GOVERNMENT OF MALAYSIA

HNDP

HIGHWAY NETWORK DEVELOPMENT PLAN STUDY IN MALAYSIA

FINAL REPORT

SUMMARY

MARCH 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

Currency equivalents used in this Report are as follows:-

Currency Unit	=	Ringgit Malaysia (RM)
RM 1.00	=	US$ 0.394
RM 1.00	=	J¥ 49.349

(As of December 1992)

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Preface

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a Highway Network Development Plan Study in Malaysia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Malaysia a study team headed by Mr.Kokuro Hanawa, Fukuyama Consultants International Co.Ltd., from May 1991 to February 1993.

The team held discussions with the officials concerned of the Government of Malaysia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

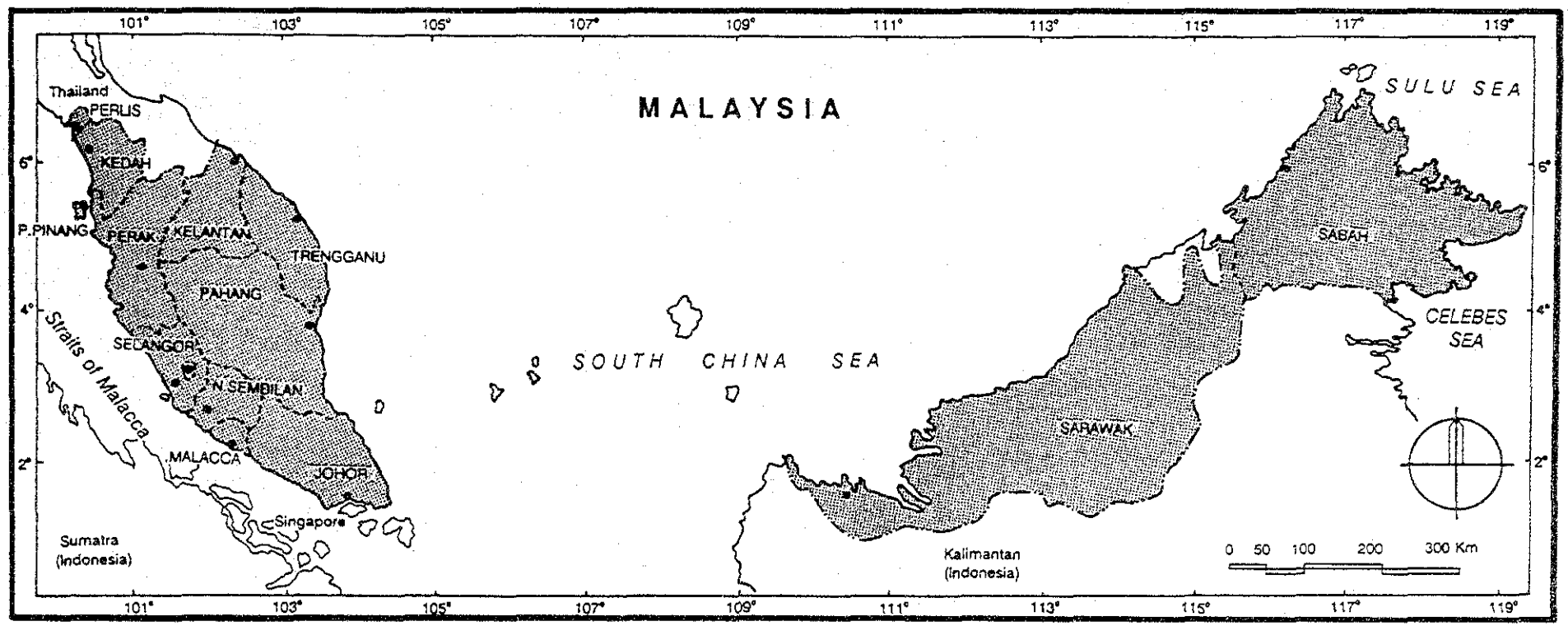
I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

March, 1993

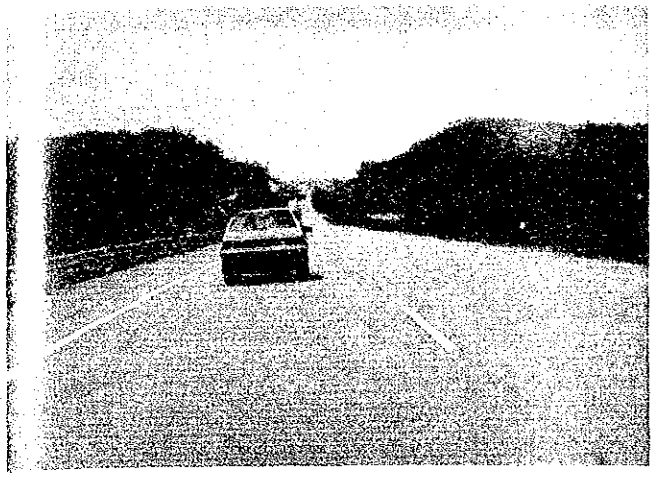
Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP

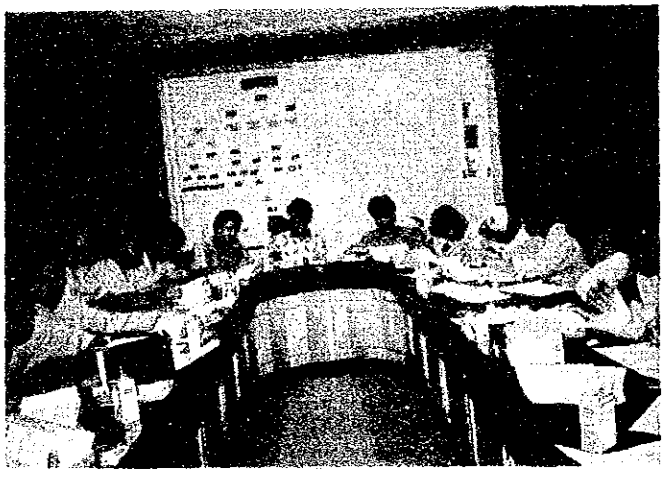


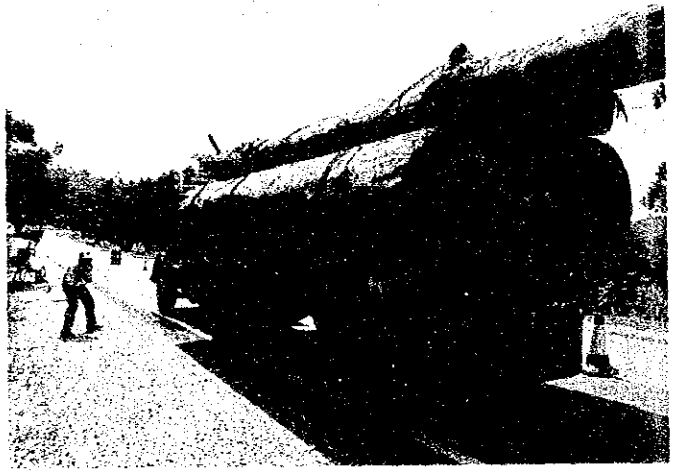
PENINSULAR MALAYSIA

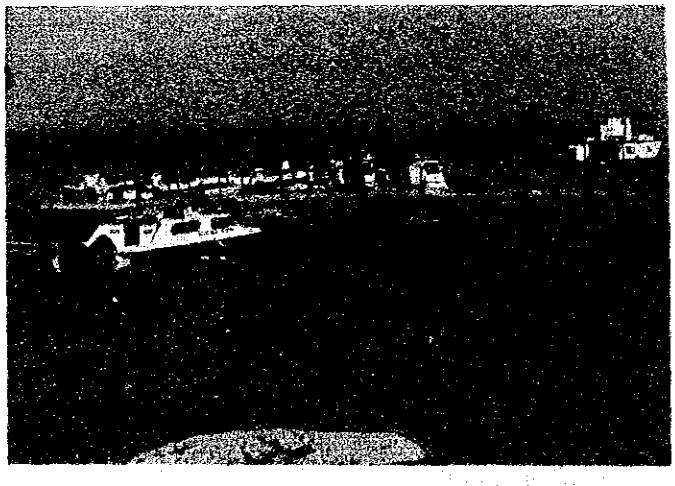


(Top To Bottom, Left To Right)

* The well maintained North–South Expressway near Pagoh in Johor
* Federal Route 1 directly cut through the town of Kampar in Perak. urban bypasses for such areas are needed to promote better level of services on the inter–urban highway.
* The national inter–urban highway network also pass by environmental areas such as the Rompin National Park in Johor.
* The rail transport in the country requires urgent improvements and modernization measures to upgrade its services so that it can become a more important alternative inter–urban transport mode.
* The Federal Route 4 passes through some steep terrain across the Main Range from Kedah to Kelantan.
* Sections of the federal road at the fringe of major urban centers often encounter traffic congestion.
* High traffic accident fatality rate in the country is now a major concern of the authority.



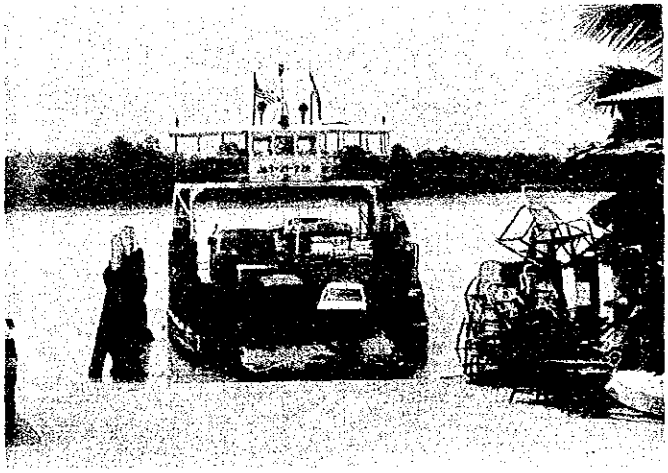


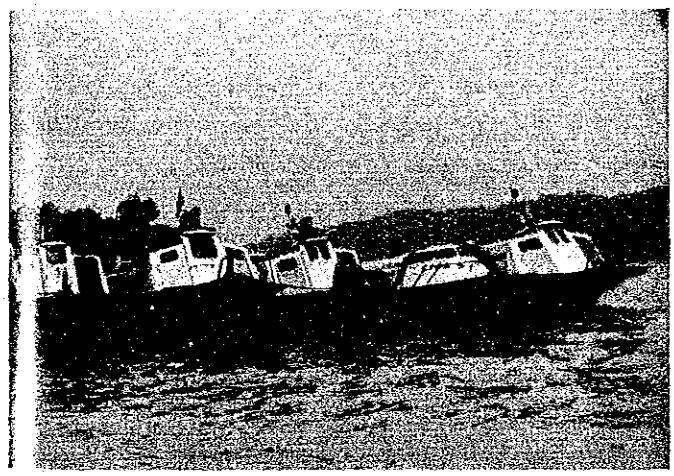


(Top To Bottom, Left To Right)

* Sampling work for the Owner Interview Survey in progress at the state JPJ office.
* One of the 14 survey operation centers set up at state JKR office throughout Peninsular Malaysia for monitoring the progress of the traffic surveys.
* Road side interview survey in progress along the North–south Expressway near Simpang Empat, Malacca
* Large truck carrying timber logs and other agricultural produce are being interviewed on the Federal Route 4 (East–West Highway)
* Road side interview survey at State boundary of Kelantan and Trengganu.
* Besides road side counting and interview survey, a simple survey on river transport was also carried out in Sarawak.

SABAH & SARAWAK





Top To Bottom, Left To Right)

This trunk road passes through some natural forest in Sarawak. Highway development that may produce adverse impacts on the natural environment requires more indepth environmental impact assessment (EIA) studies.

River transport is an important mode of travel in Sarawak. Ferry services provide important linkage across a tributory of the Rajang River High speed boats lined up a jetty near Sibu. These boats provide an important means of transport to towns such as Kapit in the interior.

* This section of the trunk road in Sarawak has just being paved. The proportion of all season roads is still low in Sarawak and Sabah compared to Peninsular.
* This section of the trunk road is undergoing pavement work. Most of the trunk road should be paved to ensure reliability in road transport.
* Conditions of trunk roads in Sabah is very similar to those in Sarawak This is the standard 2 lane highway near Sandakan.
* Sections of the trunk roads near Kota Kinabalu are well developed and maintained with wide dual carriageways.

