

Fig. 6.2 ALIGNMENT ALTERNATIVES OF THE KRABI - KHANOM HIGHWAY

yet. With a view to providing an input to the SSDP Master Plan Study, this Study forecasted the future traffic demand based on a set of assumptions prepared by the Study Team. Major assumptions are:

- 1) A container vessel call to Krabi and Khanom ports in 2001 is assumed once a week to each port, mainly consisting of regional container ships of 1,000 TEUs between Bangkok and the Middle Asia. A container vessel call in 2006 is assumed twice a week to each port, mainly consisting of international containers of 3,600 TEUs in addition to the regional containers assumed for 2001; and
- 2) The production framework of the SSDP is assumed at 18.1 billion baht in 2001 and 60.9 billion baht in 2006 based on an assumption that the SSDP will raise per capita GRP of the Southern Region equal to the national average in 2011.

Traffic demand on the Highway was estimated based on the above assumptions as well as the planning framework prepared for the "Highway Development Master Plan in the Southern Region". Daily average traffic demand on the Highway was estimated in the range of 3,000 - 5,000 AADT in 2001 and 9,000 - 12,000 AADT in 2006 excluding business and commuting trips. Due to the intermittent arrival of container ships to the ports, daily traffic demand is likely to fluctuate to a considerable extent. It can be concluded, however, that a four lane highway should be constructed in the first phase with the right-of-way wide enough to accommodate additional lanes in the future.

### 6.3 Outline of the Highway

As show in Fig. 6.3, the Highway is designed as a four lane highway with a center median which is wide enough to accept additional lanes in the future. The average width of the right-of-way required for the Highway excluding pipeline and railway is estimated at less than a half of the 200 meters proposed by the SSDP. The width of right-of-way at intersections, however, will be in the range of 500 - 550 meters. Design speed is assumed at 120 kilometers per hour and a maximum gradient of 2 percent. The height of embankment is designed at 3 - 6 meters from the existing ground level to secure the height clearance for the crossing highways and rural roads.

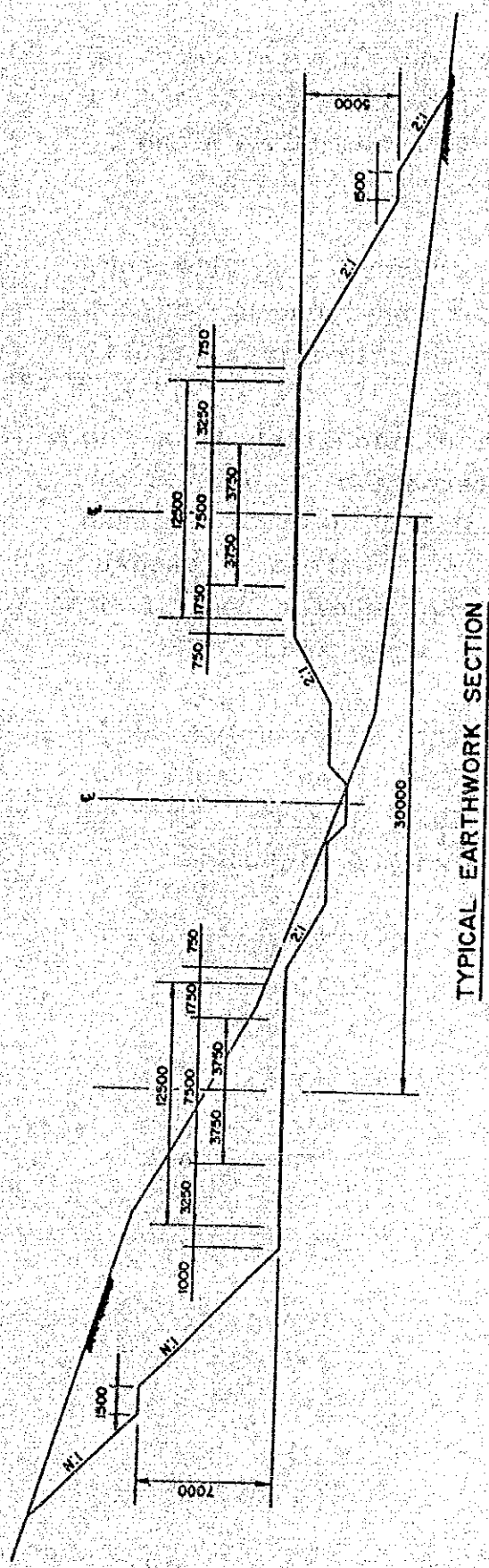
Project cost is estimated at:

