,078 |

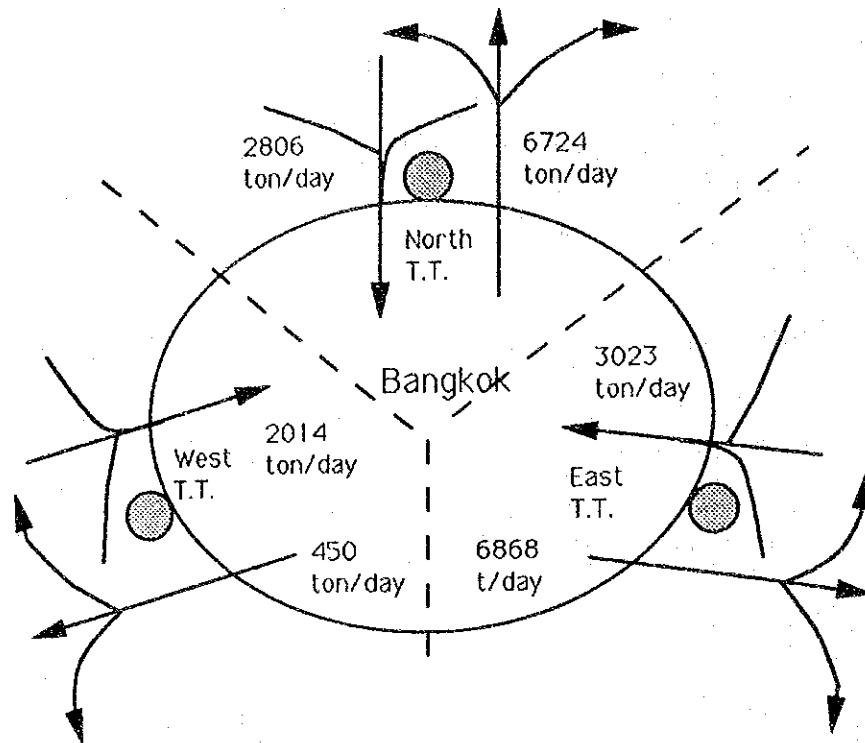


Figure 4.3.8 Daily Commodities Volume Handled at Each Truck Terminal; 2000 (Case 2-b)

4.3.2 Forecast of Diverted Number of Trucks

A. Coefficients for Diversion

1. Average Loading Volume by Each Type of Truck

Based on the O-D results of the DLT survey, average loading volume by each type of truck are shown in Table 4.3.15. This loading volume was adopted, since there was little difference between the truck driver interview survey and the DLT survey.

Table 4.3.15 Average Loading Volume of Each Type of Trucks

(Unit : ton/vehicle)

| | 1985 | 1986 | 1987 | 1988 | 1989 | Ave.1985-89 |
|-------------------|-------|-------|-------|-------|-------|-------------|
| 4 Wheeled Truck | 1.62 | 1.52 | 1.35 | 1.44 | 2.06 | 1.60 |
| 6 Wheeled Truck | 2.90 | 2.77 | 2.44 | 2.34 | 3.53 | 2.80 |
| 10 Wheeled Truck | 11.60 | 11.50 | 11.54 | 11.62 | 10.61 | 11.37 |
| 3-Axles Tractor | 16.24 | 14.16 | 14.68 | 12.88 | 15.00 | 14.59 |
| 4-Axles Tractor | 14.50 | 14.55 | 13.84 | 14.15 | 12.38 | 13.88 |
| 5-Axles Tractor | 20.42 | 19.99 | 19.51 | 19.44 | 18.75 | 19.62 |
| Multi-Axles(Ave.) | 20.22 | 19.80 | 19.34 | 19.34 | 18.74 | 19.62 |

Source : DLT

2. Ratio of unloaded trucks

Based on the O-D results of the DLT survey, the ratio of unloaded truck trips are shown in Table 4.3.16.

Table 4.3.16 The Ratio of Empty Truck Trips

| Item | | 1981 | 1982 | 1983 | 1984 | 1985 |
|-----------------------|-----------|---------|---------|---------|---------|---------|
| Truck Trips (million) | Total | 3.80 | 4.04 | 4.38 | 6.34 | 6.52 |
| | Empty | 1.39 | 1.57 | 1.72 | 2.69 | 2.98 |
| | Ratio (%) | (36.6%) | (38.9%) | (39.3%) | (42.4%) | (45.7%) |

| | 1986 | 1987 | 1988 | 1989 |
|--|---------|---------|---------|---------|
| | 7.41 | 8.02 | 8.67 | 9.26 |
| | 3.49 | 3.78 | 3.90 | 4.45 |
| | (47.1%) | (47.1%) | (45.0%) | (48.1%) |

Source : DLT

One of the reasons for building truck terminals is to improve the loading factor of trucks. Well systematized truck terminal can make the most of truck transportation. In other words, line-haul heavy-truck inbound to the Bangkok will be able to unload and load outbound cargo in return at the truck terminal. And also delivery truck will be able to load and unload within one round trip. In this study, it was assumed that no truck using truck terminal is unloaded both to and from the truck terminal. So 0% empty truck ratio was adopted.

B. Origin and Destination of Freight Trips at Truck Terminal

Freight trips of each truck terminal in each study case results are shown in Table 4.3.17 and Figure 4.3.9 for Case 2-b. In Case 2-b, the result of diversion from daily handled cargo volumes into 10-wheel trucks was estimated about 1,720 vehicles, assuming that all cargo volumes between Bangkok and the Region were carried by 10-wheel truck. In this estimation, maximum number of inbound or outbound vehicles was adopted as mentioned before.