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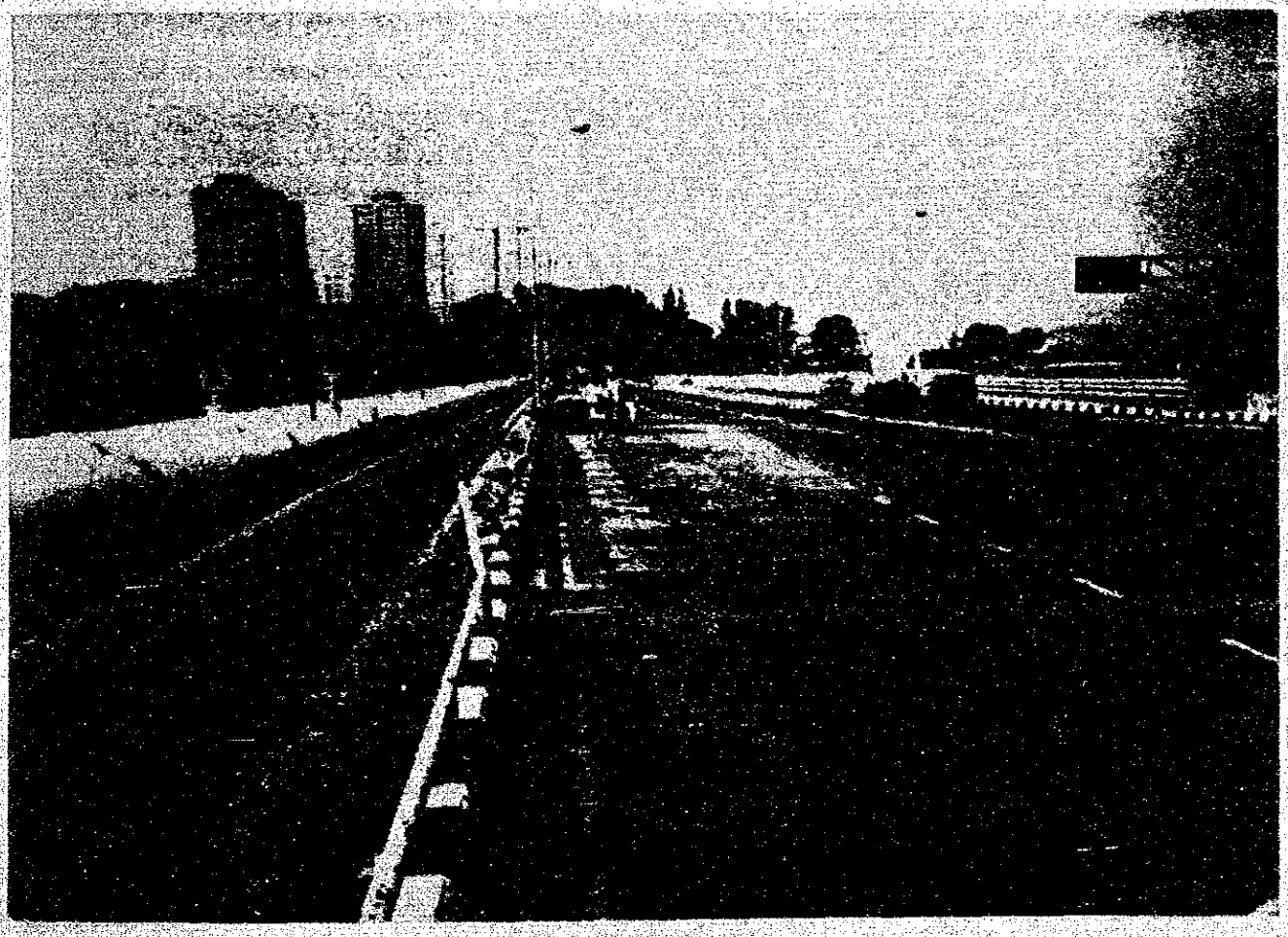
EXECUTIVE SUMMARY



Johor–Singapore Causeway

EXECUTIVE SUMMARY

A. Outline of The Study

In response to the request by the Government of Malaysia for technical cooperation in conducting a Highway Network Development Plan Study in Malaysia (hereinafter referred to as HNDP Study), the Government of Japan, through the Japan International Cooperation Agency (JICA), dispatched a Study Team to carry out this Study jointly with the Government of Malaysia. The study in Malaysia started in May 1991 and completed in February 1993.

There are two main objectives to be achieved. These are:

1. To formulate a development plan of the national highway network up to the year 2010,

2. To prioritize new and improved linkages in the planned network with respect to technical and economic considerations and to formulate a road development program.

The Study covers the 13 states of Malaysia and the Federal Territories. Due to geographical, social and developmental differences between Peninsular Malaysia with Sabah and Sarawak, different traffic surveys were designed to suit the different conditions. Analyses and traffic demand forecasting for example, were carried out separately for P.Malaysia and Sabah and Sarawak.

This Study focuses primarily on the inter-urban road network excluding intra-urban facilities such as bypasses and ring roads that do not affect inter-urban traffic. The total study road length was 16,291 km.

The study team carried out extensive data collection from existing data sources as well as traffic surveys. A total of seven different types of traffic surveys were conducted throughout the study area. About 50,000 vehicle owners were interviewed on their trip patterns while traffic counting and roadside interviews were carried out at 73 locations on the existing highway network in Malaysia. Hearings with various state planning authorities and site observation surveys were also carried out.

Based on analyses of these collected data, the study team prepared the existing OD matrices and an updated road inventory, calibrated various traffic demand models and identified the existing road transport problems in the study area. Road development index (RDI) was used as an indicator of road development in Malaysia with other developed countries, and between Peninsular Malaysia, Sabah and Sarawak.

Using macro socio-economic indicators provided by the Economic Planning Unit of the Malaysian Government, the study team forecasted the necessary future socio-economic indicators by traffic zones. Applying these results and the calibrated traffic demand models, future vehicle traffic demand for the study area was forecasted to the year 2010. In estimating the future vehicle traffic demand, the study team examined the role of road transport in relation to other modes of travel in Malaysia, particularly rail transport.

A set of broad goals and specific objectives on highway development in Malaysia was proposed by the study. These goals and objectives were aimed at solving the existing road transport problems such as traffic congestion and high number of traffic accidents and for promoting an efficient highway system. They are formulated to be in line with the overall national development policies of the Government of Malaysia as given in the Vision 2020 and Outline Perspective Plan.

In deriving a highway network concept plan for the study area, the study team analyzed and examined in detail various highway planning constraints and considerations. These include the physical and topographic features of the study area, climatic influences, urban development hierarchy system in Malaysia, industrial development plans and programs, tourist development projects, transport facilities planning, regional land development schemes and environmental conservation areas. While road linkages are important and should be provided to the various development schemes or projects, difficult topographic and environmental conservation areas were avoided as much as possible.

For Peninsular Malaysia, the future highway network concept plan stresses on strengthening the highway network for the economically important west coast region, improving east-west linkages, extending the expressway network to the east coast and developing a highway to promote development in the central corridor. For Sabah and Sarawak, the future network concept plan stresses on expanding the existing highway network to the coastal and interior areas, providing a direct linkage between the two states and strengthening the east-west linkages in Sabah.

Three alternative highway network development plans for Peninsular Malaysia were formulated based on the concept plan. Due to the low development level in Sabah and Sarawak, only one alternative highway network plan is proposed.

These alternative plans are evaluated on their functional suitability of the networks, their economic feasibilities and lastly their impacts on promoting social and regional development in the country.

Cost estimates for the alternative plans were carried out by the study team based on detail studies on unit construction cost of various highway structural types in Malaysia and preliminary engineering design of highway cross-sections. Although there are many direct and indirect benefits that can be derived from road development, the two main quantifiable benefits namely savings in vehicle operating costs and travel time are estimated for each of the alternative plans.

For evaluating the functional suitability of the alternative network plans, indicators such as future average volume/capacity ratio, average travel speed and average trip length were used. For economic evaluation, three economic indicators namely the benefit-cost ratio (BCR), internal rate of return (IRR) and net present value (NPV) were used. Road development index is utilized as an indicator for assessing the impact of the alternative plans on social and regional development.

Results of the above evaluation and analyses showed that Alternative 2 was the best performing plan and therefore it is recommended to be the future highway network

development plan to the year 2010 in Peninsular Malaysia. The future network plan proposed for Sabah and Sarawak was also found to be functionally and economically feasible. It is therefore proposed to be the future highway development plan for these two states.

The study team analyzed the past investment trend in road development by the Malaysian Government from the Second Malaysia Plan to the Sixth Plan from 1971 to 1995. Analyses were also carried out to rank the proposed highway projects based on their network formation, cost effectiveness, future traffic volume and v/c ratios. These projects were ranked from 1 to 3 according to their level of priority. Projects that can be implemented under the privatization scheme were also identified. Based on these analyses, an implementation plan was proposed with three implementation phases. Lastly, the study team also proposed a set of implementation policies and put forward various recommendations.

B. Conclusions

(1) Overall Highway Network Development

Results of technical and economic studies showed that the proposed Highway Network Development Plan to the year 2010 with a total road length of 15,298 kilometres is economically and socio-environmentally feasible. When fully implemented, this plan is expected to support and promote the national and regional development plans formulated in the "Vision 2020" and 'NDP' by providing an efficient and reliable road transport infrastructure necessary to meet the future demand for greater mobility and transportation of people and goods throughout the country.

(2) Future Highway Network Configuration

The proposed future highway network for Malaysia will provide accessibility to all regions while strengthening further the existing growth corridors. In Peninsular Malaysia, the Principal Highway Network System comprising of expressways and major highways, is planned along 3 north-south corridors (east, west and central) and 5 east-west corridors. For Sabah and Sarawak, this highway network system is being planned along the entire coastal corridor along Sarawak and continue to Sabah via a new link between Marudi and Lawas. The proposed highway network development plan is shown in Figures 1 and 2.

The Principal Highway Network System thus is the main frame that connects the national capital with national level regional centres and regional capitals, the principal growth areas of industrial development and other strategic growth areas.

This Principal Highway Network System is supplemented and supported by minor highways and primary roads. These roads thus connect regional capitals with regional centres and sub-centres with the main role of providing good accessibility to growth and industrial development areas within the region.

Table 1 : Proposed Highway Network in Malaysia to 2010

(In kilometre)

		Peninsular Malaysia	Sabah	Sarawak	Malaysia
Principal Highway	Expressways	1,394	-	-	1,394
	Major Highways	4,114	892	972	5,978
Sub Total for Principal Highway		5,508	892	972	7,372
Minor Highways		1,826	-	35	1,861
Primary Roads		3,516	1,113	1,436	6,065
Total		10,850	2,005	2,443	15,298