Alternative A	8.44 billion baht
Alternative B	9.42 billion baht
Alternative C	8.44 billion baht

### 6.4 Preliminary Evaluation of the Project

The SSDP would be non-existent if the "Trans-Thai Land Bridge" is not a component of the Program. In this case, Krabi and Khanom ports would remain as a regional port just facing to one side of the Peninsula. The corridor would not attract any significant attention of the international investors. It is likely, therefore, that economic benefit attributable to the Krabi - Khanom Highway would be a portion of the production increment of the SSDP.

A preliminary test of project viability was performed based on the above considerations. In case the



- - Major Highways (Route 4, 41, 401)      - - Provincial Highways and Rural Roads

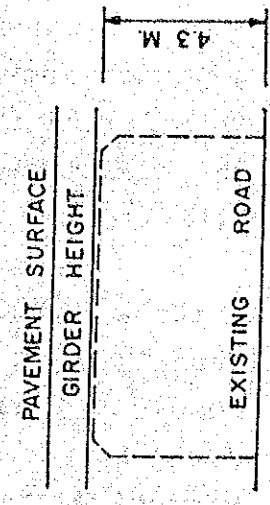
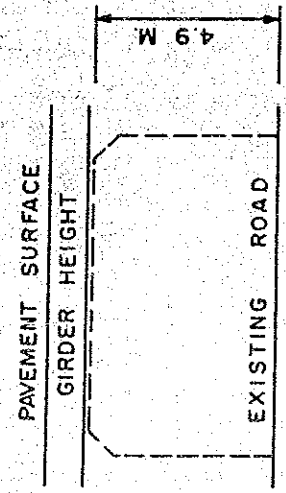


Fig. 6.3 TYPICAL CROSS-SECTION AND HEIGHT OF EMBANKMENT FOR CROSSING HIGHWAYS

production increment of the SSDP, the internal rates of return for Alternative A and C are calculated at 11 - 19 % while Alternative B at 10 - 18 %. Alternative A and C, therefore, are slightly better than Alternative B.

In terms of preservation of natural environment, Alternative B needs a careful environment impact assessment because the route passes through a natural reserve forest by a tunnel. In terms of land acquisition, Alternative C likely have more difficulties than the other alternatives because Alternative C passes the vicinity of Krabi city where population density and land price are higher. In terms of regional context, Alternative A would be better than others because it provides shorter access to Phuket direction.

As a preliminary conclusion, the Alternative A is considered the best alignment of the three. Volume 5 of the Final Report describes more details of the feasibility study on the Krabi - Khanom Highway.

MAIN TEXT



# ROAD DEVELOPMENT STUDY IN THE SOUTHERN REGION

## VOLUME 2: MAIN TEXT

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# CHAPTER 1

## **Introduction**



## CHAPTER 1. INTRODUCTION

### 1.1 Background of the Study

Highway development master plans have been prepared for the Northern, North-Eastern and Central regions with only the Southern Region remaining with no specific highway development plan. The Department of Highways (DOH), in this context, has an urgent need to prepare a highway development master plan for the Southern Region to complete nationwide highway development plans.