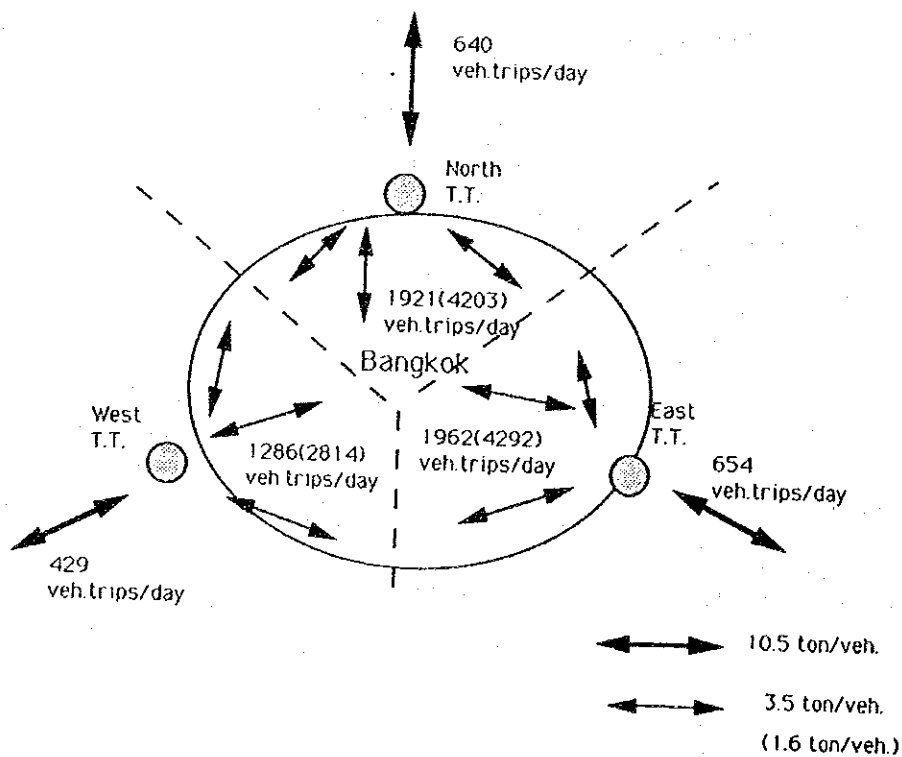


Figure 4.3.9 Number of Trucks Using Each Public Truck Terminal, 2000; Case 2-b

Table 4.3.17 Estimated Number of Truck Trips Using Public Truck Terminals

| Case | Truck Terminal | | Daily Handled Forecast of Number of Trucks | | | |
|--|----------------------|-----------|--|-----------------------------|----------------------------------|----------------------------------|
| | | | Cargo Volume ton/day | Heavy Truck 10.5ton/vehicle | Delivery Truck(1) 3.5ton/vehicle | Delivery Truck(1) 1.6ton/vehicle |
| Case 1 (Existent Condition) | North Truck Terminal | Inbound | 1032 | 98 | 295 | 645 |
| | | Outbound | 1295 | 123 | 370 | 809 |
| | | Max. Veh. | | 123 | 370 | 809 |
| | West Truck Terminal | Inbound | 748 | 71 | 214 | 468 |
| | | Outbound | 939 | 89 | 268 | 587 |
| | | Max. Veh. | | 89 | 268 | 587 |
| | East Truck Terminal | Inbound | 771 | 73 | 220 | 482 |
| | | Outbound | 968 | 92 | 276 | 605 |
| | | Max. Veh. | | 92 | 276 | 605 |
| | Total | Inbound | 2551 | 243 | 729 | 1594 |
| Outbound | | 3202 | 305 | 915 | 2001 | |
| Max. Veh. | | | 305 | 915 | 2001 | |
| Case 2-a (Restriction of 24 hr for Inner Area) | North Truck Terminal | Inbound | 3746 | 357 | 1070 | 2341 |
| | | Outbound | 7744 | 738 | 2213 | 4840 |
| | | Max. Veh. | | 738 | 2213 | 4840 |
| | West Truck Terminal | Inbound | 2594 | 247 | 741 | 1621 |
| | | Outbound | 5131 | 489 | 1466 | 3207 |
| | | Max. Veh. | | 489 | 1466 | 3207 |
| | East Truck Terminal | Inbound | 3925 | 374 | 1122 | 2453 |
| | | Outbound | 7846 | 747 | 2242 | 4904 |
| | | Max. Veh. | | 747 | 2242 | 4904 |
| | Total | Inbound | 10265 | 978 | 2933 | 6416 |
| Outbound | | 20722 | 1974 | 5921 | 12951 | |
| Max. Veh. | | | 1974 | 5921 | 12951 | |
| Case 2-b (Restriction of 24 hr for Inner Area) | North Truck Terminal | Inbound | 2806 | 267 | 802 | 1754 |
| | | Outbound | 6724 | 640 | 1921 | 4203 |
| | | Max. Veh. | | 640 | 1921 | 4203 |
| | West Truck Terminal | Inbound | 2014 | 192 | 576 | 1259 |
| | | Outbound | 4503 | 429 | 1286 | 2814 |
| | | Max. Veh. | | 429 | 1286 | 2814 |
| | East Truck Terminal | Inbound | 3023 | 288 | 864 | 1889 |
| | | Outbound | 6868 | 654 | 1962 | 4292 |
| | | Max. Veh. | | 654 | 1962 | 4292 |
| | Total | Inbound | 7843 | 747 | 2241 | 4902 |
| Outbound | | 18095 | 1723 | 5170 | 11309 | |
| Max. Veh. | | | 1723 | 5170 | 11309 | |
| Case 3-a (Restriction of 24 hr for Larger Area) | North Truck Terminal | Inbound | 7192 | 685 | 2055 | 4495 |
| | | Outbound | 15286 | 1456 | 4367 | 9553 |
| | | Max. Veh. | | 1456 | 4367 | 9553 |
| | West Truck Terminal | Inbound | 4799 | 457 | 1371 | 3000 |
| | | Outbound | 10139 | 966 | 2897 | 6337 |
| | | Max. Veh. | | 966 | 2897 | 6337 |
| | East Truck Terminal | Inbound | 5029 | 479 | 1437 | 3143 |
| | | Outbound | 10637 | 1013 | 3039 | 6648 |
| | | Max. Veh. | | 1013 | 3039 | 6648 |
| | Total | Inbound | 17020 | 1621 | 4863 | 10638 |
| Outbound | | 36062 | 3434 | 10303 | 22539 | |
| Max. Veh. | | | 3434 | 10303 | 22539 | |
| Case 3-b (Restriction of 24 hr for Larger Area) | North Truck Terminal | Inbound | 5258 | 501 | 1502 | 3286 |
| | | Outbound | 13188 | 1256 | 3768 | 8242 |
| | | Max. Veh. | | 1256 | 3768 | 8242 |
| | West Truck Terminal | Inbound | 3527 | 336 | 1008 | 2205 |
| | | Outbound | 8760 | 834 | 2503 | 5475 |
| | | Max. Veh. | | 834 | 2503 | 5475 |
| | East Truck Terminal | Inbound | 3692 | 352 | 1055 | 2307 |
| | | Outbound | 9187 | 875 | 2625 | 5742 |
| | | Max. Veh. | | 875 | 2625 | 5742 |
| | Total | Inbound | 12478 | 1188 | 3565 | 7799 |
| Outbound | | 31134 | 2965 | 8896 | 19459 | |
| Max. Veh. | | | 2965 | 8896 | 19459 | |

Table 4.3.18 Effect of Heavy Truck Reduction by Truck Terminal (Case 1)

| | Cargo Flow | | Average Loading per Truck ton/vehicle | Number of Truck Trips/day | Number of Empty Truck Trips/day | Number of Total Truck Trips/day (A) | Cargo Flow Handled at Truck Terminal ton/day | Truck Trips Using Truck Terminal Trips/day | Curtailed Empty Truck Trips/day (B) | Ratio of Truck Terminal Effect (B)/(A) |
|----------|-------------|---------|---------------------------------------|---------------------------|---------------------------------|-------------------------------------|--|--|-------------------------------------|--|
| | ton/year | ton/day | | | | | | | | |
| Inbound | 93,692,625 | 256,692 | 12.43927 | 20,636 | 45% 16,884 | 37,519 | 2,551 | 243 | 199 | 0.53% |
| | | | | 72 | 59 | 131 | | | | |
| | | | | 1,515 | 1,239 | 2,754 | | | | |
| | | | | 14,715 | 12,040 | 26,755 | | 243 | 199 | 0.74% |
| | | | | 4,333 | 3,546 | 7,879 | | | | |
| Outbound | 23,866,117 | 65,387 | | 5,256 | 4,301 | 9,557 | 3,202 | 305 | 250 | 2.61% |
| | | | | 18 | 15 | 33 | | | | |
| | | | | 386 | 316 | 701 | | | | |
| | | | | 3,748 | 3,067 | 6,815 | | 305 | 250 | 3.66% |
| | | | | 1,104 | 903 | 2,007 | | | | |
| Total | 117,558,742 | 322,079 | | 25,892 | 21,184 | 47,077 | 5,752 | 548 | 448 | 0.95% |
| | | | | 91 | 74 | 165 | | | | |
| | | | | 1,900 | 1,555 | 3,455 | | | | |
| | | | | 18,464 | 15,107 | 33,570 | | 548 | 448 | 1.34% |
| | | | | 5,437 | 4,449 | 9,886 | | | | |