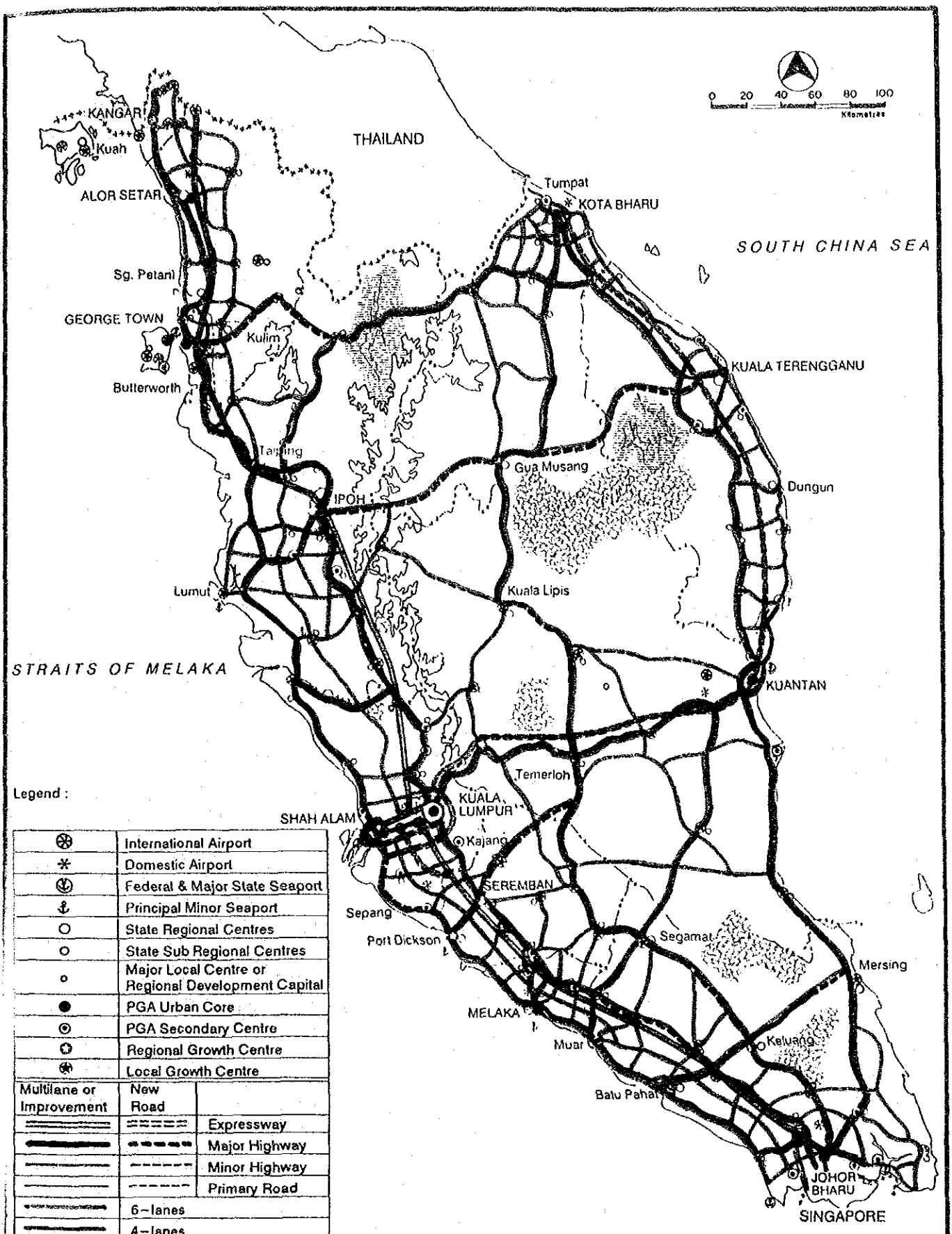


Figure 1 : Proposed Highway Network in Peninsular Malaysia to 2010

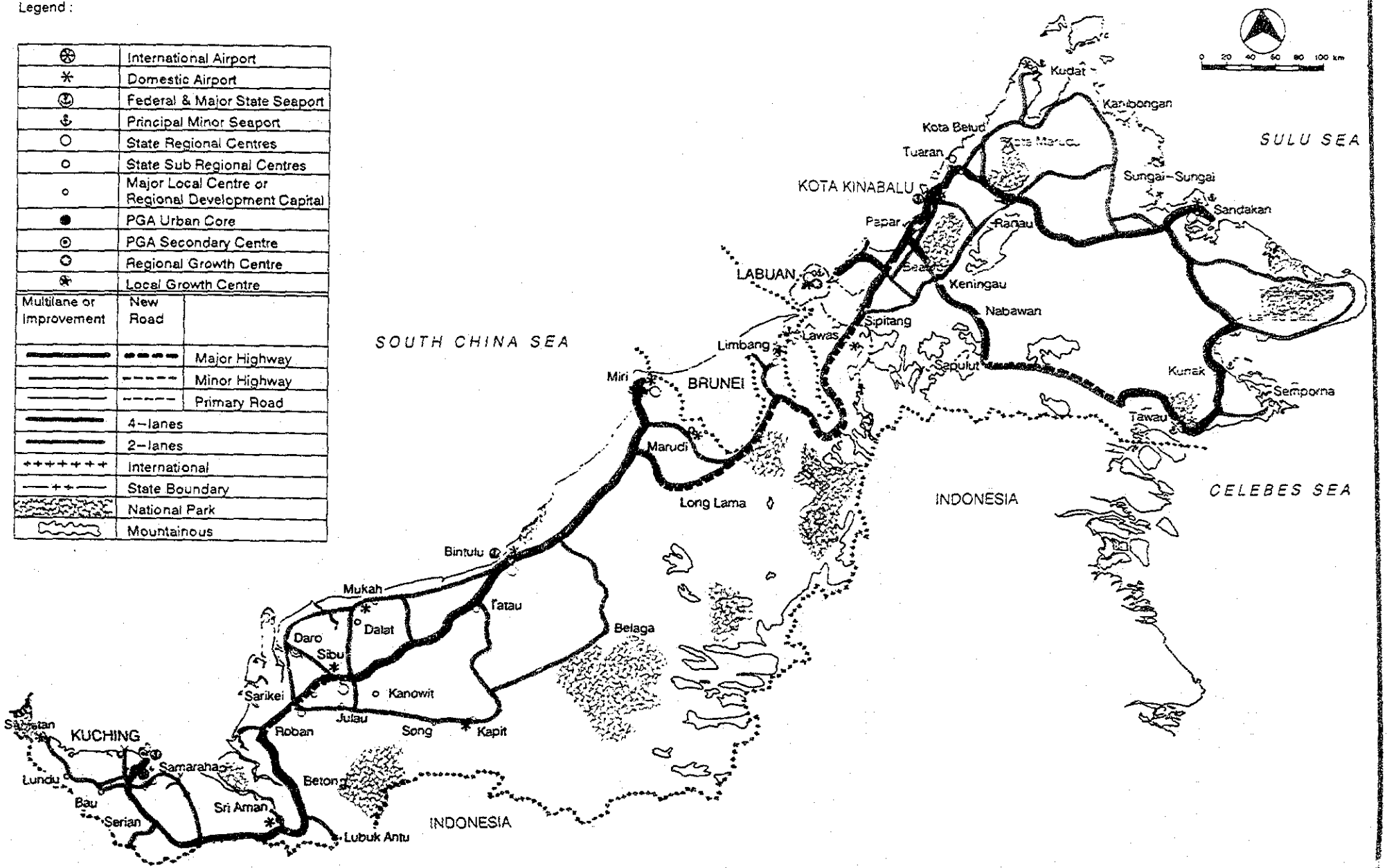


Figure 2 : Proposed Highway Network Plan in Sabah and Sarawak to 2010

(3) Investment Requirements

The total investments required for realizing the proposed future highway network described above by the year 2010 are estimated to be approximately RM 53.0 billion.

Even if some of the proposed projects are assumed to be implemented by privatization scheme, the investment requirements may not be sufficiently met by the highway and bridge allocations in the federal government's development fund. Therefore, it is suggested that :-

1. The Government considers allocating a higher highway and bridge development fund in the coming 7th, 8th and 9th plans,

2. A portion of the road user charges (such as road tax, and other users revenue) which become the General Federal Government Revenue at present should be specifically given to the development of highways.

Table 2 : Investment Requirements for Highway Development to Year 2010

(in RM million)

Category	Peninsular	Sabah	Sarawak	Malaysia
Expressways	8,134.1	-	-	8,134.1
Major Highways	14,030.5	4,213.2	3,724.2	21,967.9
Minor Highways	7,022.2	-	118.6	7,140.8
Primary Roads	6,917.0	3,879.1	4,967.2	15,763.3
Total	36,103.8	8,092.3	8,810.0	53,006.1

Source : Study Team estimates

(4) Implementation Programme

The technical and economic studies carried out in this study reveal that the following projects should be preferably implemented according to the implementation schedule.

Table 3: Implementation Programme for Future Highway Development to 2010

(in RM million)

Region	Phase I (1996-2000)	Phase II (2001-2005)	Phase III (2006-2010)
Peninsular Malaysia	8,236.6	11,336.6	16,530.6
Sabah	2,118.0	2,488.0	3,486.3
Sarawak	2,448.0	2,647.3	3,714.7
Total	12,802.6	16,471.9	23,731.6

C. Recommendations

Based on the various findings and conclusions derived in this study, the following recommendations are put forward.

1. The proposed inter-urban highway network shall be developed as the main transport system in meeting future traffic demand in Malaysia.

2. To ensure that road transport is not over-burdened in future, the government of Malaysia has to encourage the use of other transport modes, particularly rail transport through modernization of the existing rail transport infrastructure, expanding its network and development of inland ports for the promotion of multi-modalism between rail and other modes in the country.

3. Highway development planning should strive for the achievement of a functional hierarchy system as proposed while urban bypasses shall be provided to relieve congestions around major urban areas.

4. More effective road safety programs are to be provided and supported with a revolving fund for its implementation. Facilities such as motorcycle lanes, pedestrian bridges or subways and grade separated accesses along expressways and major highways are to be provided to improve traffic safety.

5. Detail environmental impact assessment (EIA) studies must be carried out on all highway planning and construction to minimize the foreseeable adverse impacts on the natural environment.

6. The present privatization scheme is to be reviewed and further encouraged for development of highways in Malaysia through joint-ventures and cross-subsidy.

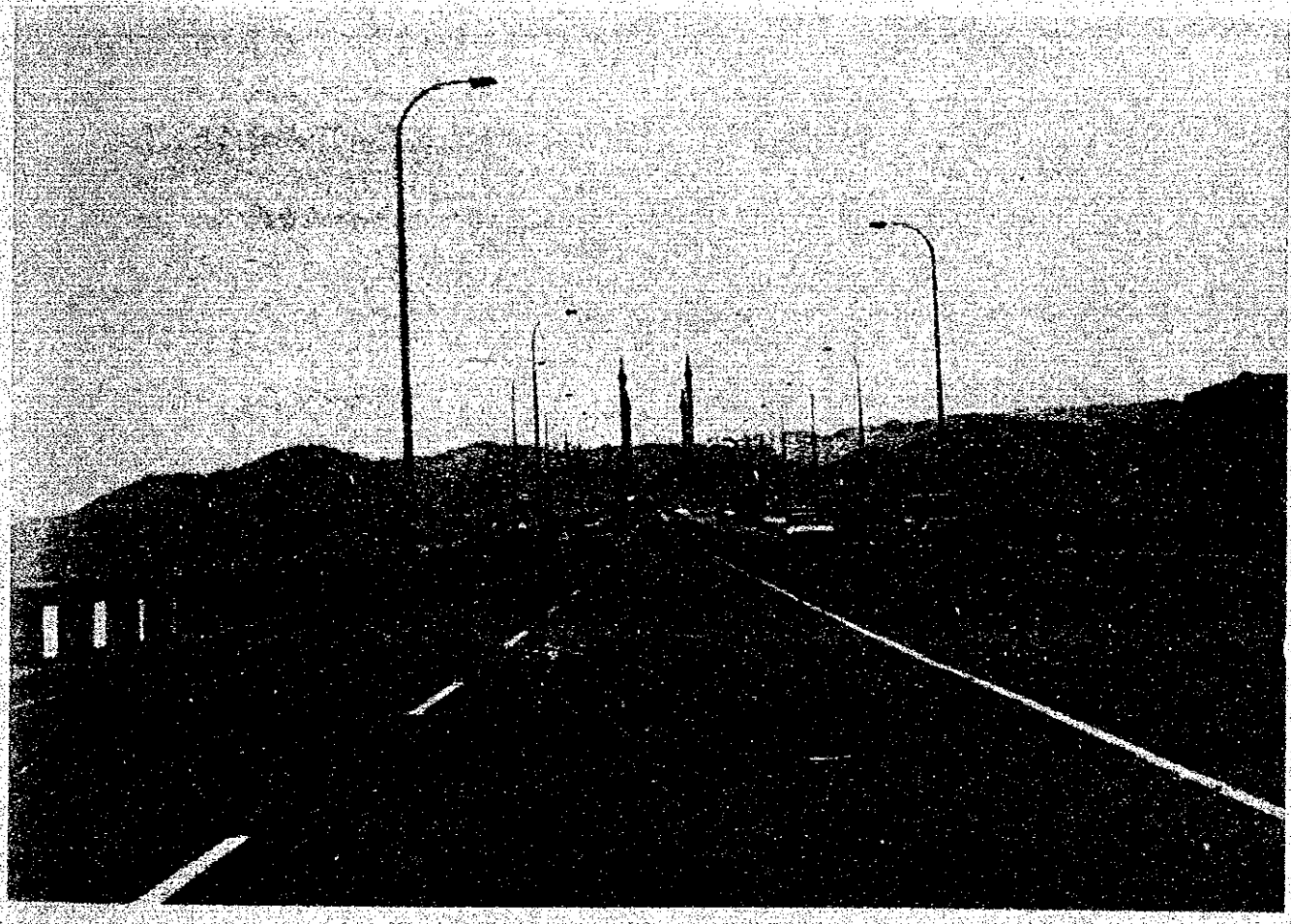
7. Examining the past road development expenditures by the Government of Malaysia, allocations for road development in the coming 7th, 8th and 9th Malaysia Plan will have to be increased in order to implement the proposed national highway network as planned. It is recommended that a portion of the road users revenue be allocated directly for road development.

8. Feasibility/engineering studies on the proposed priority highway projects are to be carried out as soon as possible. Four high priority projects are identified:

   - Kuala Lumpur Outer Ring Road/South Klang Valley Expressway,
   - Sabah and Sarawak Linkage
   - Kuala Lumpur - Kuantan Expressway
   - Port Dickson - Seremban Highway.

9. A periodical review of this HNDP study shall be conducted every five years to update the road development program.

SUMMARY



Penang Bridge

1.0 INTRODUCTION

1.1 Background

In response to the request by the Government of Malaysia for technical cooperation in conducting a Highway Network Development Plan Study in Malaysia (hereinafter referred to as HNDP Study), the Government of Japan, through the Japan International Cooperation Agency (JICA), dispatched a Study Team to carry out this Study. The study in Malaysia started in May 1991 and ended in February 1993.

This Summary of the Final Report presents the major findings, proposal and recommendations for a comprehensive highway network development plan for Malaysia to the year 2010.

1.2 Objectives of Study

There are two main objectives to be achieved. These are:

1. To formulate a development plan of the national highway network up to the year 2010,

2. To prioritize new and improved linkages in the planned network with respect to technical and economic considerations and to formulate a road development program.

1.3 Study Area

The Study is to cover the whole 13 states of Malaysia and the Federal Territories.

The Study focuses primarily on inter-urban road network excluding intra-urban facilities such as bypasses and ring roads that do not affect inter-urban traffic. The total study road length amounted to 16,291 km.

1.4 Study Approach and Scope of Work

The Study for preparing the National Highway Network Development Plan is divided into three (3) phases:

Phase I: Formulation of Highway Development Concept Plan,
Phase II: Proposal for the National Highway Network Development Plan,
Phase III: Preparation of the Final Report.

The major study activities of these phases are given in a flowchart in Figure 1.1.

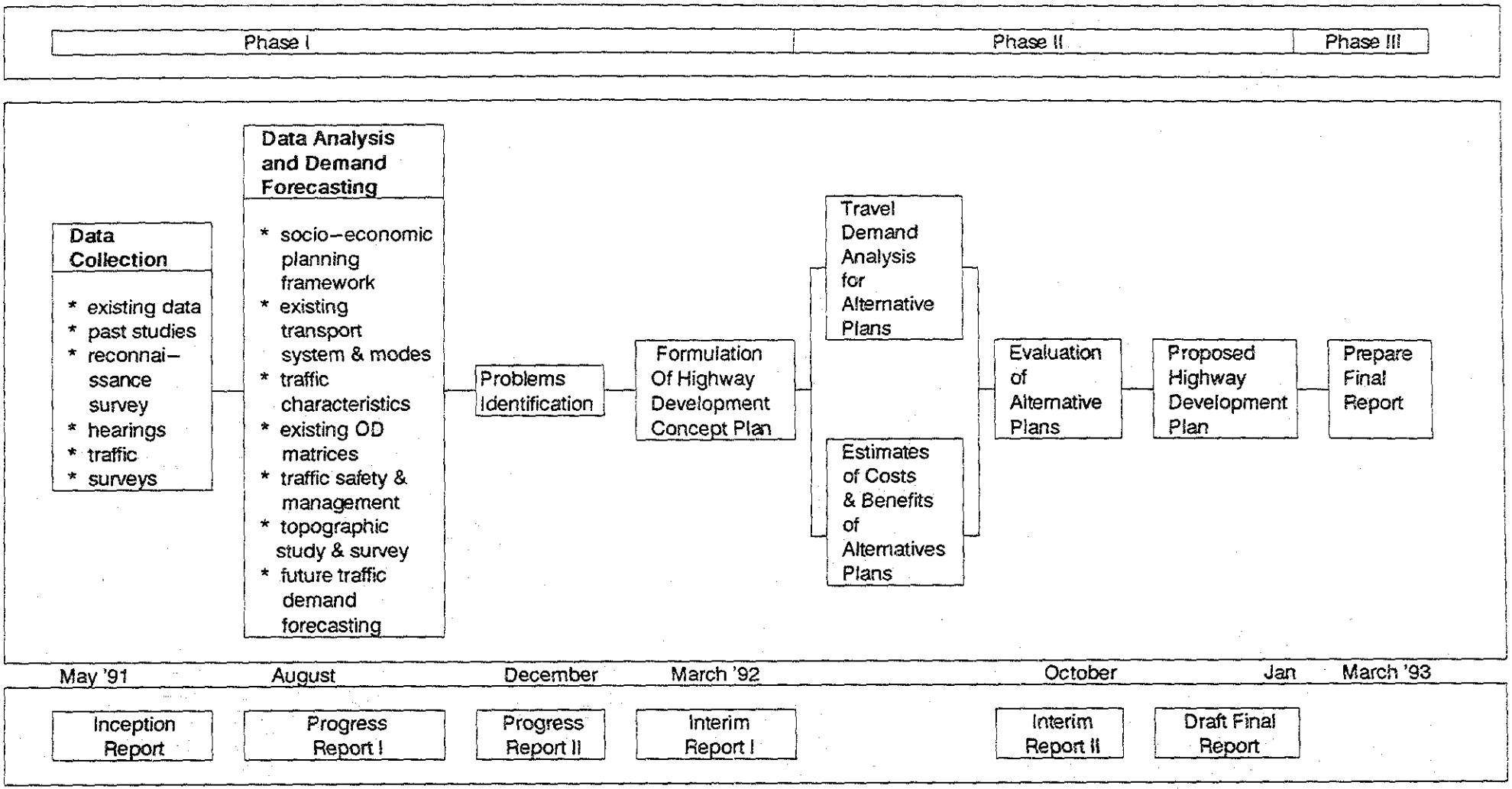


Figure 1.1 : Flowchart of Study Approach and Phasing

1.5 Reporting

The Final Report of this HNDP Study consists of 3 volumes of reports:

- Summary
- Main Volume
- Appendix Volume

Prior to the submission of this Final Report, 2 Progress Reports, 2 Interim Reports and a Draft Final Report were submitted. Details of technical studies and analyses as well as tabulation and data are compiled in 15 volumes of technical reports.