In preparing a highway development master plan of the Southern Region, special attention should be paid to the unique characteristics of the region, particularly:

- 1) the region has stronger connections with other countries than the other regions of Thailand;
- 2) the region is divided into the east and west coasts by the mountain ranges stretching north-south along the spine of the region;
- 3) most part of the mountains are designated as conservation forest area including forest reserve, national park and wildlife sanctuary; and
- 4) the region has repeatedly been attacked by natural disasters which damage highways in most parts of the region.

A government decision to introduce the Southern Seaboard Development Program (SSDP) in Krabi - Khanom area is also important to the study. The "Trans-Thai Land Bridge" to connect Krabi on the west coast and Khanom on the east coast is an important component of the SSDP. The Study, however, includes a feasibility study on the Krabi - Khanom Highway Link independently with the highway development master plan in the Southern Region because the development scheme of the SSDP has not been fixed yet.

### 1.2 Objectives of the Study

The objectives of the study are:

- 1) to develop a highway development master plan of the Southern Region with a target year of 2001 and to identify priority projects to be implemented by the year 1996;

- 2) to carry out a feasibility study on the Krabi - Khanom Highway Link as a part of the Southern Seaboard Development Program (SSDP);
- 3) to carry out feasibility studies on the priority projects identified in the 1) above; and
- 4) to facilitate technical transfer to the Thai counterparts throughout the study period.

### 1.3 Study Area

The study area is located in the Malay Peninsula with the Gulf of Thailand on the east side and the Andaman Sea on the west side. The northwestern part of the study area borders with the Socialist Republic of the Union of Myanmar and the southern part borders with Malaysia, as shown in Fig. 1.3.1.

The study area stretches from north to south with a total length of about 600 kilometers while the east-west width is about 250 kilometers at the maximum and about 65 kilometers at the minimum. The study area covers about 70,700 square kilometers, being equal to about 13.8% of the whole country.

In the study area, there are fourteen provinces and fourteen DOH district offices under the three division offices as shown in Table 1.3.1.

Table 1.3.1 PROVINCES AND DOH DIVISION OFFICES  
IN THE STUDY AREA

Provinces	DOH Division Office
1. Songkhla	Songkhla
2. Yala	ditto
3. Pattani	ditto
4. Phatthalung	ditto
5. Narathiwat	ditto
6. Satun	ditto
7. Nakhon Si Thammarat	Nakhon Si Thammarat
8. Trang	ditto
9. Krabi	ditto
10. Phuket	ditto
11. Surat Thani	ditto
12. Phangnga	ditto
13. Ranong	Prachuap Khiri Khan
14. Chumphon	ditto