Table 4.3.18 Effect of Heavy Truck Reduction by Truck Terminal (Case 2-a)

| | Cargo Flow | | Average Loading per Truck ton/vehicle | Number of Truck Trips/day | Number of Empty Truck Trips/day | Number of Total Truck Trips/day (A) | Cargo Flow Handled at Truck Terminal ton/day | Truck Trips Using Truck Terminal Trips/day | Curtailed Empty Truck Trips/day (B) | Ratio of Truck Terminal Effect (B)/(A) | |
|----------|-------------|---------|---------------------------------------|---------------------------|---------------------------------|-------------------------------------|--|--|-------------------------------------|--|--|
| | ton/year | ton/day | | | | | | | | | |
| Inbound | 93,692,625 | 256,692 | 12.43927 | total | 20,636 | 37,519 | 10,265 | 978 | 800 | 2.13% | |
| | | | | 4 -Wheel | 72 | 16,884 | 131 | | | | |
| | | | | 6 -Wheel | 1,515 | 1,239 | 2,754 | | | | |
| | | | | 10-Wheel | 14,715 | 12,040 | 26,755 | | | | |
| Outbound | 23,256,117 | 65,387 | | total | 5,256 | 9,557 | 20,722 | 1,974 | 1,615 | 16.90% | |
| | | | | 4 -Wheel | 18 | 4,301 | 33 | | | | |
| | | | | 6 -Wheel | 386 | 316 | 701 | | | | |
| | | | | 10-Wheel | 3,748 | 3,037 | 6,815 | | | | |
| Total | 117,558,742 | 322,079 | | total | 25,892 | 47,077 | 30,987 | 2,951 | 2,415 | 5.13% | |
| | | | | 4 -Wheel | 91 | 21,184 | 165 | | | | |
| | | | | 6 -Wheel | 1,900 | 1,555 | 3,455 | | | | |
| | | | | 10-Wheel | 18,464 | 15,107 | 33,570 | | | | |
| | | | | Multi-Axle | 5,437 | 4,449 | | | | | |

Table 4.3.18 Effect of Heavy Truck Reduction by Truck Terminal (Case 2-b)

| | Cargo Flow | | Average Loading per Truck ton/vehicle | Number of Truck Trips/day | Number of Empty Truck Trips/day | Number of Total Truck Trips/day (A) | Cargo Flow Handled at Truck Terminal ton/day | Truck Trips Using Truck Terminal Trips/day | Curtailed Empty Truck Trips/day (B) | Ratio of Truck Terminal Effect (B)/(A) | |
|----------|-------------|---------|---------------------------------------|---------------------------|---------------------------------|-------------------------------------|--|--|-------------------------------------|--|--|
| | ton/year | ton/day | | | | | | | | | |
| Inbound | 93,692,625 | 256,692 | 12.43927 | total | 20,636 | 37,519 | 7,843 | 747 | 611 | 1.63% | |
| | | | | 4 -Wheel | 72 | 16,884 | 131 | | | | |
| | | | | 6 -Wheel | 1,515 | 1,239 | 2,754 | | | | |
| | | | | 10-Wheel | 14,715 | 12,040 | 26,755 | | | | |
| Outbound | 23,666,117 | 65,387 | | Multi-Axle | 4,333 | 7,879 | | 747 | 611 | 2.28% | |
| | | | | total | 5,256 | 9,557 | 18,095 | 1,723 | 1,410 | 14.75% | |
| | | | | 4 -Wheel | 18 | 33 | | | | | |
| | | | | 6 -Wheel | 386 | 701 | | | | | |
| Total | 117,558,742 | 322,079 | | 10-Wheel | 3,748 | 6,815 | | 1,723 | 1,410 | 20.69% | |
| | | | | Multi-Axle | 1,104 | 2,007 | | | | | |
| | | | | total | 25,892 | 47,077 | 25,938 | 2,470 | 2,021 | 4.29% | |
| | | | | 4 -Wheel | 91 | 165 | | | | | |
| | | | | 6 -Wheel | 1,900 | 3,455 | | 2,470 | 2,021 | 6.02% | |
| | | | | 10-Wheel | 18,464 | 33,570 | | | | | |
| | | | | Multi-Axle | 5,437 | 9,886 | | | | | |
| | | | | total | 25,892 | 47,077 | 25,938 | 2,470 | 2,021 | 4.29% | |

Table 4.3.18 Effect of Heavy Truck Reduction by Truck Terminal (Case 3-a)

| | Cargo Flow | | Average Loading per Truck ton/vehicle | Number of Truck Trips/day | Number of Empty Truck Trips/day | Number of Total Truck Trips/day (A) | Cargo Flow Handled at Terminal ton/day | Truck Trips Using Terminal Trips/day | Curtailed Empty Truck Trips/day (B) | Ratio of Truck Terminal Effect (B)/(A) | |
|----------|-------------|---------|---------------------------------------|---------------------------|---------------------------------|-------------------------------------|--|--------------------------------------|-------------------------------------|--|--------|
| | ton/year | ton/day | | | | | | | | | |
| Inbound | 93,692,625 | 256,692 | 12.43927 | total | 20,636 | 37,519 | 17,020 | 1,621 | 1,326 | 3.53% | |
| | | | | 4 -Wheel | 72 | 16,884 | 131 | | | | |
| | | | | 6 -Wheel | 1,515 | 1,239 | 2,754 | | | | |
| | | | | 10 -Wheel | 14,715 | 12,040 | 26,755 | | 1,621 | 1,326 | 4.96% |
| Outbound | 23,866,117 | 65,387 | | total | 4,333 | 7,879 | 36,062 | 3,434 | 2,810 | 29.40% | |
| | | | | 4 -Wheel | 5,256 | 4,301 | 9,557 | | | | |
| | | | | 6 -Wheel | 18 | 15 | 33 | | | | |
| | | | | 10 -Wheel | 386 | 316 | 701 | | 3,434 | 2,810 | 41.23% |
| Total | 117,558,742 | 322,079 | | total | 1,104 | 2,007 | 53,082 | 5,055 | 4,136 | 8.79% | |
| | | | | 4 -Wheel | 25,892 | 21,184 | 47,077 | | | | |
| | | | | 6 -Wheel | 91 | 74 | 165 | | | | |
| | | | | 10 -Wheel | 1,900 | 1,555 | 3,455 | | 5,055 | 4,136 | 12.32% |
| | | | | Multi-Axle | 5,437 | 9,886 | | | | | |