1. Traffic Survey Planning
2. Traffic Survey Planning - Appendix
3. Roadside Interview and Counting Survey in P.Malaysia
4. Roadside Interview and Counting Survey in Sabah and Sarawak
5. Travel Speed Survey
6. Socio-economic Study
7. Traffic Demand Analysis - Methodology
8. Traffic Demand Analysis - Computer Operation Manual
9. Natural Conditions
10. Environmental Study
11. Road Inventory Survey - Analysis
12. Road Inventory Survey - HNDP Road Inventory Data
13. Road Inventory Survey - Road Inventory Data Sources
14. Preliminary Engineering Design and Project Cost Estimates
15. Preliminary Engineering Design and Project Cost Estimates - Appendix

2.0 CONCLUSION AND RECOMMENDATIONS

2.1 Conclusion

1. The existing transport system in Malaysia is found to be over dependent on road transport for both passenger travel and freight. Road transport accounted for more than 98% of the total passenger and freight transport in the country. The use of other transport modes especially rail transport should be encouraged. A concrete rail transport development plan and policy is needed to modernize the existing KTM rail transport facilities.

2. The existing highway network is inadequate and suffers from various functional inefficiencies such as severe traffic congestions around major urban areas, under capacity in many sections of major roads and high accident rates. More than 50% of the existing federal trunk roads examined by the study are actually found to be deficient in their designed carriageway width. Fatality rates in road traffic accidents are very high at 7.4 fatalities/10,000 registered vehicles. This is about 5 times higher than corresponding rate in Japan. Accidents in Malaysia are characterized by the high number of injuries involving motor cyclists.

3. Road network along the west coast of Peninsular Malaysia needs to be further strengthened to cater for the expected high future traffic demand generated by the continued and rapid economic growth along the entire west coast corridor. Although the North-South Expressway will be completed soon, parallel north-south federal trunk roads especially route 1 and 5 must be upgraded. Road network in the east coast on the other hand requires improvements and further extensions to less developed areas and regional land development schemes. Linkages of urban centers in the east coast with established growth poles like Kuantan and Kuala Lumpur need to be improved. A highway is needed along the central corridor of P.Malaysia to promote development of this resource-rich region. There are also many tourist attraction and development areas in the east and central regions of P.Malaysia. Better road accesses to these areas are also needed.

4. While 85% of roads in P.Malaysia are paved, only 35% of the roads in Sabah and Sarawak are paved. Upgrading and improvement of trunk roads in Sabah and Sarawak are therefore the most urgent tasks. A direct road linkage between Sabah and Sarawak is urgently required to promote economic cooperations between the two states. River transport remains the main transport mode for most of the interior and coastal areas in Sarawak. Future road network shall therefore be planned to provide road accesses to the interior areas of Kapit, Belaga and Long Lama; and coastal towns of Daro, Mukah and Kabang.

5. Road development index for Malaysia is relatively low (0.128) compared to the developed countries (Japan 0.239, USA 0.486 and Germany 0.323). Road development index is also found to be unbalanced between the west and east coasts of Peninsular Malaysia and between P.Malaysia (0.173) and Sabah (0.103) and Sarawak (0.081). Future highway development shall therefore correct these imbalances.

6. The Malaysian GDP is expected to grow at a rate of 7.0% per annum to the year 2010. Total GDP is forecasted to reach RM155.65 billion by year 2000 and RM304.88 billion by 2010. Per capita GDP is hence forecasted to increase rapidly from RM4,500 in 1991 to RM11,860 by 2010. This factor will result in a very rapid motorization rate in the near future in the country.

7. Total population in Malaysia is estimated to reach 27.5 million by year 2010 at an average annual growth rate of 2.1%.

8. The total vehicle traffic demand is forecasted to increase from 7.1 million vehicle trip a day in 1991 to about 22.0 million vehicle trips a day by 2010 for P.Malaysia. For Sabah and Sarawak, the future vehicle traffic demand is estimated to be about 5.0 million vehicle trips a day in 2010 compared to only 1.6 million vehicle trips a day at present.

9. Three alternative network plans for P.Malaysia are formulated and evaluated. Although all the plans are found to be economically and functionally feasible, Alternative 2 is the best performing plan. It is thus proposed to be the future highway network development plan for P.Malaysia. One alternative plan is formulated for Sabah and Sarawak and this is found to be economically and functionally feasible.

10. The proposed future highway network development plan for Malaysia to year 2010 is expected to contribute significantly to the socio-economic development of Malaysia in the next two decades in achieving the national goal of attaining the status of a developed nation by the year 2020.

11. The proposed highway network development plan has a functional hierarchy system, consisting of 1,394 km of expressway, 5,933 km of major highways, 1,861 km of minor highways and 6,065 km of primary roads, that is essential for the efficient transport of passengers and freight. The proposed network is able to meet an expected future traffic demand of about 22 million vehicle trip a day in Peninsular Malaysia and another 5 million vehicle trips a day in Sabah and Sarawak.

12. Road development level in Malaysia as a whole is still low and is unbalanced between different regions in the country. The proposed highway network development plan is able to improved the road development index in Peninsular Malaysia to a level of 0.20 and 0.14 ~ 0.13 for Sabah and Sarawak by the year 2010 whereby bringing about a positive impact on social and regional development. In terms of the level of service of the network, it is able to improve the congestion degree of 2.2 as predicted in the "Do-Nothing" scenario to 0.7 in the year 2010.

13. The proposed highway network development plan requires a total investment of RM53 billion (at 1992 prices). Out of this total sum, RM22,700 million will be for new construction, RM12,410 will be for improvement and RM17,890 million will be for widening of the existing highways.

14. The proposed plan is economically and functionally feasible and it estimated to achieve a benefit/cost ratio of 3.34 for P.Malaysia, 2.11 for Sabah and 1.04 for Sarawak. The plan is also able to achieve high IRR values of 29.8% for P.Malaysia, 23.7% for Sabah and 12.4% for Sarawak.

15. The proposed future highway development plan for Malaysia to the year 2010 is to be implemented in three phases. Phase I (1996-2000) will require an investment of RM12,800 million, Phase II (2001-2005) will require RM16,470 million and Phase III (2006-2010) will require RM23,730 million.

2.2 Recommendations

For the successful implementation of the recommended highway network development plan to the year 2010, the following implementation policies and strategies are proposed.

The two main overriding national road transport policies are:

P1 The proposed inter-urban highway network shall be the major transport system to handle future traffic demand in Malaysia.

P2 Other transport modes, especially rail transport shall be modernized to encourage its use for both passenger and freight transport.

These overall policies will be the main guidelines for highway development for the next 20 years, P1 for whole study area and P2 for Peninsular Malaysia. They shall be further supplemented by the following implementation strategies.

To ensure a functional national highway network configuration in future, the following strategies are recommended:

S1: A functional hierarchy of highway according to the proposed network plan shall be developed and maintained in the country.

S2: The expressway network shall be extended to East Coast of Peninsular Malaysia.

S3: The highway network in West Coast shall be further strengthened forming a ladder pattern configuration.

S4: More linkages between East and West Coasts of Peninsular Malaysia shall be provided.

S5: Urban bypasses shall be provided especially on the Principal and Minor Highway System to relieve traffic congestions around the urban areas.

S6: A direct road linkage between Sabah and Sarawak shall be provided.

S7: Road accesses to the coastal towns and interior of Sabah and Sarawak shall be developed.

In view of the alarming increase in fatality rate among motor cyclist and pedestrians, more stringent effective measures must be introduced. Policy P1 and strategy S5 will help to reduce road accidents. However to enhance road safety more road safety facilities and appropriate education programs should be introduced through the following recommendations.

S8 : Specific lanes for motorcycles are to be provided in heavily trafficked roads.

S9 : More pedestrian subways or bridges shall be constructed.

S10: Appropriate driver education system shall be introduced in order to instill safer driving habits and to promote road safety awareness and etiquette,

S11: Develop a five year road safety programme and provide sufficient funds preferably a revolving fund to implement the above programme.

To mitigate and minimize the short and long term impacts of highway development on the natural and living environments, it is recommended that:

S12: In conducting feasibility and engineering studies of the highway, alignment and structure of the road shall be carefully studied by means of Environment Impact Assessment (EIA) studies to minimize effects on the natural environment.

S13: During construction of the highway, suitable construction methods be chosen to minimize the adverse effects on the environment.

S14: Upon completion of a highway, prompt action shall be taken to protect the exposed ground by tree planting, turfing of slopes and other slope protection measures.

S15: Sufficient right-of-way shall be provided to reduce noise and air pollution by erection of noise screens such as tree planting, setback or bunking.

S16: The grade separated accesses shall be provided to neighbouring communities whenever possible to safeguard safety of roadside residents.

S17: The appropriate landuse planning for land adjacent to the highways shall be carried out so as not to affect the intended function of the highways.

S18: Regulations with respect to smoke emission and noise level control shall be effectively enforced.

Since the Malaysian Government has decided to implement modernization of the Malayan railway through double tracking between Rawang-Seremban and KL-Port Klang and introduce other related facilities, the following policies are recommended to supplement P2.

S19: The modernization program of KTM shall be further extended to the entire west coast line in Peninsular Malaysia,

S20: More inland ports and terminal facilities shall be constructed at strategic locations to encourage multi-modalism especially between road and rail transport and between maritime and rail transport.

The Study has forecasted the increase of freight traffic demand in future from 640 million tonne in 1991 to 2,400 million tonne by 2010. To meet this huge demand in future and to promote better freight transport, it is necessary to enhance the development of highway network as well as to modernize the present freight transport system. The traffic survey conducted in this Study indicated a large proportion of lorry trips were unladen. It is therefore necessary to improve freight transport to achieve a higher loading efficiency.

S21: Efficient freight transport shall be established through containerization, segregation of inter-city line hauliers from intra city distributors including introduction of multi-modalism.

S22: Modernization of the freight transport industry through agglomeration of individual small transporters shall be introduced.

S23: Freight terminals such as truck terminals, container terminals and inland ports shall be established at strategic locations,

S24: Study on modernization of freight transport shall be undertaken.

Observations of the existing privatized projects show that the performances of these projects are generally good at present. However these companies might face financial difficulties in future similar to those experienced by the highway concession companies in France and Italy. The Government should consider incorporating together highways which have less traffic demand with heavily trafficked roads in order to speed up road development in the country. Therefore it is recommended that:

S25: The present privatization scheme shall be reviewed either through full privatization, joint-venture with private enterprises or encourage cross-subsidy from a more profitable project to another.

The HNDP Study has recommended the development of a future highway network in achieving national and regional development goals in Malaysia. The Study has accordingly identified some of the proposed highways as priority projects on the basis of their role in network formation and traffic demand.

To ensure continuity and on-schedule implementation, it is recommended that,

S26: ***Feasibility/Engineering Study on highway development projects shall be undertaken.***

The high priority projects for the immediate conduct of feasibility and engineering studies are:

(1) Kuala Lumpur Outer Ring Road/South Klang Valley Expressway
(2) Sabah and Sarawak Linkage
(3) Kuala Lumpur - Kuantan Expressway
(4) Port Dickson - Seremban Highway

The proposed highway network development planed has been analyzed based on 1991 traffic demand and future socio-economic indicators from EPU. The existing population data, one of the basic data for traffic demand forecasting is also estimated. Even though the 1991 population census has been completed, the processing of the data has not been finished. Moreover, unforeseeable economic changes might be happen. Therefore:

S27: ***The review of the HNDP study shall be conducted every five years to update the road development program or from time to time when necessary.***

3.0 OUTLINE OF THE STUDY

3.1 Existing Road Transport and Traffic Conditions

3.1.1 Data Collection

The Study team carried out extensive data collection from both existing data sources such as study reports, statistical publications, papers and documents as well as actual traffic surveys which were planned and executed throughout Malaysia. A total of 7 different types of survey were conducted. About 50,000 vehicle owners were interviewed on their trip patterns. Traffic counts were executed at 73 locations throughout the country. The study team visited the various state planning authorities and conducted hearings with the officials in charge on aspects of road planning, implementation and other issues. Road observation surveys were also carried out by the team to gather information on the general conditions of the study road length for preparing the road inventory data.

3.1.2 Existing Road Transport Conditions

The national transport system is comprised of the four major modes of road, rail, air and maritime transport. Road transport remains the most important mode both for goods and passengers in the country. It accounted for about 99.8% of the total passenger traffic a year in P.Malaysia in 1991 and 98.5% of the total freight transport.

The total traffic demand in Peninsular Malaysia on the roads was estimated at some 7.1 million trips a day in 1991 based on results from the traffic surveys. The average trip production rate for the entire vehicle population except motorcycles and trailers therefore was estimated at 3.5 trips a day per vehicle. Taking into account the distance travelled, there were some 122.3 million vehicle-kilometre of traffic a day on the existing road network. In terms of passenger-kilometre carried by this volume of traffic, the amount was estimated at 242.4 million passenger-km a day. In comparison, Sabah had only 971,000 veh trips a day in 1991 and Sarawak 640,000 trips. Together there were only 1.6 million trips a day for both states.

Figure 3.1 shows the total vehicle trip OD desire lines between states for P.Malaysia in 1991. Travel desires are strong among the west coast states and Pahang. There were some 600,000 trips a day between Selangor and KL. Travel desire between Johor and Singapore was also found to be substantially large at 35,800 trips a day. The travel desire line between P.Pinang and Kedah was 27,600 trips a day indicating the importance of Kedah as a hinterland to Penang. Travel desire of N.Sembilan with Selangor and Kuala Lumpur were about 19,000 and 10,000 respectively. Trip volume between the east coast states were only within the range of 7000 a day.