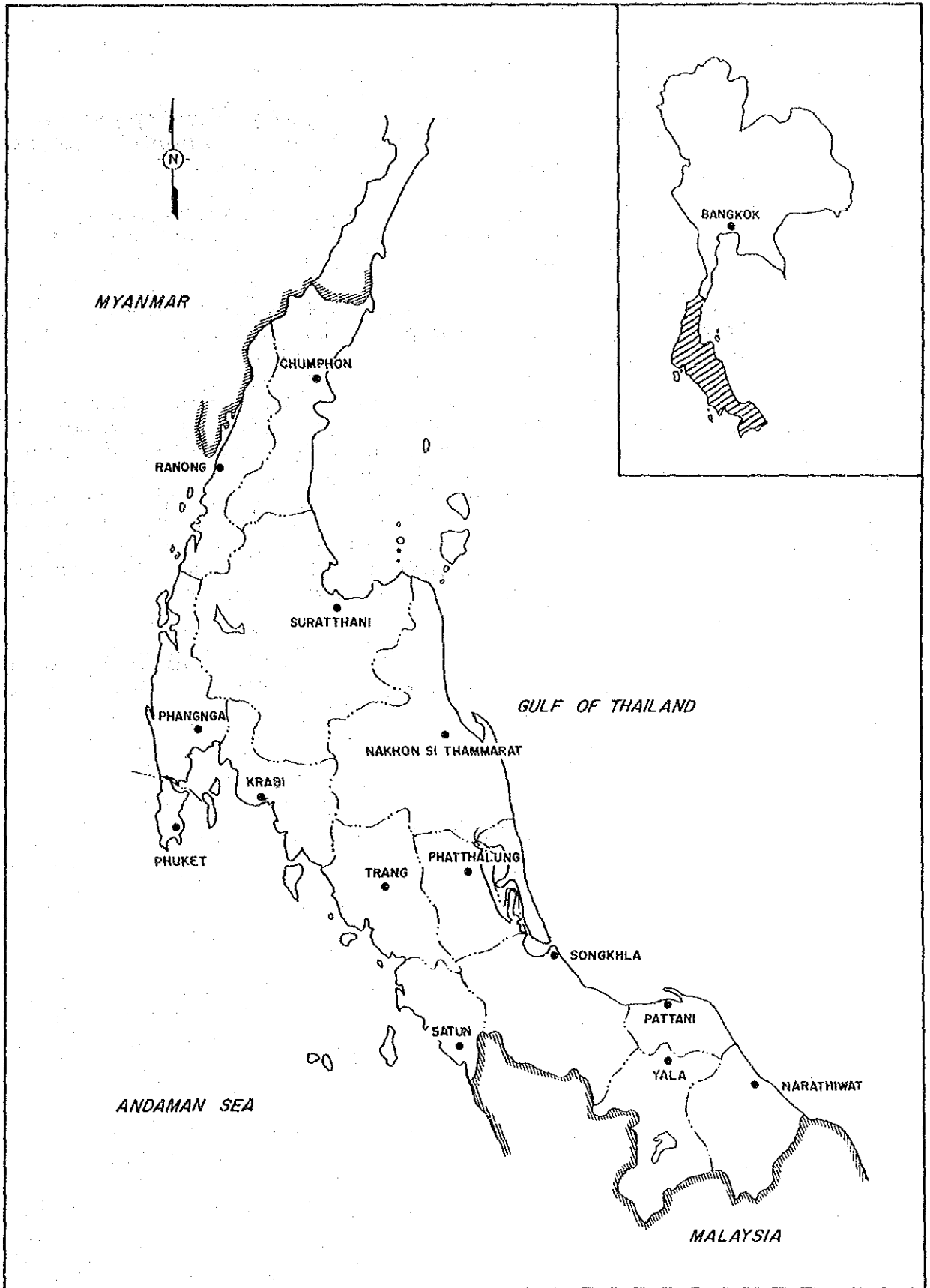


Fig. 1.3.1 LOCATION MAP OF THE STUDY AREA



#### 1.4 Implementation of the Study

The study comprises three phases:

- 1) Phase 1 Study to develop a highway development master plan of the Southern Region and to identify priority projects in conjunction with the objective 1);
- 2) Phase 2 Study to carry out a feasibility study on the Krabi - Khanom Highway Link in conjunction with the objective 2); and
- 3) Phase 3 Study to carry out feasibility studies on the selected priority projects in conjunction with the objective 3).

Fig. 1.4.1 shows a general flow chart of the study. The Phase 1 Study was commenced in February 1990 to continue by November 1990. The Phase 2 Study was commenced in July 1990 to continue by November 1990. The results of the Phase 1 and 2 studies were compiled into the Interim Report which was submitted at the end of November 1990. The Phase 3 Study started in December 1990 to continue by July 1991. All the results of the study was compiled into the Draft Final Report which was submitted at the middle of July 1991. The Final Report is to be submitted at the middle of September 1991.

Table 1.4.1 shows the participants of the Study including Project Principals of the DOH, members of JICA Study Team and Thai Counterparts to the JICA Study Team.