Table 4.3.18 Effect of Heavy Truck Reduction by Truck Terminal (Case 3-b)

| | Cargo Flow | | Average Loading per Truck/vehicle ton/vehicle | | Number of Truck Trips/day | Number of Empty Truck Trips/day | Number of Total Truck Trips/day (A) | Cargo Flow Handled at Truck Terminal ton/day | Truck Trips Using Truck Terminal Trips/day | Curtailed Empty Truck Trips/day (B) | Ratio of Truck Terminal Effect (B)/(A) |
|----------|-------------|---------|---|------------|---------------------------|---------------------------------|-------------------------------------|--|--|-------------------------------------|--|
| | ton/year | ton/day | | | | | | | | | |
| Inbound | 93,692,625 | 256,692 | 12.43927 | | 20,636 | 16,884 | 37,519 | 12,478 | 1,188 | 972 | 2.59% |
| | | | | total | 72 | 59 | 131 | | | | |
| | | | | 4 -Wheel | 1,515 | 1,239 | 2,754 | | | | |
| | | | | 6 -Wheel | 14,715 | 12,040 | 26,755 | | 1,188 | 972 | 3.63% |
| | | | | 10-Wheel | 4,333 | 3,546 | 7,879 | | | | |
| | | | | Multi-Axle | 5,256 | 4,301 | 9,557 | 31,134 | 2,965 | 2,426 | 25.38% |
| Outbound | 23,866,117 | 65,387 | | total | 18 | 15 | 33 | | | | |
| | | | | 4 -Wheel | 386 | 316 | 701 | | | | |
| | | | | 6 -Wheel | 3,748 | 3,067 | 6,815 | | 2,965 | 2,426 | 35.60% |
| | | | | 10-Wheel | 1,104 | 903 | 2,007 | | | | |
| | | | | Multi-Axle | 25,892 | 21,184 | 47,077 | 43,612 | 4,154 | 3,398 | 7.22% |
| Total | 117,558,742 | 322,079 | | total | 91 | 74 | 165 | | | | |
| | | | | 4 -Wheel | 1,900 | 1,555 | 3,455 | | | | |
| | | | | 6 -Wheel | 18,464 | 15,107 | 33,570 | | 4,154 | 3,398 | 10.12% |
| | | | | 10-Wheel | 5,437 | 4,449 | 9,886 | | | | |
| | | | | Multi-Axle | | | | | | | |

C. The effect on the Traffic Congestion Relieving

The effect of the truck terminal realization on the traffic congestion relieving are mainly expected for the improvement of two different problems.

One is to reduce the traffic volume owing to the curtailment of the empty truck trips through the rationalization of cargo flow. And the other is to facilitate the traffic flow by the improvement of road capacity caused by the curtailment of loading and unloading on the road.

In this chapter the effects on the traffic volume reduction were estimated. In case that all cargo flows were carried by 10-wheel trucks, corresponding empty truck trips with loaded truck trips on artery road were shown in Table 4.3.18. At first inbound and outbound truck trips per day for all cargo flows were estimated using the average loading volumes by type of truck and the future share of truck trips by type of truck. The share of truck trips to and from Bangkok in future were determined using the proportion of truck trips by type to the registered number of trucks by type prepared by DLT. Future registered truck numbers by type were prepared by the study of socio-economic framework (Table 4.3.19). The estimated ratio of curtailed truck trips to the whole truck trips ranged 0.95% in Case 1 to 8.79% in Case 3-a.

Table 4.3.19 Composition Ratio of Trips by Each Type of Trucks

| Truck Type | Truck Trips To and From Bangkok 1989 | Registered Truck Numbers in Whole Kingdom 1989 | Average Trips per Vehicle Trips/Vehicle (A) | Registered Truck Numbers in Whole Kingdom 2000 (B) | (A)X(B) |
|-------------|--------------------------------------|--|---|--|---------------------|
| 4 Wheel | 1,222 (0.4%) | 50,540 | 0.024 | 94,287 | 2,280 (0.4%) |
| 6 Wheel | 26,462 (8.6%) | 118,477 | 0.223 | 213,180 | 47,614 (7.3%) |
| 10 Wheel | 255,105 (82.5%) | 83,666 | 3.049 | 151,667 | 462,446 (71.3%) |
| Multi-Axles | 26,516 (8.6%) | 24,470 | 1.084 | 125,666 | 136,173 (21.0%) |
| Total | 309,305 (100.0%) | 277,153 | - | 584,800 | 648,513 (100.0%) |

4.3.3 Facility Size for Each Truck Terminal

A. Facilities Modules for Truck Terminal

As public truck terminals are unprecedented in Bangkok, average volume handled in public truck terminals is derived from the cases in Tokyo metropolitan area. Twenty (20) ton per day is adopted as a facilities' modules for public truck terminals.

B. Facilities Sizes for Each Truck Terminal

Necessary berths for each public truck terminals in each study case are shown in Tables 4.3.20 and 4.3.21.

Table 4.3.20 Facility Size of Existent Public Truck Terminals in Tokyo Metropolitan Area

| Item | Number of Berths | Handled Cargo Volume ton/day | Facilities Module (ton/dayxberth) | Remarks |
|-------------------------|------------------|------------------------------|-----------------------------------|---------|
| Keihin Truck Terminal | 433 | 10,150 | 23.4 | 1991 |
| Itabashi Truck Terminal | 320 | 7,262 | 22.7 | 1991 |
| Adati Truck Terminal | 320 | 8,335 | 26.0 | 1991 |
| Kasai Truck Terminal | 432 | 7,964 | 18.4 | 1991 |
| Total | 1,505 | 33,711 | 22.4 | |

Table 4.3.21 Estimated Necessary Number of Berths; 2000

| Case | Truck Terminal | Direction | Daily Handled Cargo Volume ton/day | Necessary Number of Berths |
|--|----------------------|-----------|------------------------------------|----------------------------|
| Case 1 (Existent Condition) | North Truck Terminal | Inbound | 1,032 | 52 |
| | | Outbound | 1,295 | 65 |
| | | Total | 2,327 | 116 |
| | West Truck Terminal | Inbound | 748 | 37 |
| | | Outbound | 939 | 47 |
| | | Total | 1,687 | 84 |
| | East Truck Terminal | Inbound | 771 | 39 |
| | | Outbound | 968 | 48 |
| | | Total | 1,738 | 87 |
| | Total | Inbound | 2,551 | 128 |
| | | Outbound | 3,202 | 160 |
| Total | | 5,752 | 288 | |
| Case 2-a (Restriction of 24 hr for Inner Area) | North Truck Terminal | Inbound | 3,746 | 187 |
| | | Outbound | 7,744 | 387 |
| | | Total | 11,490 | 575 |
| | West Truck Terminal | Inbound | 2,594 | 130 |
| | | Outbound | 5,131 | 257 |
| | | Total | 7,725 | 386 |
| | East Truck Terminal | Inbound | 3,925 | 196 |
| | | Outbound | 7,846 | 392 |
| | | Total | 11,772 | 589 |
| | Total | Inbound | 10,265 | 513 |
| | | Outbound | 20,722 | 1,036 |
| Total | | 30,987 | 1,549 | |
| Case 2-b (Restriction of 24 hr for Inner Area) | North Truck Terminal | Inbound | 2,806 | 140 |
| | | Outbound | 6,724 | 336 |
| | | Total | 9,530 | 477 |
| | West Truck Terminal | Inbound | 2,014 | 101 |
| | | Outbound | 4,503 | 225 |
| | | Total | 6,517 | 326 |
| | East Truck Terminal | Inbound | 3,023 | 151 |
| | | Outbound | 6,868 | 343 |
| | | Total | 9,891 | 495 |
| | Total | Inbound | 7,843 | 392 |
| | | Outbound | 18,095 | 905 |
| Total | | 25,938 | 1,297 | |
| Case 3-a (Restriction of 24 hr for Larger Area) | North Truck Terminal | Inbound | 7,192 | 360 |
| | | Outbound | 15,286 | 764 |
| | | Total | 22,478 | 1,124 |
| | West Truck Terminal | Inbound | 4,799 | 240 |
| | | Outbound | 10,139 | 507 |
| | | Total | 14,939 | 747 |
| | East Truck Terminal | Inbound | 5,029 | 251 |
| | | Outbound | 10,637 | 532 |
| | | Total | 15,666 | 783 |
| | Total | Inbound | 17,020 | 851 |
| | | Outbound | 36,062 | 1,803 |
| Total | | 53,082 | 2,654 | |
| Case 3-b (Restriction of 24 hr for Larger Area) | North Truck Terminal | Inbound | 5,258 | 263 |
| | | Outbound | 13,188 | 659 |
| | | Total | 18,446 | 922 |
| | West Truck Terminal | Inbound | 3,527 | 176 |
| | | Outbound | 8,760 | 438 |
| | | Total | 12,287 | 614 |
| | East Truck Terminal | Inbound | 3,692 | 185 |
| | | Outbound | 9,187 | 459 |
| | | Total | 12,879 | 644 |
| | Total | Inbound | 12,478 | 624 |
| | | Outbound | 31,134 | 1,557 |
| Total | | 43,612 | 2,181 | |