This vehicle OD pattern clearly displays the prominence of KL-Selangor in the Central Region, Johor in the South Region, Penang in the North Region and Pahang in the East Region. Desire lines between Kelantan, Trengganu with P.Pinang, Perak are rather negligible due to the lack of direct road linkages. Whereas desire lines between Pahang with KL, Selangor and Johor are sizeable with the direct good road linkages.

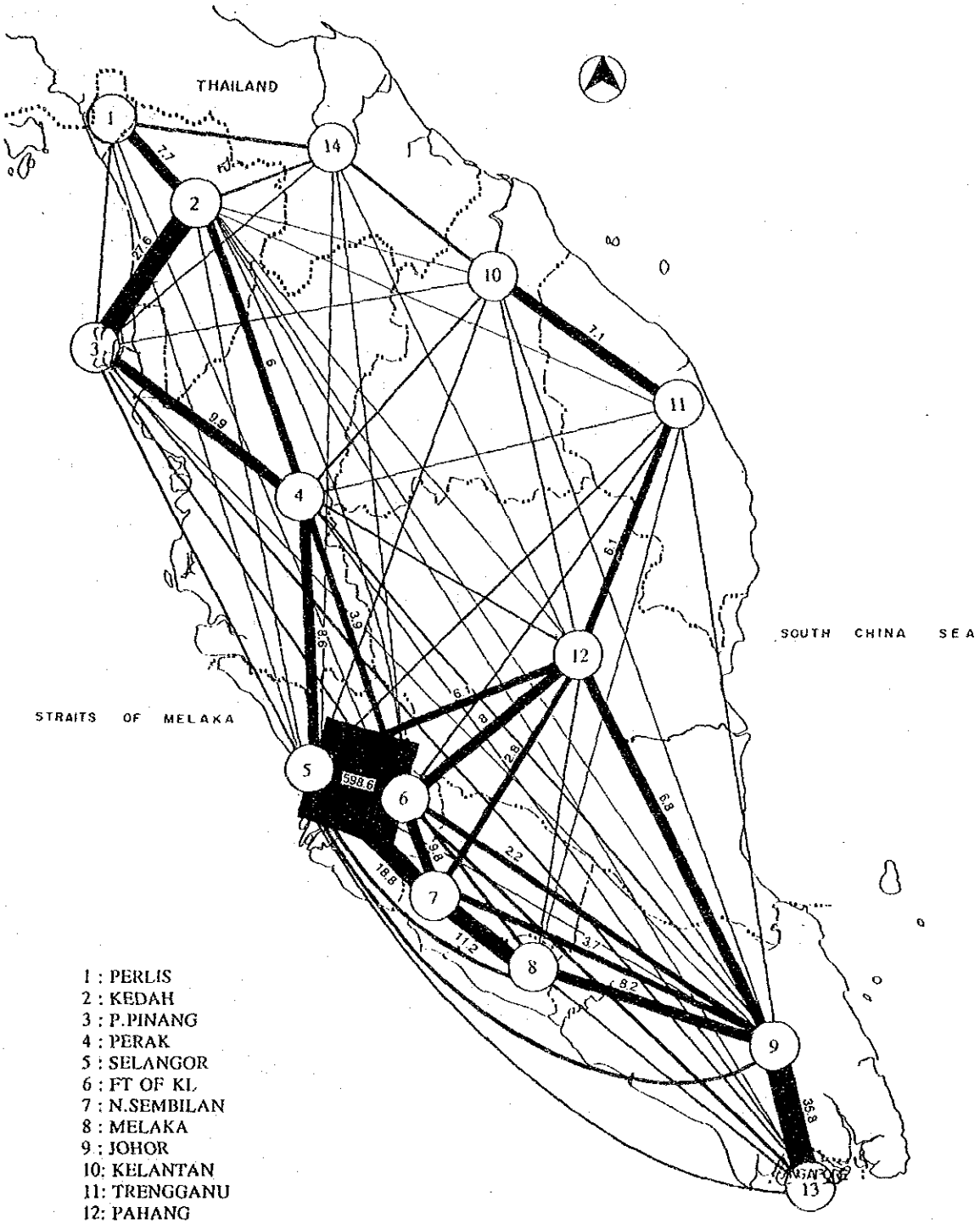


Figure 3.1: Vehicle Trip OD Pattern in P.Malaysia in 1991

Similar desire lines are plotted for Sabah and Sarawak and shown in Figures 3.2 and 3.3. In Sabah, strong desire line is found between K.Kinabalu and Beaufort, Lahad Datu with Tawau. East to west desire lines are not significant due to largely the poor road linkages. Desire lines in Sarawak are small except for Kuching with Sri Aman. The desire lines clearly reflect the low road development level in Sarawak.

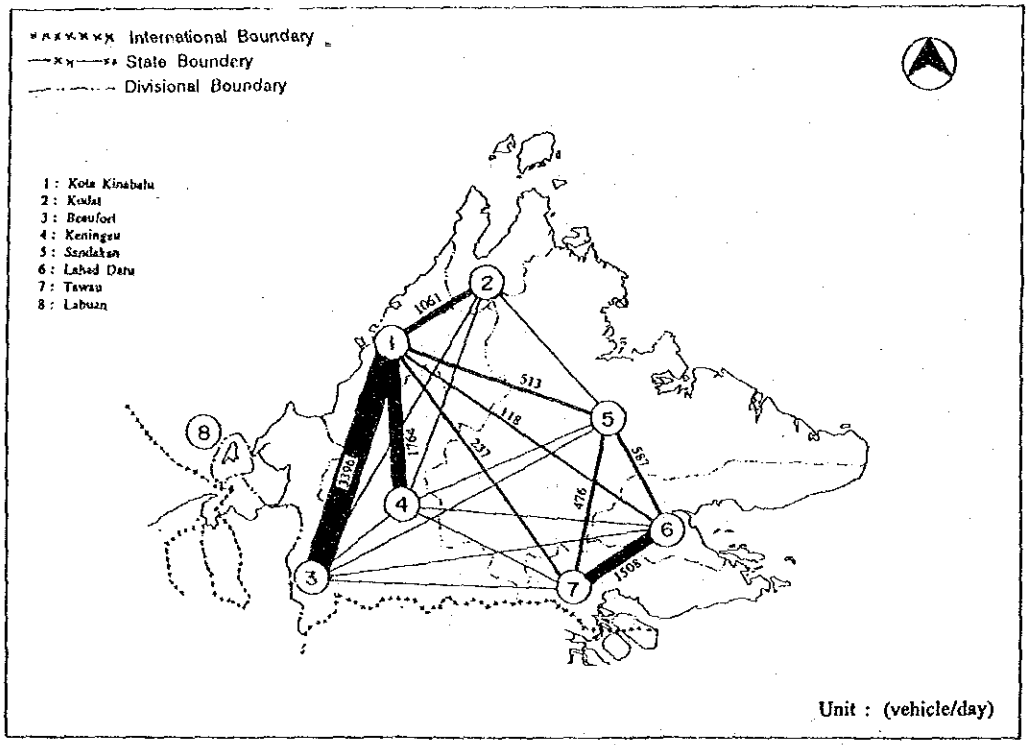


Figure 3.2: Vehicle Trip OD Pattern in Sabah in 1991

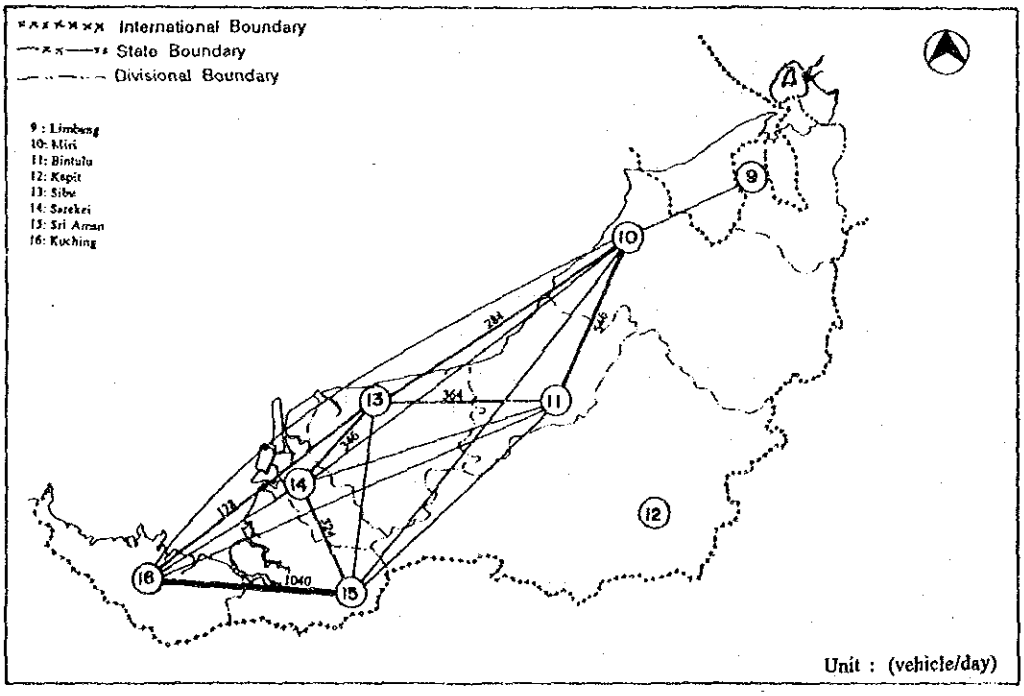


Figure 3.3: Vehicle Trip OD Pattern in Sarawak in 1991

3.1.3 Existing Highway Network Conditions

Of the total 63,445 km of roads in Malaysia, 49,909 km or 79% are in P.Malaysia, 13% in Sabah and 8% in Sarawak.

In Peninsular Malaysia, roads are classified on the basis of jurisdiction and general purpose into Federal, State, Municipal and Other Roads. For Sabah and Sarawak, roads are currently classified more according to their functions although there is an effort to change this to be in line with that of the Peninsular. In Sabah, roads are categorized into Class I, II or III roads, depending on their service as trunk, district or local roads. In Sarawak, roads are designated as Trunk, Secondary, Improved Feeder and Feeder Roads depending on the average daily traffic volumes.

There is no significant changes to the classification system of roads. For the purpose of administration, roads in Malaysia are classified according to the source of funds allocated for construction and maintenance of these roads. The description of these five categories are given in the table below.

Table 3.1 : Road Classification According To Administration

Category	Descriptions
Federal Roads	Federal roads are roads that are gazetted under the Federal Road Ordinance and are usually roads that link the major towns and cities, the different states and also the entrance/exit points to the country. Federal roads also include roads leading to Land Development Schemes and to Federal Institutions. These roads are constructed and maintained using funds from the Federal Government. They come under the jurisdiction of Federal Public Works Department.
Toll Expressway and Highway	These are highways linking the major towns and cities and are constructed and maintained by Malaysian Highway Authority as alternative routes to the Federal Roads. However, starting from 31.11.1988,most of the toll highways are being privatized.
State Roads	These are roads built to upgrade the standards of intra state linkages and also to provide a road network within the states. The construction and maintenance of these roads are funded by the Federal and State Governments. These roads are under the jurisdiction of the State Public Works Department.
Municipal and Local Council Roads	These roads which are located within the Municipal and Local Council areas are constructed and maintained by the Municipal or the Local Authorities. These include also the roads in residential estates constructed by developers but consequently surrendered to the local authorities or municipalities. The funds for the construction and maintenance of these roads are from the Municipal and Local Council Budgets but subsidized by the Federal Government.
Other Roads	These are rural roads which are constructed and maintained by the District Office and the allocation comes from the State Government.

The present highway network in P.Malaysia is formed by the North-South Expressway, the Karak Highway and other arterials classified as Federal and State Roads. Of the total 49,909 km of classified roads in P.Malaysia, 10,643 km or about 21% are Federal Roads. The configurations of the highway network in P.Malaysia is more or less a ladder type of network with the expressway and two federal routes running from north to south on the east and west coast of the Peninsular. This road network configuration is shown in Figure 3.4.

Highway network in Sarawak consists of a simple trunk road of about 1,300 km running along the coastal region of the state. The network in Sabah on the other

hand has two major routes, one along the east coast and the other connecting this to the west coast. These can be seen in Figure 3.5.

A total of 16,291 km are to be studied in this Study consisting of the North-South Expressway and some 117 highway routes. This consists of 409 km of expressway, 8,887 km of Federal Trunk Road and 6,995 km of major State Roads. This study network is derived based on examination of their classification and function in the existing network. Since this is a high level planning of a highway network for the country, most of the federal routes and major state roads have been included while minor state roads, urban and access roads are excluded in this Study.

Of the total 63,445 km of roads in the country, 74% are paved. While 85% of the roads are paved in P.Malaysia, only 35% of roads in Sabah and Sarawak however are paved roads. Road transport is the dominant mode in Peninsular Malaysia and Sabah while Sarawak still relies to a large extent on marine and river transport.

More than 50% of the existing federal trunk roads nationwide examined in this Study are actually found to be deficient in their designed carriageway width. As much as 78% of these deficient roads are in the Peninsular.

Traffic congestions are found in the outskirts of all state capitals except Kangar and Alor Setar in P.Malaysia. Federal Route 1 is congested except sections having parallel North-South Expressway sections that have been opened to the public. Federal Route 2 is congested from Port Klang to Temerloh. Sections in urbanized areas are also congested. In contrast, there is no serious traffic congestion in Sabah and Sarawak.

Traffic congestion and poor traffic flow is also greatly influenced by the proportion of heavy vehicles in the traffic stream. In P.Malaysia, for example, the states of Johor, Pahang have more than 20% heavy vehicles in the traffic stream while Selangor, Perak, Penang, Trengganu and N.Sembilan have more than 15%. These states therefore generally have higher congestion problems.

Malaysia's road development level is still very low compared to the developed countries. Malaysia's road development level is only one-fifth that of US, or one-sixth that of Japan.

By road development index, both indices in Sabah and Sarawak are about half that of P.Malaysia indicating the high necessity to uplift road development level in the two states. By road density, the figures for the two states are only one-fifth to one-fourth that of P.Malaysia. The east coast of P.Malaysia has a comparatively high road development index. The road density in the east coast however has only about half that of the west coast. This is attributed to the concentration of population in the west coast. In recognizing that road infrastructure is the basic amenities to encourage urban and industrial development in the east coast, road development must be given higher priority to the east coast of P.Malaysia.