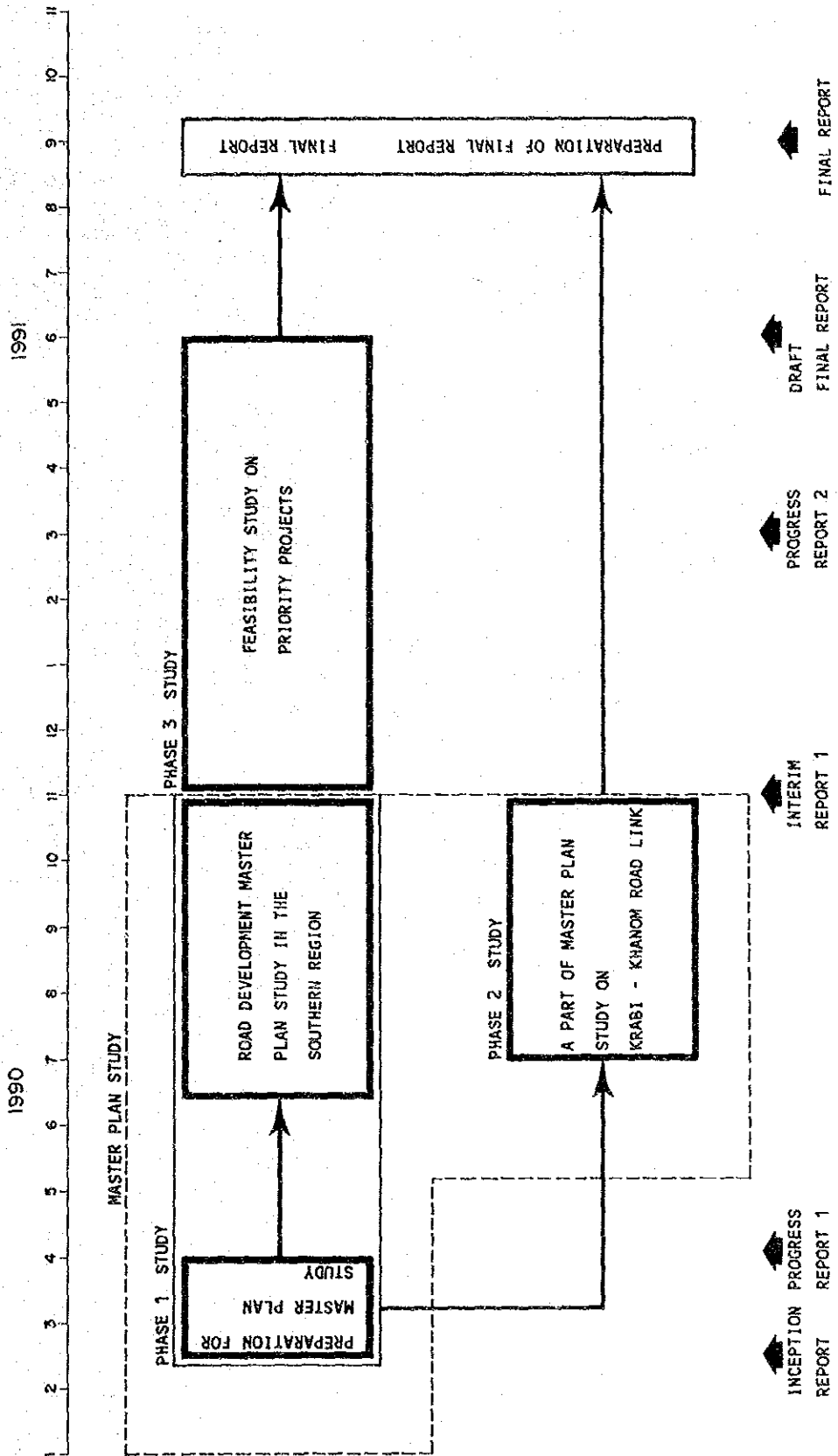


Fig. 1.4.1 GENERAL FLOW CHART OF THE STUDY

Table 1.4.1 LIST OF STUDY PARTICIPANTS

-----  
 DOH PROJECT PRINCIPALS:

Mr. Songsawasdi Duangratana	Deputy Director General for Engineering
Mr. Kanchit Tongmark	Director of Planning Division
Mr. Bancha Vadhanasindhu	Chief of Programming Section

JICA STUDY TEAM:

Mr. Nobuhiro Koyama	Team Leader
Mr. Masashi Oshitari	Deputy Team Leader
Mr. Yoshikazu Umeki	Transport Planner
Mr. Shuichi Yumoto	Regional Planner
Mr. Surapong Laoha-unya	Traffic Engineer
Mr. Sakae Takada	Soil Engineer
Mr. Takao Inami	Highway Engineer
Mr. Koji Wada	Structure Engineer
Mr. Hajime Kinugawa	Cost Engineer
Mr. Akihisa Kojima	Economist

DOH COUNTERPARTS:

Mr. Chusak Gaywee	Project Coordinator
Mr. Isarath Hongsakul	Senior economist
Mr. Kiattikun Leepayakun	Engineer
Mr. Somchai Kessomboon	Engineer
Ms. Siriphan Jitprasithsiri	Economist
Mr. Supaporn Musiklad	Economist

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## CHAPTER 2

# **Present Situation in the Southern Region**



## 2. PRESENT SITUATION IN THE SOUTHERN REGION

### 2.1 General

This chapter outlines the present conditions of the Southern Region in terms of natural conditions, socio-economic conditions and transport network.

About 35 % of total land of the Southern Region is mountainous area and about 40 % of the total land belongs to national conservation area which includes most of the mountainous areas. In rainy season, heavy rainfall causes flooding. This suggests that new highway construction adding to the existing network would be constrained by the requirements for environmental protection and that disaster prevention measures would be required for coping with possible highway damage.

The economy of the Southern Region is highly dependent on international as well as inter-regional trading. Each mode of transport including highway, railway, sea and air transport has been playing an important role to support these trading activities particularly in terms of long distance transport of passengers and cargos. These facts suggest that provision of better linkage between railway stations/sea ports/airports and highway network would be essential to support the future economic growth of the Southern Region.

Traffic volume on most of the highway network has surpassed the designed traffic capacity. Upgrading of the existing highway network, capacity increase in particular, would be the most important issue to be addressed in preparing a highway development master plan of the Southern Region.

### 2.2 Natural Conditions

#### 2.2.1 Geography

The topography of the Southern Region are mountainous, approximately 35 % of the region. There lies, as shown in Fig. 2.2.1, the Phuket Mountain Range at the northwest part of the Peninsula and Nakhon Si Thammarat Mountain Range from the south of Changwat Surat Thani to Changwat Satun. The Sankalakhiri Mountain Range stretches from the east to the west in the lower southern part of the region to separate Thailand from Malaysia.

Land feature of the east coast originally occurred from raised level of land by nature, while that of the west coast originated from erosion of land.