The result is that necessary berths range considerably with the estimated handled volumes. Considering the aspects described in sections 1, 2 and 3, facilities sizes of each truck terminal were determined in Table 4.3.22.

Table 4.3.22 Necessary Number of Berths at Each Public Truck Terminal; 1995 and 2000

| | (unit : berths) | | | |
|---|----------------------------|---------------------------|---------------------------|-------|
| | North Truck Terminal | West Truck Terminal | East Truck Terminal | Total |
| Necessary Number of Berths in 2000 | 480 | 320 | 480 | 1280 |
| Necessary Number of Berths in 1995 (Staged Construction) | 350 | 250 | 350 | 950 |

1. Possibility of the enforcement of whole day restriction

It will be well likely that excessive restriction will cause inefficiencies of the industrial activities. Careful attention should be paid to determine the facilities sizes of truck terminals

2. Propriety of the sizes of the public truck terminals in Tokyo Metropolitan area

Cases of public truck terminals in Tokyo metropolitan area range from 320 berths to 460 berths and amount to 1,505 berths in all. Proper sizes should be adopted according to the scale of the cities.

3. Efficiency of the facilities size

From the economical and functional efficiency points of view, minimum sizes should be ensured.

Case 1 does not follow the movement toward the whole day traffic restriction. The existent restriction hardly rationalize the cargo flow system. There was some uncertainty in estimation of the changes in packaging the commodities caused by the rationalization of cargo flow system in the course of the industrial modernization. This case has also the disadvantage of scale merits and arrangement of multiple truck terminals.

In Case 3, the estimated number of berths are considerably large. Judging from the examples in Tokyo Metropolitan area, one could suspect the number was probably overestimated. Also, the restriction will most likely have negative economic impacts on the industrial activities in Bangkok.

Thus, Case 2 is most appropriate. Two different values were used as the use ratio of truck terminal. The assumption of 100% loading level to all commodities, which could be unrealistic, results in high level services.

In this study, with the assumptions, Case 2-b was adopted as the adequate results of estimation.

Based on the results of Case 2-b, necessary berths were shown in rounded number. The estimated cargo volumes handled differs considerably depending on the collection and delivery area.

Table 4.3.22 shows the staged construction schedules of the years 1995 and 2000.

Cargo flow origin and destination (O-D) matrices are shown in Tables 4.3.23 through 4.3.26.

Table 4.3.23 2000 Cargo Flow O-D Matrix (Total)

(Unit : ton/year)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | |
|-----------|------------|-----------|-----------------|--------|--------|--------|---------|--------|-------|-------|--------|--------|-------|--------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Total | Central | Inbound | 106172 | 32153 | 24489 | 12204 | 44140 | 24919 | 3218 | 3854 | 18995 | 13586 | 2501 | 12792 |
| | | Outbound | 242629 | 73479 | 55279 | 26245 | 79619 | 48150 | 3345 | 4007 | 38779 | 27889 | 2600 | 13298 |
| | | Total | 348801 | 105632 | 79769 | 38449 | 123759 | 73069 | 6563 | 7861 | 57774 | 41476 | 5102 | 26090 |
| | North | Inbound | 83599 | 29317 | 19104 | 9180 | 29211 | 17326 | 1488 | 1782 | 13749 | 9874 | 1157 | 5915 |
| | | Outbound | 378956 | 114784 | 86232 | 40734 | 121025 | 73827 | 4597 | 5506 | 59843 | 43065 | 3573 | 18274 |
| | | Total | 462555 | 140082 | 105336 | 49915 | 150236 | 91153 | 6085 | 7288 | 73592 | 52939 | 4730 | 24188 |
| | North-East | Inbound | 80491 | 24376 | 18980 | 8829 | 28001 | 16631 | 1409 | 1688 | 13211 | 9488 | 1095 | 5502 |
| | | Outbound | 300622 | 91041 | 68427 | 32361 | 96614 | 58817 | 3761 | 4504 | 47605 | 34253 | 2923 | 14850 |
| | | Total | 381113 | 115417 | 86817 | 41190 | 124615 | 75447 | 5170 | 6192 | 60816 | 43741 | 4019 | 20552 |
| | East | Inbound | 205450 | 62219 | 47246 | 23274 | 81004 | 46394 | 5395 | 6462 | 35796 | 25635 | 4194 | 21447 |
| | | Outbound | 515576 | 156139 | 117488 | 55768 | 169161 | 102306 | 7104 | 8508 | 82399 | 59260 | 5522 | 28238 |
| | | Total | 721027 | 218358 | 164712 | 79042 | 250165 | 148701 | 12499 | 14970 | 118195 | 84895 | 9715 | 49686 |
| | South | Inbound | 104796 | 31737 | 23994 | 11619 | 38048 | 22311 | 2195 | 2557 | 17546 | 13590 | 1660 | 8438 |
| | | Outbound | 277527 | 84047 | 63138 | 29799 | 88208 | 53892 | 5287 | 3926 | 43794 | 31476 | 2555 | 13065 |
| | | Total | 382323 | 115784 | 87132 | 41418 | 126257 | 76203 | 5422 | 6494 | 61280 | 44065 | 4214 | 21553 |
| | West | Inbound | 277605 | 84071 | 64064 | 31966 | 118420 | 65572 | 8604 | 10305 | 49895 | 35674 | 6688 | 34204 |
| | | Outbound | 436828 | 132290 | 99493 | 47176 | 142363 | 86283 | 5938 | 6991 | 69604 | 50066 | 4537 | 23205 |
| | | Total | 714433 | 216361 | 163557 | 79162 | 260783 | 151854 | 14442 | 17297 | 119489 | 85740 | 11225 | 57408 |
| Total | Inbound | | 858113 | 259879 | 197287 | 97092 | 336825 | 193153 | 22250 | 26649 | 149181 | 108846 | 17294 | 88448 |
| | | Outbound | 2152139 | 651760 | 490036 | 232083 | 696990 | 423275 | 27931 | 33452 | 341965 | 246009 | 21710 | 111030 |
| | | Total | 3010252 | 911634 | 687323 | 329175 | 1033815 | 616427 | 50182 | 60101 | 491146 | 352856 | 39005 | 199478 |