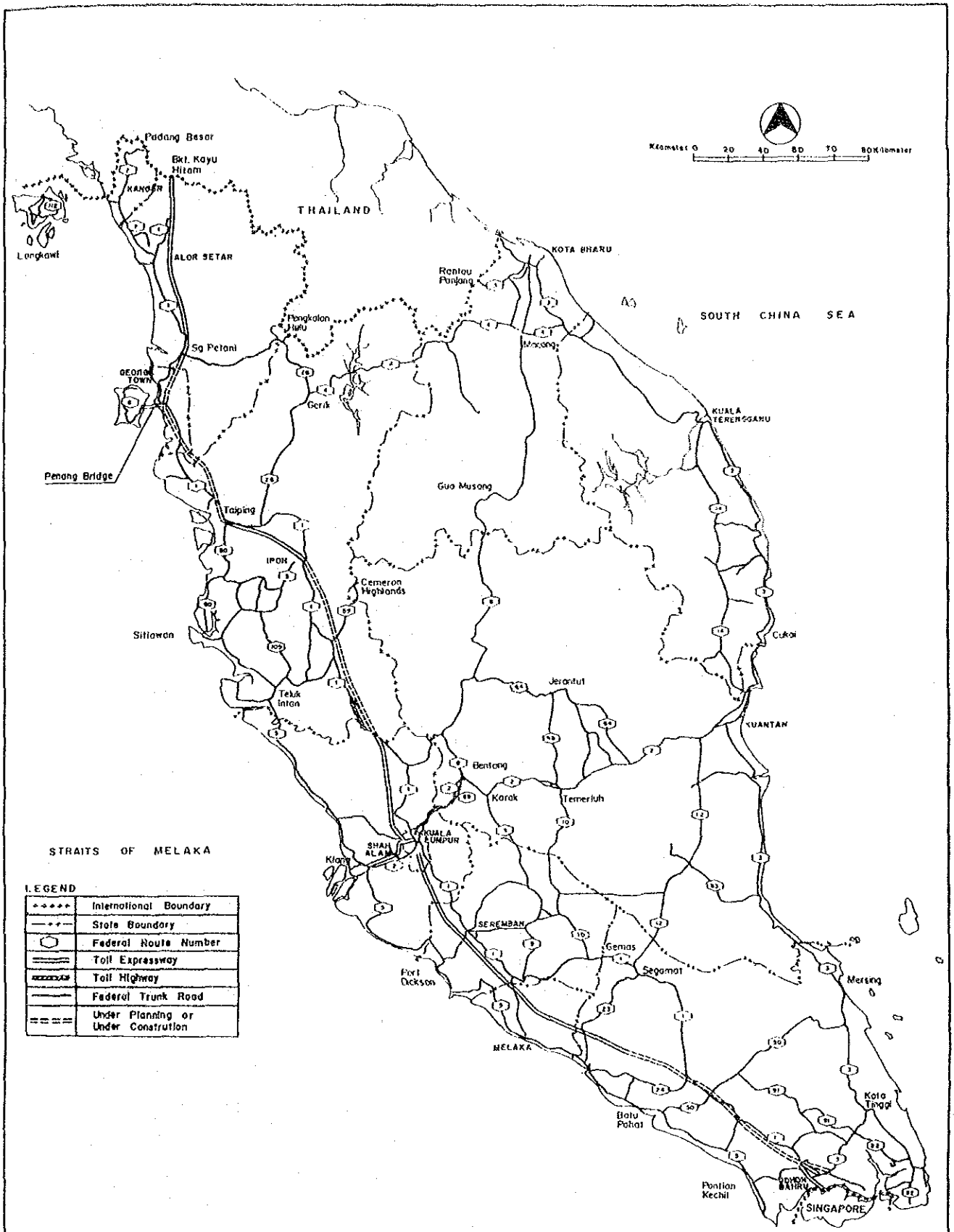


Figure 3.4: Existing Highway Network in P.Malaysia

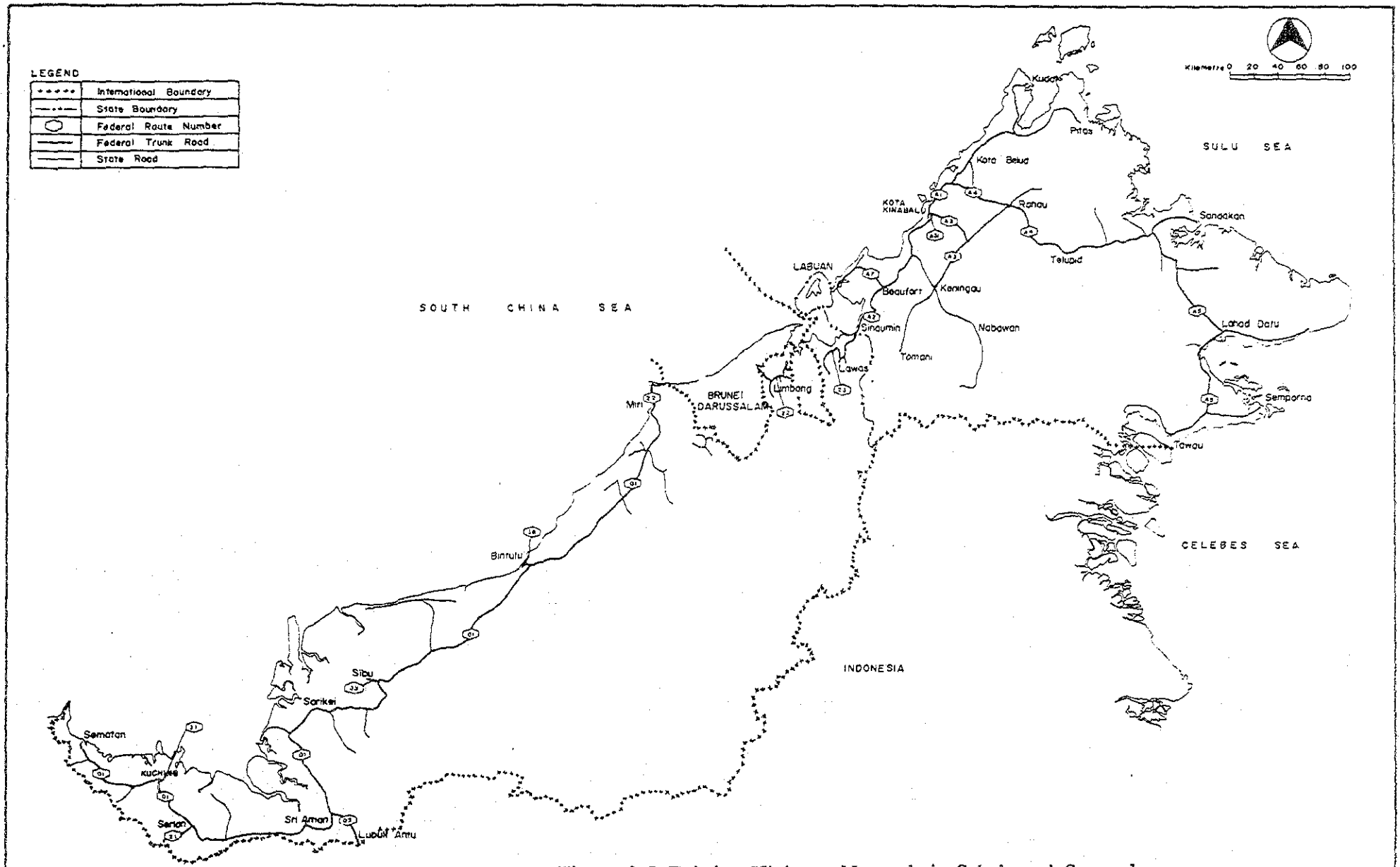


Figure 3.5: Existing Highway Network in Sabah and Sarawak

3.1.4 Existing Road Transport Problems in Malaysia

Problems and issues on existing road transport and highway network are summarized below:

(1) Need to Strengthen the Present Highway Network

The existing highway network in P.Malaysia is a partially developed network with two main axes from north to south and one from east to west. Linkages between some regions are still weak such as between the east coast states and Penang or Kedah. In addition, there are sections that are found to have under capacity cross-sectional design not compatible with the actual function of the roads.

The completion of the North-South Expressway will influence the traffic flow to a great extent in the west coast of P.Malaysia. For efficient usage of highway network along this important corridor, the improvement of existing federal roads and major state roads at the regional level is very important.

New linkages are particularly needed in the central corridor and the east coast states to encourage regional development programs. To ensure total reliability of road transport, alternative routes or mitigation measures for flood and landslide prone areas must be implemented.

Highway networks in Sabah and Sarawak are not well developed. Moreover, there is no direct linkage between the two states. A network should be planned to bring basic services and amenities to the hinterland areas of both states. Such a network will also encourage development to the vastly undeveloped areas in the interior.

(2) Need to Mitigate Traffic Congestion

The completion of the North-South Expressway is expected to temporary relieve traffic congestion along Federal Route 1 in the west coast of P.Malaysia. Widening and upgrading of this Federal Route should be considered. Traffic congestion on Federal Route 2 and other trunk road sections within major urban areas and their conurbations will deteriorate in the near future. Urban bypasses are needed for fast growing urban conurbations in both the east and west coasts of P.Malaysia to help relieve traffic congestion around urban areas.

(3) Need To Strengthen Road Structure and Alignment

Sections of existing federal highways having under capacity problems and which are suffering from low travel speed and traffic bottlenecks must be identified and improved. Along with this effort is the need to strengthen the road structures and alignment of some deficient sections of the federal highways such as Grik-K.Kangsar Road in Perak. The improvement plan should therefore aim at according the federal routes the adequate capacity for performing the intended functions of these highways.

Alignment selection should strike a balance between topographic features, composition of traffic, cost and safety level for routes running through hilly and

mountainous regions. The constructions of more sophisticated facilities such as tunnels and steel bridge should be pursued if only to serve the alignment needs and reduce the lost of environmental features and surface vegetation.

For Sabah and Sarawak, increasing the surface pavement rate of federal and state roads is a high priority task. The existing federal and major states routes must be improved to be all season roads as much as possible.

(4) Need to Rationalize the Role of Road Transport

The present share of road transport in the country is overwhelmingly high. The fact remains however that this share is not going to come down so quickly in future given the versatility of this mode of transport and the weakness of other modes. If no efforts are made to shift some of the traffic demand to other modes, large investments will be needed in the near future to continuously expand the road infrastructures in the country.

Certain freight transport such as long haul general cargoes can in fact be shifted to rail transport. Long distance passenger rail transport should be improved to shoulder some of the traffic demand in the future.

(5) Need to Consider Traffic Safety

The present road traffic safety level in Malaysia is worrisome. Accident statistics show the very high accident and fatality rates in the country compared to the developed nations. It is important to consider the factor of traffic safety in highway planning such as ensuring better horizontal and vertical alignments, sight distance, gradient, road surface conditions, geometrics and lighting. The Government has recognized road safety as a national problem and has in fact set a target of reducing fatalities caused by road traffic accidents by 30% by the year 2000.

3.2 Socio-economic Planning Framework

3.2.1 Setting of Future Socio-economic Planning Framework

The approach in setting the future planning framework in this Study follows a three-steps study method. It begins with forecasting the macro-level socio-economic indicators for Malaysia and then proceed to estimate the indicators for each of the 13 states and finally to the district (traffic zone) level. As the HNDP study is required to be in line with the OPP2 and Vision 2020 plans by the Government, macro socio-economic indicators therefore adopts the targets set by the Economic Planning Unit (EPU). Indicators for the state and district levels are estimated by the Study based on the overall targets.

(1) Macro Socio-Economic Framework

The socio-economic framework for future development in Malaysia is based on the expectation that Malaysia becomes one of the industrialized countries by the year 2020. The future planning framework for this Study is given in Table 3.2.

Table 3.2 : Macro Socio-Economic Indicators, 1980-2010

Year / Indicator	1980	1990	2000	2010	Average Annual Growth Rate (%) 1980-1990	Average Annual Growth Rate (%) 1990-2010
Population ('000 persons)	13,879.2	18,010.2	22,660	27,500.4	2.6	2.1
Labour Force ('000 persons)	5,108.9	7,046.5	9,365	12,104.8	3.3	2.7
Employment ('000 persons)	4,816.9	6,621.0	8,986	11,736.0	3.2	2.9
Unemployment Ratio (%)	5.7	6.0	4.0	3.0	-	-
No. of Households ('000 households)	2,558.9	3,613.8	4,760.5	6,071.7	3.5	2.6
GDP in million (at 1978 prices)	44,702	79,154	155,653	304,882	5.9	7.0
GDP Per-Capita (RM at 1978 prices)	3,130	4,400	5,000	11,100	3.60	4.70

Data Sources: 5thMP, 6thMP, OPP2 and EPU

The population of the country has increased from 14 million in 1980 to an estimated 18 million in 1990 and is expected to grow to 27.5 million by the year 2010. The annual increasing rate of the total population is expected to be 2.1% during the period 1990-2010, compared to the rate of 2.6% in 1980-1990 period.

The total employment in Malaysia is expected to increase at a rate of 2.9% per annum, a little lower than the rate of 3.2% during the 1980-1990 period. Among the factors that influenced the increase in employment are the high speed expansion of the national economy and the improvement in the labour productivities. This has resulted the higher increase of the employment compared to the labour force and therefore decreases the unemployment rate to 3.0% by the year 2010.

The GDP of the country is expected to grow at a rate of 7.0% per annum for the next twenty years. GDP of Malaysia is expected to grow from RM85,089 million in 1991 to RM155,653 million by 2000 and further to RM305,882 million by the year 2010. The growth of GDP during the period of 1990-2010 will be led by the expansion in the secondary and tertiary sectors. The manufacturing sector is forecasted to grow at a higher rate i.e 9.26% and is expected to has a share of 41.13% by the year 2010. The GDP per-capita is expected to increase accordingly from a level of RM4,500 per person in 1990 to RM11,860 per person by the year 2010.

(2) Regional Socio-economic Framework

The state of Selangor achieved the highest share of the 1990 total GDP which was about 18.3% followed by Kuala Lumpur (12.5%) and Johor (10.6%). The changes in the distribution of GDP among the states is one of the underlying cause of inter-state migration where employment opportunities played an important role.