Table 4.3.24 2000 Cargo Flow O-D Matrix Case 2-b
(Construction Materials)

(Unit : ton/year)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | | Prime | | | 0.95 Inbound | | | 0.003249 Outbound | | |
|------------------------|------------|-----------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|---|---|--------------|---|---|-------------------|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Construction Materials | Central | Inbound | 11459 | 3470 | 2842 | 1795 | 10951 | 5250 | 1514 | 1814 | 3397 | 2386 | 1177 | 6019 | | | | | | | | | |
| | | Outbound | 4339 | 1314 | 1076 | 680 | 4146 | 1988 | 573 | 587 | 1286 | 903 | 446 | 2279 | | | | | | | | | |
| | | Total | 15798 | 4784 | 3918 | 2475 | 15097 | 7237 | 2088 | 2500 | 4684 | 3289 | 1623 | 8298 | | | | | | | | | |
| | North | Inbound | 180 | 54 | 45 | 28 | 172 | 82 | 24 | 28 | 53 | 37 | 18 | 95 | | | | | | | | | |
| | | Outbound | 3144 | 952 | 780 | 493 | 3004 | 1440 | 415 | 498 | 932 | 655 | 323 | 1651 | | | | | | | | | |
| | | Total | 3324 | 1007 | 824 | 521 | 3176 | 1523 | 439 | 526 | 985 | 692 | 341 | 1746 | | | | | | | | | |
| | North-East | Inbound | 83 | 25 | 21 | 13 | 80 | 38 | 11 | 13 | 25 | 17 | 9 | 44 | | | | | | | | | |
| | | Outbound | 2277 | 690 | 565 | 357 | 2176 | 1043 | 301 | 360 | 675 | 474 | 234 | 1196 | | | | | | | | | |
| | | Total | 2360 | 715 | 585 | 370 | 2255 | 1081 | 312 | 374 | 700 | 491 | 242 | 1240 | | | | | | | | | |
| | East | Inbound | 1176 | 3566 | 2921 | 1845 | 11253 | 5395 | 1556 | 1864 | 3491 | 2452 | 1210 | 6186 | | | | | | | | | |
| | | Outbound | 8678 | 2628 | 2152 | 1360 | 8292 | 3975 | 1147 | 1373 | 2573 | 1807 | 891 | 4558 | | | | | | | | | |
| | | Total | 20453 | 6194 | 5073 | 3205 | 19546 | 9370 | 2703 | 3237 | 6064 | 4258 | 2101 | 10744 | | | | | | | | | |
| South | Inbound | 75 | 23 | 19 | 12 | 72 | 35 | 10 | 12 | 22 | 16 | 8 | 40 | | | | | | | | | | |
| | Outbound | 1874 | 567 | 465 | 294 | 1791 | 958 | 248 | 297 | 556 | 390 | 192 | 984 | | | | | | | | | | |
| | Total | 1950 | 590 | 484 | 305 | 1863 | 893 | 258 | 309 | 578 | 406 | 200 | 1024 | | | | | | | | | | |
| West | Inbound | 30453 | 9223 | 7553 | 4771 | 29102 | 13951 | 4024 | 4820 | 9029 | 6340 | 3128 | 15937 | | | | | | | | | | |
| | Outbound | 6053 | 1833 | 1501 | 948 | 5784 | 2773 | 800 | 958 | 1794 | 1260 | 622 | 3179 | | | | | | | | | | |
| | Total | 36506 | 11056 | 9055 | 5720 | 34886 | 16724 | 4824 | 5778 | 10823 | 7601 | 3750 | 19176 | | | | | | | | | | |
| Total | Inbound | 54027 | 16362 | 13401 | 8465 | 51629 | 24751 | 7139 | 8551 | 16018 | 11249 | 5549 | 28380 | | | | | | | | | | |
| | Outbound | 25363 | 7984 | 6539 | 4131 | 25193 | 12078 | 3484 | 4172 | 7816 | 5489 | 2708 | 13848 | | | | | | | | | | |
| | Total | 80391 | 24346 | 19940 | 12596 | 76823 | 36829 | 10623 | 12723 | 23834 | 16737 | 8257 | 42229 | | | | | | | | | | |

Table 4.3.25 2000 Cargo Flow O-D Matrix Case 2-b
(Agricultural, Forestry, Fishery and Relevant Products)

(Unit : ton/year)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | | 0.003249 Outbound |
|-----------------------|------------|-----------|-----------------|--------|--------|-------|--------|--------|------|-------|-------|-------|------|-------|-------------------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Agricultural Products | Central | Inbound | 52280 | 15833 | 11913 | 5660 | 17224 | 10403 | 734 | 879 | 8371 | 6020 | 570 | 2916 | |
| | | Outbound | 24505 | 7421 | 5625 | 2751 | 9341 | 5401 | 583 | 698 | 4200 | 3010 | 453 | 2317 | |
| | | Total | 76785 | 23254 | 17538 | 8412 | 26565 | 15804 | 1317 | 1577 | 12570 | 9029 | 1023 | 5234 | |
| | North | Inbound | 50178 | 15196 | 11434 | 5433 | 16531 | 9985 | 704 | 843 | 8034 | 5777 | 547 | 2799 | |
| | | Outbound | 24609 | 7453 | 5649 | 2763 | 9381 | 5424 | 585 | 701 | 4218 | 3023 | 455 | 2327 | |
| | | Total | 74787 | 22649 | 17083 | 8196 | 25912 | 15409 | 1290 | 1545 | 12252 | 8800 | 1002 | 5126 | |
| | North-East | Inbound | 49840 | 15094 | 11357 | 5396 | 16420 | 9918 | 699 | 938 | 7980 | 5739 | 544 | 2780 | |
| | | Outbound | 29904 | 9056 | 6864 | 3357 | 11399 | 6591 | 711 | 952 | 5125 | 3873 | 553 | 2828 | |
| | | Total | 79744 | 24150 | 18222 | 8754 | 27819 | 16509 | 1411 | 1690 | 13105 | 9412 | 1097 | 5608 | |
| | East | Inbound | 66680 | 20194 | 15195 | 7219 | 21968 | 13269 | 936 | 1121 | 10676 | 7678 | 727 | 3720 | |
| | | Outbound | 56582 | 17136 | 12988 | 6352 | 21588 | 12471 | 1346 | 1612 | 9697 | 6950 | 1046 | 5351 | |
| | | Total | 123262 | 37329 | 28183 | 13572 | 43556 | 25739 | 2282 | 2733 | 20373 | 14627 | 1774 | 9071 | |
| | South | Inbound | 30472 | 9228 | 6944 | 3299 | 10039 | 6064 | 428 | 512 | 4879 | 3509 | 332 | 1700 | |
| | | Outbound | 15982 | 4840 | 3669 | 1794 | 6092 | 3522 | 380 | 455 | 2739 | 1983 | 296 | 1511 | |
| | | Total | 46454 | 14068 | 10613 | 5094 | 16131 | 9586 | 808 | 968 | 7618 | 5472 | 628 | 3211 | |
| | West | Inbound | 121237 | 36716 | 27627 | 13126 | 39942 | 24125 | 1701 | 2038 | 19412 | 13959 | 1322 | 5763 | |
| | | Outbound | 46259 | 14009 | 10618 | 5193 | 17633 | 10195 | 1101 | 1318 | 7928 | 5682 | 855 | 4375 | |
| | | Total | 167496 | 50725 | 38246 | 18320 | 57575 | 34320 | 2802 | 3356 | 27339 | 19641 | 2178 | 11138 | |
| Total | Inbound | | 370688 | 112260 | 84471 | 40135 | 122123 | 73763 | 5202 | 6230 | 59352 | 42681 | 4043 | 20578 | |
| | | Outbound | 197842 | 59915 | 45413 | 22212 | 75414 | 43604 | 4707 | 5637 | 33906 | 24301 | 3659 | 18710 | |
| | | Total | 568529 | 172175 | 129884 | 62346 | 197537 | 117367 | 9909 | 11867 | 93258 | 66982 | 7702 | 39388 | |

Table 4.3.26 2000 Cargo Flow O-D Matrix Case 2-b
(Manufactured Goods)

(Unit : ton/year)

| Commodity | Region | Direction | Zone in Bangkok | | | | | | | | | | | | Prime | |
|--------------------|------------|-----------|-----------------|--------|--------|--------|--------|--------|-------|--------|--------|-------|--------|-------|--------------|------------------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 0.95 Inbound | 0.03249 Outbound |
| Manufactured Goods | Central | Inbound | 42432 | 12850 | 9733 | 4748 | 15966 | 9266 | 970 | 1162 | 7227 | 5181 | 754 | 3856 | | |
| | | Outbound | 213786 | 64744 | 48578 | 28814 | 86132 | 40762 | 2189 | 2622 | 33284 | 23976 | 1701 | 8702 | | |
| | | Total | 256218 | 77594 | 58312 | 27562 | 82098 | 50037 | 3159 | 3784 | 40520 | 29157 | 2456 | 12558 | | |
| | North | Inbound | 33241 | 10067 | 7625 | 3719 | 12507 | 7259 | 760 | 910 | 5661 | 4059 | 591 | 3021 | | |
| | | Outbound | 351203 | 106359 | 79804 | 37479 | 108640 | 66963 | 3596 | 4307 | 54694 | 39388 | 2795 | 14295 | | |
| | | Total | 384444 | 116426 | 87429 | 41198 | 121148 | 74221 | 4356 | 5217 | 60355 | 43446 | 3386 | 17316 | | |
| | North-East | Inbound | 39567 | 9257 | 7012 | 3420 | 11501 | 6676 | 699 | 837 | 5206 | 3792 | 543 | 2778 | | |
| | | Outbound | 268441 | 81296 | 60998 | 28647 | 83039 | 51183 | 2749 | 3292 | 41805 | 30106 | 2136 | 10926 | | |
| | | Total | 299009 | 90553 | 68099 | 32067 | 94541 | 57859 | 3448 | 4129 | 47011 | 33838 | 2680 | 13704 | | |
| | East | Inbound | 126995 | 38459 | 29131 | 14209 | 47784 | 27731 | 2304 | 3477 | 21628 | 15506 | 2257 | 11542 | | |
| | | Outbound | 450317 | 136375 | 102325 | 48056 | 139300 | 85850 | 4611 | 5522 | 70129 | 50503 | 3584 | 18329 | | |
| | | Total | 577311 | 174835 | 131456 | 62265 | 187084 | 113591 | 7514 | 9000 | 91757 | 66009 | 5841 | 29871 | | |
| South | Inbound | 74247 | 22485 | 17031 | 8308 | 27937 | 16213 | 1698 | 2033 | 12645 | 9065 | 1319 | 6748 | | | |
| | Outbound | 259671 | 78640 | 59005 | 27711 | 80326 | 49511 | 2659 | 3184 | 40439 | 29122 | 2067 | 10569 | | | |
| | Total | 333919 | 101125 | 76036 | 36018 | 108263 | 65724 | 4356 | 5218 | 53084 | 38188 | 3386 | 17317 | | | |
| West | Inbound | 125915 | 38132 | 28893 | 14089 | 47377 | 27495 | 2879 | 3448 | 21444 | 15374 | 2238 | 11444 | | | |
| | Outbound | 384517 | 116448 | 87974 | 41034 | 118946 | 73315 | 3937 | 4715 | 59892 | 43124 | 3060 | 15661 | | | |
| | Total | 510431 | 154581 | 116256 | 55122 | 166323 | 100810 | 6816 | 8163 | 81326 | 58498 | 5298 | 27054 | | | |
| Total | Inbound | 433397 | 131251 | 99415 | 48493 | 163072 | 94638 | 9909 | 11868 | 73811 | 52917 | 7702 | 39389 | | | |
| | Outbound | 1927935 | 583862 | 438084 | 205741 | 596983 | 387593 | 19741 | 23643 | 300243 | 216220 | 15344 | 78471 | | | |
| | Total | 2361332 | 715113 | 537499 | 254233 | 759456 | 462231 | 29650 | 35510 | 374054 | 269137 | 23046 | 117861 | | | |

CHAPTER 5

SELECTION OF LOCATION FOR TRUCK TERMINALS

CHAPTER 5 SELECTION OF TRUCK TERMINAL LOCATION

5.1 General

Objectives of this chapter is to select the best locations for truck terminals and to decide the size of planned truck terminal.

For this purpose, this chapter studies the question of which parts of the Greater Bangkok area are the most suitable to construct the public truck terminal. In the course, first some criteria for selection have been shown. Secondly wider areas are designated as a candidate areas, and lastly specific ideal sites are selected in framework of a widely applicable screening methodology.

The methodology of selecting the best area for the public truck terminal is shown in Figure 5.1.1.

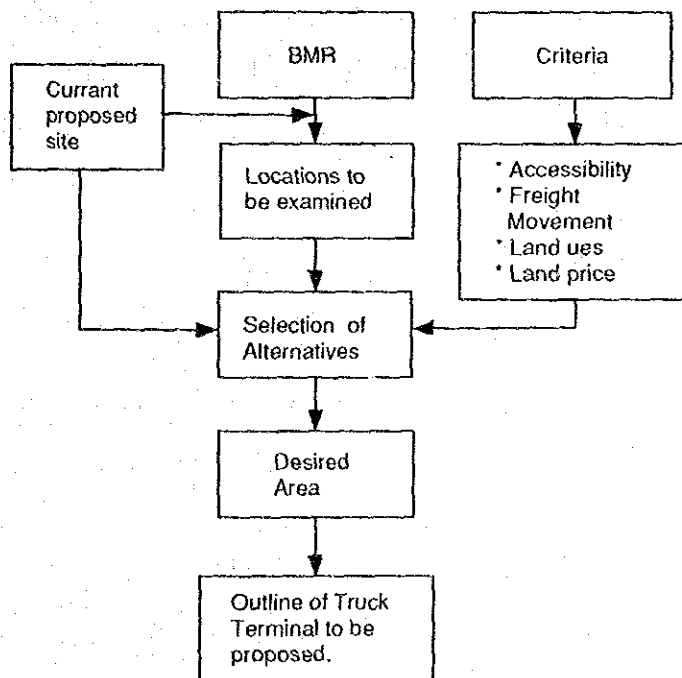


Figure 5.1.1 Methodology to Decide Desired Area

The followings are the major points examined in this chapter.