Analyses of past growth rates during 1980-1990 period and the current stage or government's policy on industrialization and regional development formed the bases for estimating the GDP growth rates and shares by state. For instance, the existing growth poles i.e. Pulau Pinang, Selangor and Kuala Lumpur, will experience relatively lower GDP growths than in the past which implies that industrial dispersion from these growth poles to the neighbouring states such as from Pulau Pinang to Kedah and from Kuala Lumpur and Selangor to Negeri Sembilan and Melaka can be expected. Based on these analyses, the states are divided into the following regional groupings:

Group 1: States whose GDPs are expected to grow at the fastest pace compared with the past trend: Kedah, Kelantan, Negeri Sembilan, Pahang and Perak.

Group 2: States whose GDPs are expected to grow at relatively higher speed compared with the past trend: Johor and Perlis.

Group 3: States whose GDPs are expected to grow at relatively lower speed compared with the past trend: Melaka, Pulau Pinang, Selangor and Kuala Lumpur.

Group 4: States whose GDPs are expected to grow at the modest pace compared with the past trend: Trengganu, Sabah and Sarawak.

Based on the above grouping of regional growth characteristics, GDP by state to the year 2010 are estimated with the macro-forecast as the control. The results are given in Table 3.3.

Table 3.3 : Gross Domestic Products by State, 1980-2010

(Unit: Million $ at 1978 prices)

State	1980	1990	1991*	2000	2010	Growth Rate (%)	Composition Ratios (%)	
						1990–2010	1990	2010
1. Johor	4682	8515	9188	20099	42903	8.4	10.6	13.2
2. Kedah	2299	3604	3858	8102	18168	8.4	4.5	5.6
3. Kelantan	1305	2063	2212	4435	10358	8.4	2.6	3.2
4. Melaka	1046	1976	2147	4062	8197	7.4	2.5	2.5
5. N.Sembilan	1934	2650	2863	5276	10398	7.1	3.3	3.2
6. Pahang	2492	3749	4009	8163	18588	8.3	4.7	5.7
7. P.Pinang	3413	5798	6371	10850	19730	6.3	7.2	6.0
8. Perak	5046	7146	7660	13449	27430	7.0	8.9	8.4
9. Perlis	329	564	603	1101	2369	7.4	0.7	0.7
10. Selangor	6846	14663	16106	32487	60820	7.4	18.3	18.6
11. Trengganu	1964	5497	5709	9183	14328	4.9	6.8	4.4
12. Kuala Lumpur	6097	10068	10981	18910	33677	6.2	12.5	10.3
PENINSULAR	37453	66293	71706	136118	266965	7.2	82.6	81.8
13. Sabah	3077	7021	7420	13536	29746	7.5	8.7	9.1
14. Sarawak	2980	6969	7386	14315	29492	7.5	8.7	9.0
MALAYSIA	43510	80282	86511	163969	326203	7.3	100.0	100.0

Note : GDP is the one before adjustment by Imputed bank service charge (less) and Import duties (add)

* : Estimated by Study Team

Source: 5MP and EPU

Analyses on past population growth trends by states are used to estimate future population growth to the target year.

The states of Perak, Melaka, Negeri Sembilan, Pulau Pinang, Kedah and Johor have experienced lower growth rates than the national average in the 1980s due to substantial nett out-migration of the population to other states mainly Selangor and Kuala Lumpur.

The high population growth rates in Pahang, Trengganu and Kelantan are largely due to the large number of settlers who have moved to the new land development schemes as well as the high fertility rates and the attachment of the local population to their hometowns. Being the most developed, industrialized and urbanized states, Selangor and Kuala Lumpur will remain the main destinations of the migrants from other states in the next two decades.

The population growth trend is assumed to be similar in future. The total population by state are estimated to the year 2010 and given in Table 3.4.

Table 3.4 : Population Growth by State, 1980-2010

(Unit: '000 Persons)

State	1980	1990	1991*	2000	2010	Growth Rate (%)		Composition Ratio (%)	
						1980-1990	1990-2010	1991	2010
1. Johor	1644.9	2108.6	2163.3	2670.2	3223.2	2.5	2.1	11.8	11.6
2. Kedah	1120.6	1366.9	1400.2	1666.1	2005.5	2.0	1.9	7.6	7.3
3. Kelantan	897.8	1168.6	1199.1	1480.0	1860.4	2.7	2.4	6.5	6.8
4. Melaka	466.6	543.1	553.7	635.3	740.2	1.5	1.6	3.0	2.7
5. N.Sembilan	575.9	683.7	695.9	815.8	961.6	1.7	1.7	3.8	3.5
6. Pahang	802.2	1127.3	1154.7	1460.3	1858.5	3.5	2.5	6.2	6.8
7. P.Pinang	958.2	1159.0	1182.0	1357.8	1557.7	1.9	1.5	6.4	5.7
8. Perak	1812.3	2098.1	2132.1	2403.1	2756.2	1.5	1.4	11.5	10.0
9. Perlis	148.8	187.1	191.8	231.6	279.1	2.3	2.0	1.0	1.0
10. Selangor	1521.6	2206.5	2292.3	2987.4	3538.7	3.8	2.4	12.4	12.9
11. Trengganu	543.1	757.2	783.8	1011.0	1295.2	3.4	2.7	4.2	4.7
12. Kuala Lumpur	981.0	1302.8	1334.9	1600.5	1878.3	2.9	1.8	7.2	6.8
PENINSULAR	11473	14708.9	15083.8	18319.1	21954.6	2.5	2.0	81.6	79.8
13. Sabah	1055.1	1535.4	1592.2	2086.4	2765.9	3.8	3.0	8.6	10.1
14. Sarawak	1351.1	1765.9	1814.0	2255.0	2779.9	2.7	2.3	9.8	10.1
MALAYSIA	13879.2	18010.2	18490.0	22660.5	27500.4	2.6	2.1	100.0	100.0

Note * : Estimated by Study Team

Sources : 5MP, 6MP, OPP2, EPU

Similar method is used in the breakdown of the estimated state economic output and population into the district or traffic zone level.

3.2.2 Future Vehicle Population

Socio-economic indicators such as population, GDP are found to be the major parameters influencing vehicle ownership. Mathematical models are used to forecast the future vehicle population with the forecasted socio-economic indicators to year 2010. The results are given in Table 3.5. The number of motor vehicles in Malaysia is expected to increase from 2,426,000 in 1990 to 4,386,000 in the year 2000 and further to 7,100,000 by the year 2010.

Table 3.5 : Forecasted Future Vehicle Number, 2010

(in '000)

Area	Type	1980	1990	2000	2010	Average Annual Growth Rate (%)	
						1990-2000	2000-2010
P.Malaysia	Car	729.1	1567.9	2883.0	4645.6	6.28	4.89
	Bus	13.1	21.5	35.9	57.6	5.26	4.84
	Lorry	223.3	435.5	748.5	1139.3	5.57	4.29
	Total	965.5	2024.9	3667.4	5842.5	6.12	4.77
Sabah	Car	86.4	140.0	248.6	456.5	5.91	6.27
	Bus	0.8	4.0	7.4	13.2	6.35	5.96
	Lorry	42.6	82.1	134.6	231.6	5.07	5.58
	Total	129.8	266.1	390.6	701.3	5.62	6.03
Sarawak	Car	56.4	137.7	261.2	448.6	6.61	5.56
	Bus	0.7	1.3	2.3	3.8	5.87	5.15
	Lorry	15.3	36.8	64.3	103.8	5.74	4.91
	Total	72.4	175.8	327.8	556.2	6.43	5.43
Malaysia	Car	871.9	1845.6	3392.8	5550.7	6.28	5.05
	Bus	14.6	26.8	45.6	74.6	5.46	5.05
	Lorry	281.2	554.4	947.4	1474.7	5.50	4.52
	Total	1167.7	2426.8	4385.8	7100	6.10	4.94

Data Sources: JPJ Reports and Estimates by Study Team

The total vehicle population (except motorcycle) is expected to grow at 6.1% per year to 2000 and 4.94% from 2000 to 2010. In terms of motorization rate (motor vehicle per 1000 households), it is expected to increase from 671 in 1990 to 921 by year 2000. In 2010, it is estimated that there will be 941 cars to every 1000 households. This rapid increase in motorization is expected to bring about a tremendous increase demand for travel by private vehicles on the road network.

3.3 Future Traffic Demand Forecasting

3.3.1 Approach

The forecasting of future traffic demand basically follows the same approach adopted for the forecast of future socio-economic planning framework. The total traffic demand for the Malaysia ie, at macro level is forecasted for all the transport modes. The total is then distributed by state assuming some future transport policies that affect mode shares. The expected future traffic demand for vehicle transport is further forecasted by district or traffic zone level.

In examining the impact of future traffic demand at year 2010 on the highway network, a "Do-Nothing Case" analysis is used to evaluate the traffic impacts of the forecasted future travel demand on the existing highway network. The results of such an analysis thus can be used as a yardstick in evaluating the effects or performances of "Do-Something" cases such as improvement to the existing highway routes or construction of new highways. However, this analysis is only done for the macro level forecasting.

The traffic forecasting method used in this Study basically follows the four-step method of trip production, trip generation & attraction, modal split and trip assignment.

Traffic forecasting is done separately for P.Malaysia, Sabah and Sarawak as these are three separate entities as far as vehicle traffic movement is concerned. When analyzing future traffic demand on the proposed future highway network however, Sabah and Sarawak will be treated as one entity with a new proposed linkage between the two states.

3.3.2 Trip Production

A comparative analysis of the results of future trip production for P.Malaysia by various analytical methods was carried out. Results from the Multiple Linear Regression Method are found to be the most acceptable as the other methods tend to overestimate or underestimate future trip production rates.

Table 3.6 shows the total future traffic demand for passenger and freight as well as the trip production rates by vehicle type using the Multiple Linear Regression Method for P.Malaysia.

Table 3.6: Future Trip Production Rates by Vehicle Type in P.Malaysia

		1980	1991	2010
Total Passenger ('000/Year)	P.CAR	3,453,172	3,566,626	10,499,893
	BUS	1,195,253	1,295,226	2,489,929
	RAILWAY	6,257	6,564	13,907
	AIR	2,583	2,845	13,028
	TOTAL	4,657,265	4,871,261	13,016,757
	ELASTICITY*	-	1.25	1.00
Total Freight ('000 Tonne/Year)	LORRY	560,235	630,534	2,357,001
	RAILWAY	4,296	4,258	12,813
	AIR	13	15	58
	WATER	4,143	5,019	20,592
	TOTAL	568,687	639,838	2,392,464
	ELASTICITY**	-	0.92	0.93
Trip Production Rate (Trip/Veh/day)	P.CAR	3.91	3.40	2.87
	BUS	6.41	6.72	3.77
	LORRY	2.26	3.38	3.77
	ALL VEHICLE	3.54	3.43	3.07

Note: * Elasticity of Passenger Traffic to the GDP per capita
** Elasticity of Freight Traffic to the GDP

The table also shows the elasticity of traffic demand to socio-economic indicators. The socio-economic indicators applied here are GDP per Capita for passenger traffic and GDP for freight traffic. The elasticities from 1980 to 1991 indicated 1.25 and 0.92 for passenger traffic and freight traffic respectively.

Malaysia can be said to be approaching the stage of balance traffic demand growth with economic expansion. The elasticity of traffic demand for Malaysia is thus approaching 1.0. before declining to less than 1 after achieving the developed nation status by 2020. Elasticity of forecasts for 2010 in Table 3.6 show a value of 1.0 for passenger and 0.93 for freight.

3.3.3 Trip Generation and Attraction

The total number of trips produced as estimated is used as a control for estimating the total trip generation and attraction by state in P.Malaysia. The total trip demand in terms of number of passengers and tons are then converted into vehicle trips using the appropriate converting factors.

Using the calibrated trip generation and attraction models for P.Malaysia and the forecasted future socio-economic indicators, the future trip generation and attraction by state are forecasted and the results are shown in Figure 3.6.

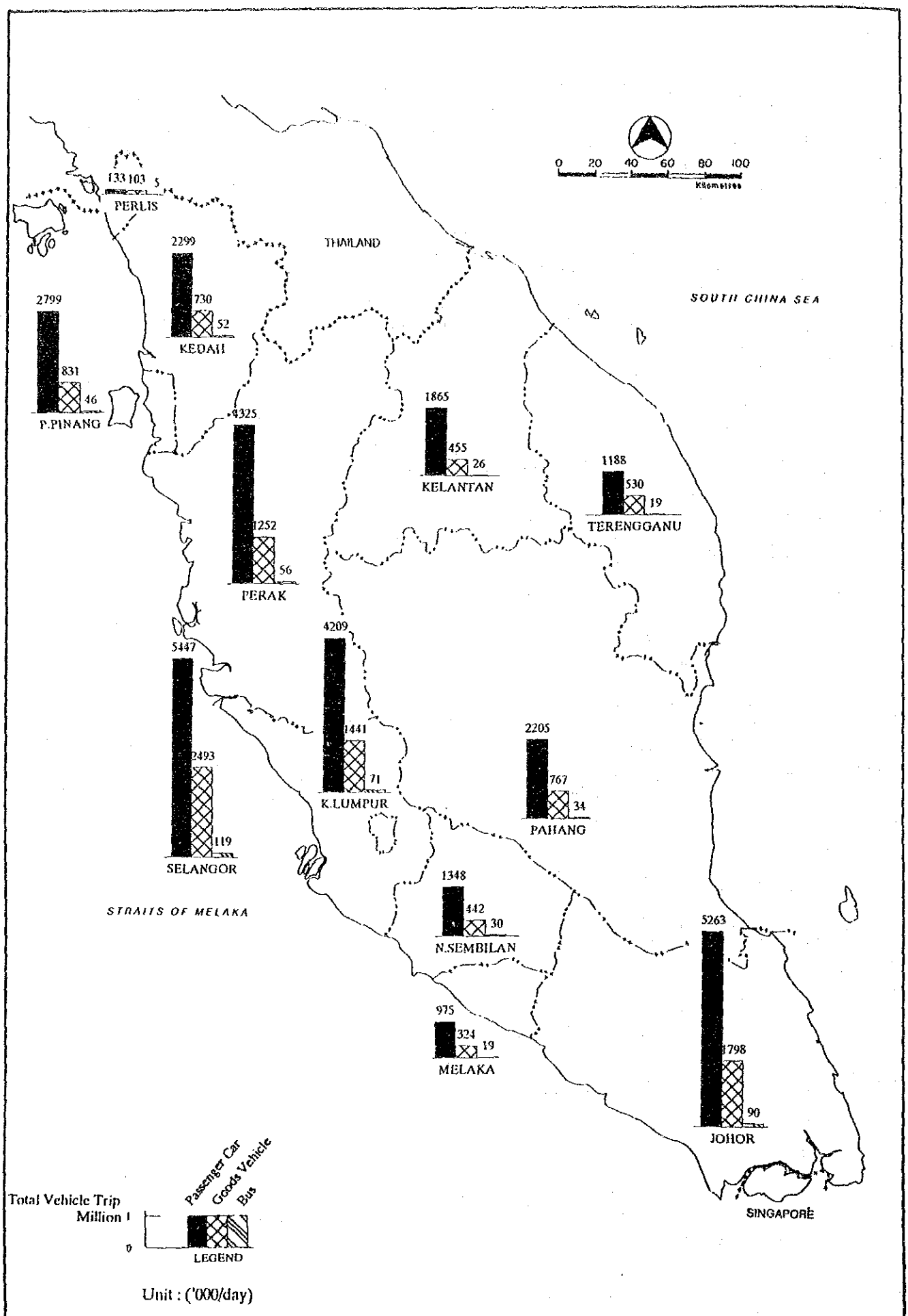


Figure 3.6: Trip Generation and Attraction for Peninsular Malaysia to Year 2010

3.3.4 Vehicle Trip Distribution

Trip distribution model is used to distribute the total trip generation and attraction forecasted to produce a trip OD matrix in the study area. Trip distribution is done both for the "Do-Nothing" and the "Do-Something" scenarios. For the "Do-Something" scenario in future, two assumptions are made:

1. Transport policies will be implemented by the Government to specifically change the shares of transport modes in the country. The railway system will be improved by introducing double tracking and more efficient operation to meet the expected demand and assuming that a percentage of road transport demand will be diverted to the rail transport.

2. Trip distribution pattern of road transport will differ from the present situation as accessibility of various regions will be improved with the proposed future road network.

As there is no concrete railway development plan in the country at present, the estimation of future rail transport capacity is based on the assumption that the existing rail network in P.Malaysia will be maintained, and no new line will be added in the near future. In addition, it is assumed that improvement works such as double tracking with re-alignment and introducing speedy coaches will be implemented to increase frequency of trains and level of services, especially along the west coast from Penang to Johor Bahru.

Using these assumptions, approximately 40 trains can operate on a single track line and 100 to 130 trains for double track lines. The diversion from road to rail transport in future is estimated to be 20% from bus, 10% from car and 5% from lorry.

Under the "Do-nothing" scenario, rail will handle only 3% to 6% of the total land transport demand along the rail corridors whereas under the "Do-Something" scenario, it is expected to handle about 10% of total land transport demand along the applicable corridors. Table 3.7 shows the future traffic demand by modes in 2010 after allowing for increase in share of rail transport in P.Malaysia.

The fact remains that even with such allowance for growth of rail transport share in future, the impact is limited to only the present rail corridors. With this limited rail network and infrastructure, the impact of rail transport increases in future on the overall national transport system remains low.

The overall mode share of road transport still remains very high at 99.6% for passenger and 98.5% for freight under the 'Do-something' scenario in 2010. Rail transport shares has increase only slightly from 0.1% to 0.3% for passenger although in real terms, rail transport will increase 7 times for passenger by 2010 from 1991 and 4 times by volume for freight.

Table 3.7 : Traffic Demand by Transport Mode in Peninsular Malaysia, in 1991 and 2010

	Mode	1991 (Composition Rate)	2010 (Composition Rate)		Annual Growth Rate (%) 1991-2010	
			Do-Nothing	Do-Something	Do-Nothing	Do-Something
Passenger Traffic ('000 Pass./Year)	Road	4,861,852 (99.8%)	12,989,814 (99.8%)	12,958,452 (99.6%)	5.31	5.30
	Rail	6,564 (0.1%)	13,905 (0.1%)	45,267 (0.3%)	4.03	10.70
	Air	2,845 (0.1%)	13,028 (0.1%)	13,028 (0.1%)	8.34	8.34
	Total	4,871,261 (100%)	13,016,747 (100%)	13,016,747 (100%)	5.31	5.31
Freight Traffic ('000 tonne/year)	Road	630,534 (98.5%)	2,359,003 (98.6%)	2,355,613 (98.5%)	7.19	7.18
	Rail	4,258 (0.7%)	12,812 (0.5%)	16,202 (0.7%)	5.97	7.29
	Air	15 (0.0%)	58 (0.0%)	58 (0.0%)	7.38	7.38
	Water	5,031 (0.8%)	20,592 (0.9%)	20,592 (0.9%)	7.70	7.70
	Total	639,838 (100%)	2,392,465 (100%)	2,392,465 (100%)	7.19	7.19

Both passenger and freight traffic demand will increase rapidly to the year 2010 with sustained high economic growth of the country corresponding to the targets of Vision 2020 in making Malaysia a fully developed and industrialized nation. The total traffic demand for passenger traffic in 2010 is predicted to be 13,016 million trips/year. The total freight traffic demand in 2010 will be 2,392 million tons/year.

Vehicle trip distribution under the "Do-Something" scenario has to consider the improvements on the existing highway network system. Once the highway network is improved, long distance travel will be made easier, faster and more comfortable. This would encourage more people to travel resulting in an overall increase in average trip length. The Gravity Model is best suited to distribute trip under the "Do-Something" scenario as it takes into account such changes in future travel characteristics. The results of trip distribution for P.Malaysia is given in Figure 3.7.

The macro level future traffic demand forecasting for P.Malaysia has produced the state level total future number of trips. These are used as controls in estimating the micro level or traffic zone level future traffic demand. The forecasted district level socio-economic indicators are used with the calibrated zonal trip generation and attraction models to forecast the traffic demand for each traffic zone.

3.3.5 Trip Assignment

The Equilibrium Trip Assignment Model is used for traffic assignment in this Study. This model assumes that equilibrium is a steady state that is reached when the demand for transportation gives rise to a service level that maintains the demand. Trip assignment is done for both the "Do-Nothing" and "Do-Something" scenarios for evaluating the impacts of the proposed future highway network.

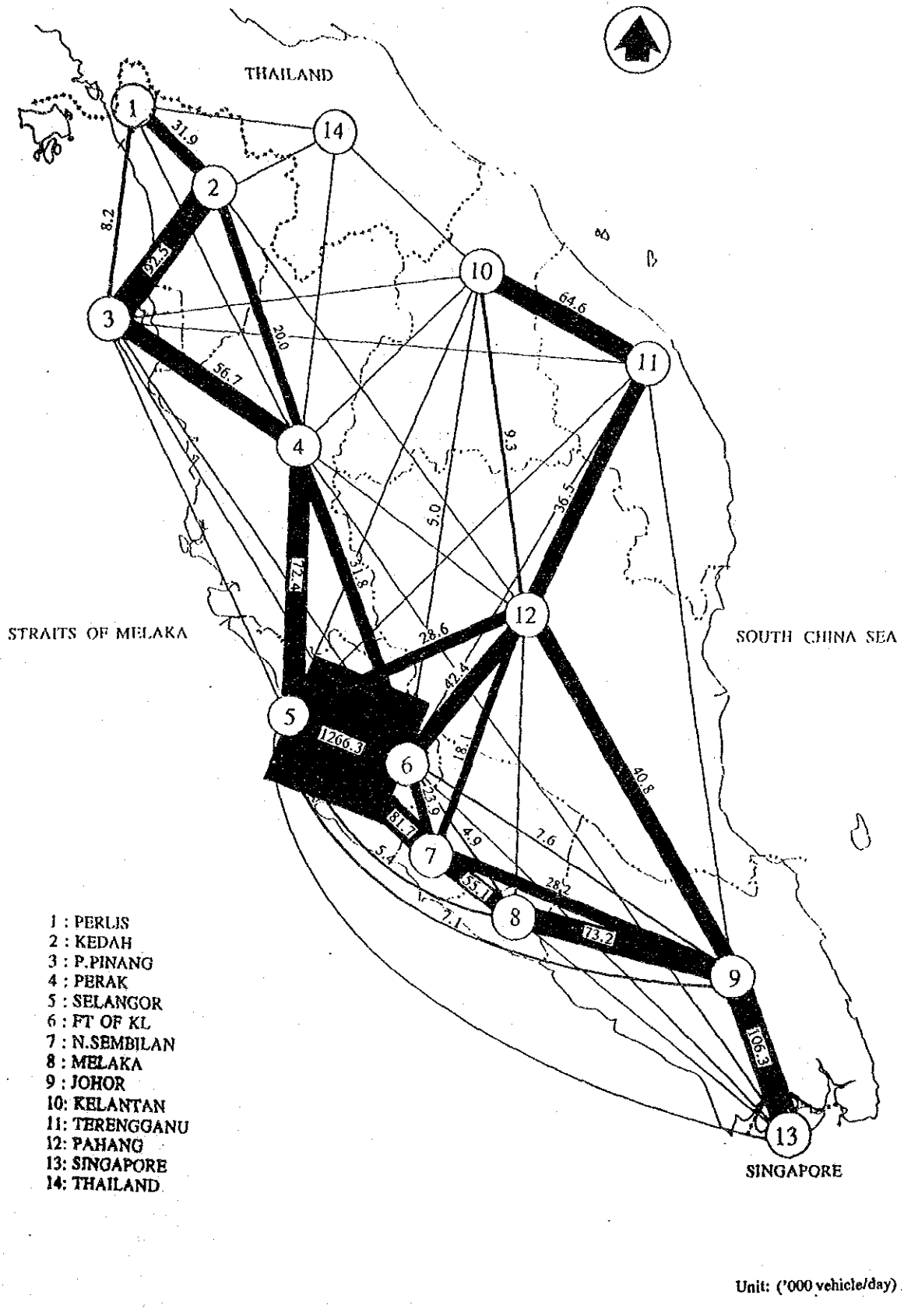


Figure 3.7: Future Vehicle Trip Distribution Pattern in P.Malaysia, 2010 under the "Do-Something" Scenario

3.3.6 Future Traffic Demand Forecasting For Sabah and Sarawak

Similar methodology in forecasting future traffic demand as for P.Malaysia is applied to Sabah and Sarawak. The results of trip generation and attraction forecasting by division in the two states are shown in Figure 3.8 while the future trip distribution pattern is given in Figure 3.9.

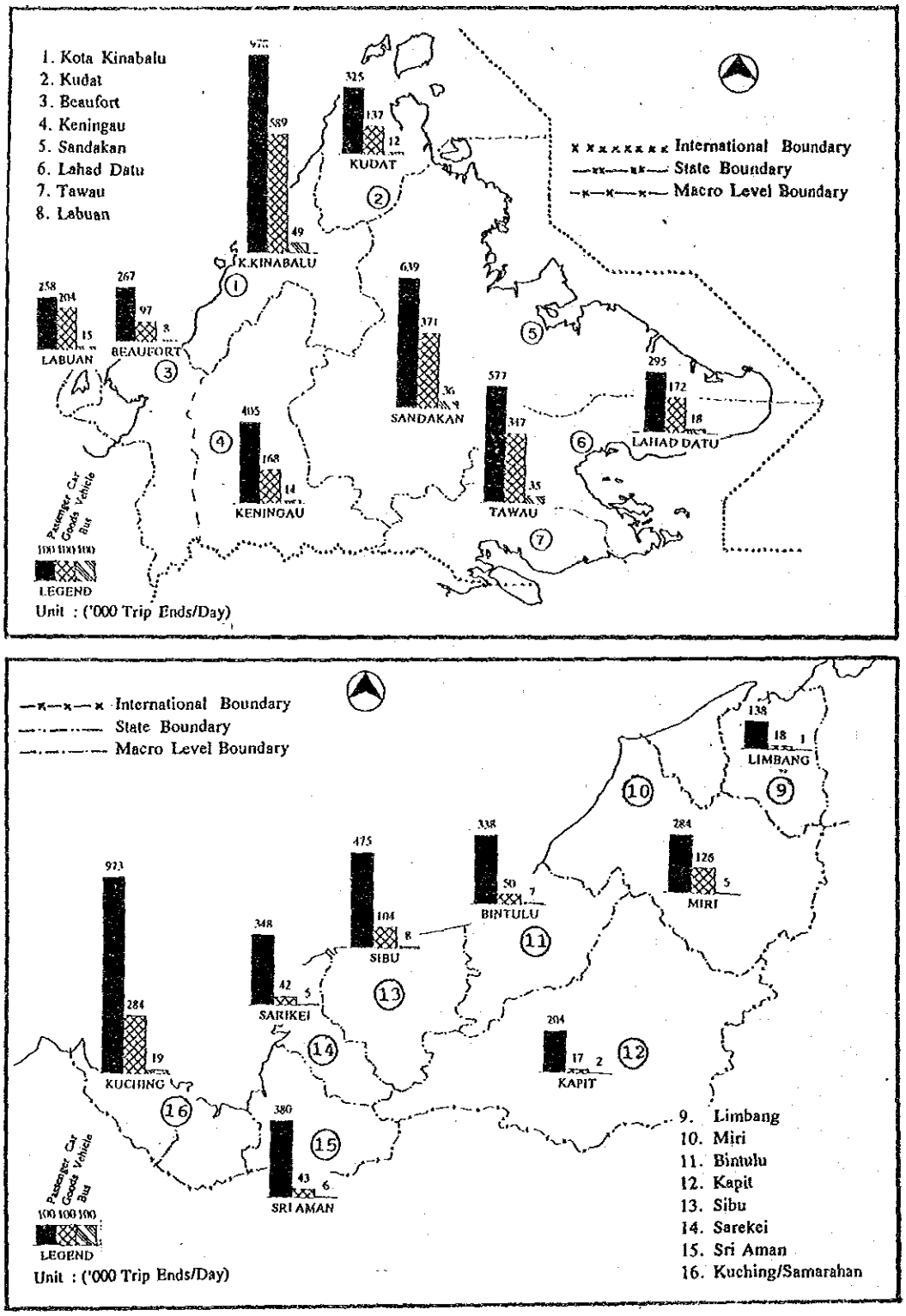


Figure 3.8: Vehicle Trip Generation and Attraction in Sabah and Sarawak, 2010