A. Currently Proposed Sites

Three routes have been surfaced which an individual bodies such as private investor, transportation association and the governmental committee, have advocated to construct the truck terminal there. Of which, some private investors had already submitted proposals to DLT.

B. Criteria for Selection of Alternatives

1. Accessibility:

Accessibility relates to a distance from trunk roads and a road network system. In this given transportation condition, a question is laid on how proposed areas are convenient for freight delivery and collection.

2. Freight Movement Pattern:

This freight movement pattern provides basic framework in formulating a modernized freight flow network, and basic data to select the best location of public truck terminal as a pivot of freight flows.

3. Land Use and Urban Structure:

Future land use and urban structure will provide a framework of the future freight generation and attraction because it outlines the spatial allocation plan of each industry.

4. Land Price:

It is apparent that the high land price had been one of the obstacles to induce the private investors to tackle the truck terminal project by themselves. Its continuous ascending trend had further worsen the situation. Thus the magnitude of land price effect on the pecuniary return is studied in terms of land price and land acquisition.

C. Location to be Examined:

According to the results mentioned above, it is carried out to arrange the locations to be discussed for truck terminals.

D. Selection of Alternatives:

Among locations in item 3 above, the alternatives are selected for the evaluation.

E. Outline of Truck Terminals to be Proposed:

Some conditions of truck terminals are listed and discussed, which are compared with each other in the next chapter.

5.2 General Conditions of Currently Proposed Site

First comprehensive study for the truck terminal in BMR was conducted by JICA in 1980. The government decided to implement its recommendations for truck terminal construction in cooperation with the private sector. However, the government could not find out appropriate private investors and the recommendations had been kept pending without any actual progress.

During this period, population and economic activities have concentrated on BMR, and the truck traffic for commodities' flows to/from BMR have remarkably increased. This induced further concentration. This vicious circle had worsened traffic congestion, and deteriorated efficiency of overall commodity flows in Bangkok.

Data shows that the detriment in efficiency is costing the nation more than 13,000 million a year in fuel bills and Bangkokian are being enforced to spend an average of 44 days a year stuck somewhere on the roads according to the Economic Review (Bangkok Review). Such big traffic jam cannot be seen even in other cities in the world.

Therefore, it is indispensable to modernize a physical distribution system to support development of BMR as a hub of the Thai economy and to alleviate the widely spread traffic congestion over the city.

In these conditions, the movements to construct truck terminals in BMR has re-surfaced from both the governmental policy planning bodies and the relevant private sectors such as transportation association. These revived movements are classified into three categories mentioned in the proceeding sections.

5.2.1 Government's Offers to Public

In the past, the government had kept their policy guideline to construct the truck terminal by the private sector. However, recognizing the necessity of truck terminal, the government at last decide to play a burden-sharing role in the project.

Responding to these change in the government policies, some private investors have responded the DLT's public announcement and have submitted proposals for the truck terminal. After evaluation on these offers, the government would provide a exclusive permission to these offerers if both sides agreed. The system of this public announcement is as shown in Figure 5.2.1.

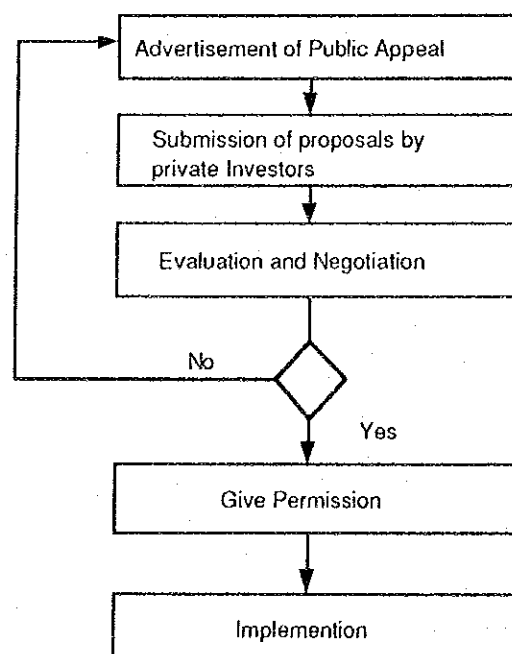


Figure 5.2.1 Procedure of Public Appeal

Such public announcements have been carried out by LTD and some private investors have submitted proposals as is mentions before.

However, government's supports in financial aspect could not be expected in the past since it was the government guideline to construct truck terminals by private sector itself.

Due to these facts, private investors had to give up constructions of truck terminals on their own expense alone.

Feasibility become low due to increasing land price as a by-product of high economic growth in BMR.

However, the government has decided to offer some assistance to support the private sector in order to improve the financial difficulties by means of land acquisition by the government and a provision of infrastructure such as transportation facilities, electricity, gas, sewage and other facilities.

Two private investors have submitted the proposals as of February 1992. They are:

A. MS Holding and Housing Co., Ltd.

B. Viriya Utsahakam Co.,Ltd.

Details of their plans are shown in the proceeding sections:

A. MS Holding and Housing Co., Ltd.

The outline of plan by MS Holding and Housing Co. Ltd, is shown in Table 5.2.1.

Its features lies on its integrated development project, a part of which is the proposed truck terminal project. Others are bus terminal, warehouses, condominium, shopping center and so on.

Table 5.2.1 Outline of Plan by MS Holding and Housing

| Item | Description |
|-----------------------|---|
| Name of Investor | MS Holding and Housing Co., Ltd. |
| Site Location | No. 2: Northern part of BMR along Route No. 1 and 43 kilometers far from the center of Bangkok (see Figure 5.2.2) |
| | No. 7: Eastern part of BMR along Route No. 34, 40 kilometers distant from the center of Bangkok |
| Size of Land | No. 2: 300 rai, a part of overall planning area as large as 1700 rai. |
| | No. 7: 236 rai |
| Planning Concept | No. 2: It forms a part of overall development project by MS Holding and Housing Co., Ltd which owns 1700 rai. The site of 300 rai is provided for truck terminal and other relevant facilities including bus terminal, warehouse and so forth. Although detail contents are not opened to public, it is supposed that condominium, department store and other commercial facilities would be constructed in the surrounding area of proposed truck terminal. |
| | No. 7: not clear |
| Peripheral Conditions | No. 2 Asian Institute of Technology (AIT) locates south to this site, 1.0 kilometer from this private company's site. A part of the proposed land is now under filling works at present. |
| | No. 7: Some industrial factories are located. |
| Access from BKK | No. 2: Route No. 1 accesses to this proposed site. An elevated express way is planned on this Route No. 1 and a part of this expressway near Bangkok is now under construction. After opening of this expressway, higher and easier accessibility will be provided. |
| | No. 7: Route No. 34 connects to Bangkok and provides high accessibility at present |