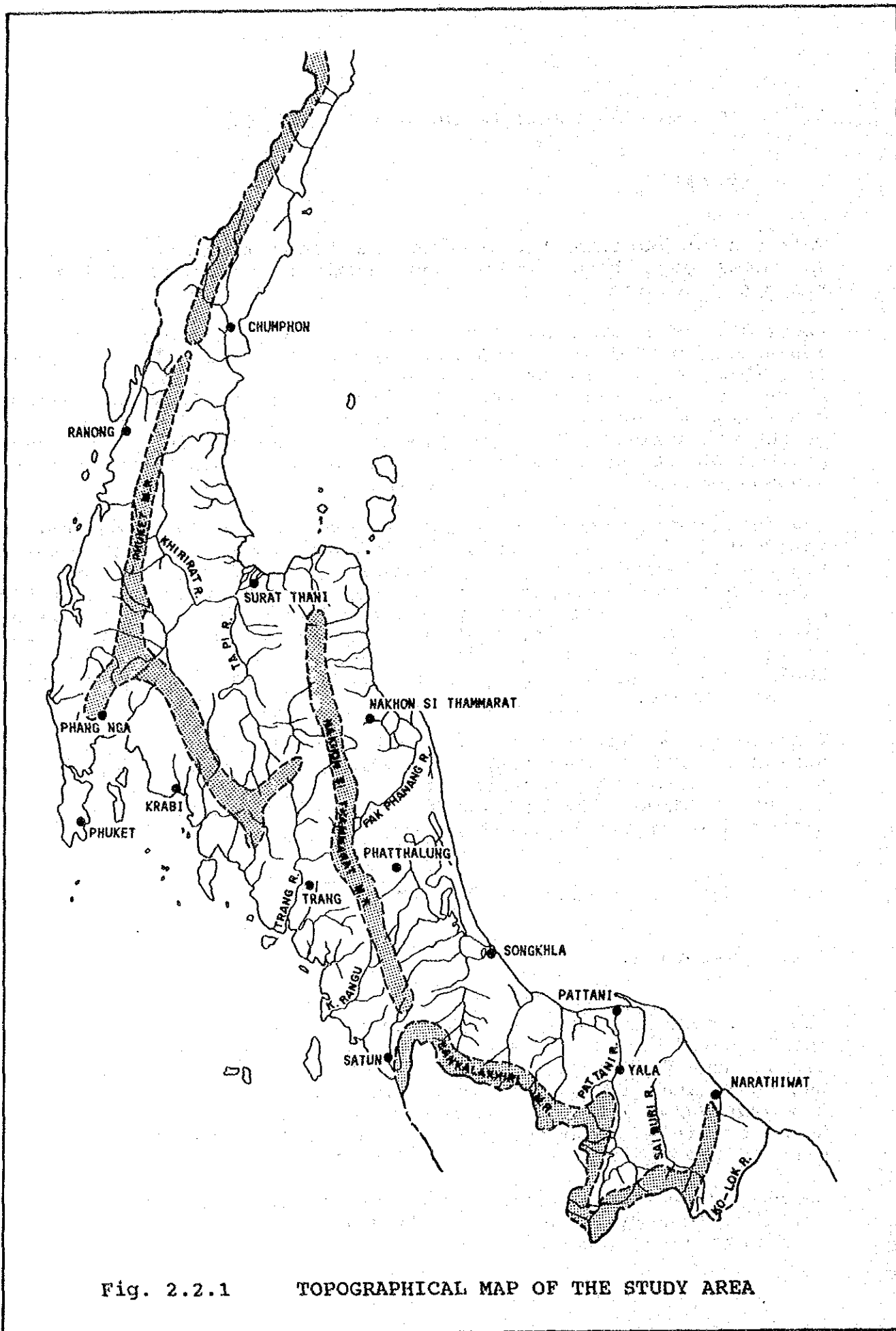


Fig. 2.2.1 TOPOGRAPHICAL MAP OF THE STUDY AREA

There are such several large rivers on the east coast as the Khirirat River, Ta Pi River, Pak Phanang River, Pattani River, Sai Buri River and Ko-Lok River, while there are fewer large rivers on the west coast than the east coast only including such rivers as the Trang River and the Khlong Rangu River. These rivers formed, especially on the east coast, river basin area such as Surat Thani Basin, Nakhon Si Thammarat Basin, Songkhla Basin, Pattani Basin, Narathiwat Basin and Trang Basin. Fan terrace along the east coast are flood prone area in the region.

Surface geological features are shown in Fig. 2.2.2. Alluvium and terrace deposits are spread over major basins around the mouth of major rivers. Most of mountainous and hilly area is covered with sedimentary and metamorphic rocks composed of tertiary sediments, for example, Thung Song limestone, Khorat series and Phuket series, while igneous rocks such as granite cover some part of high mountain areas. These igneous rocks were formed during the tertiary period.

### 2.2.2 Climate

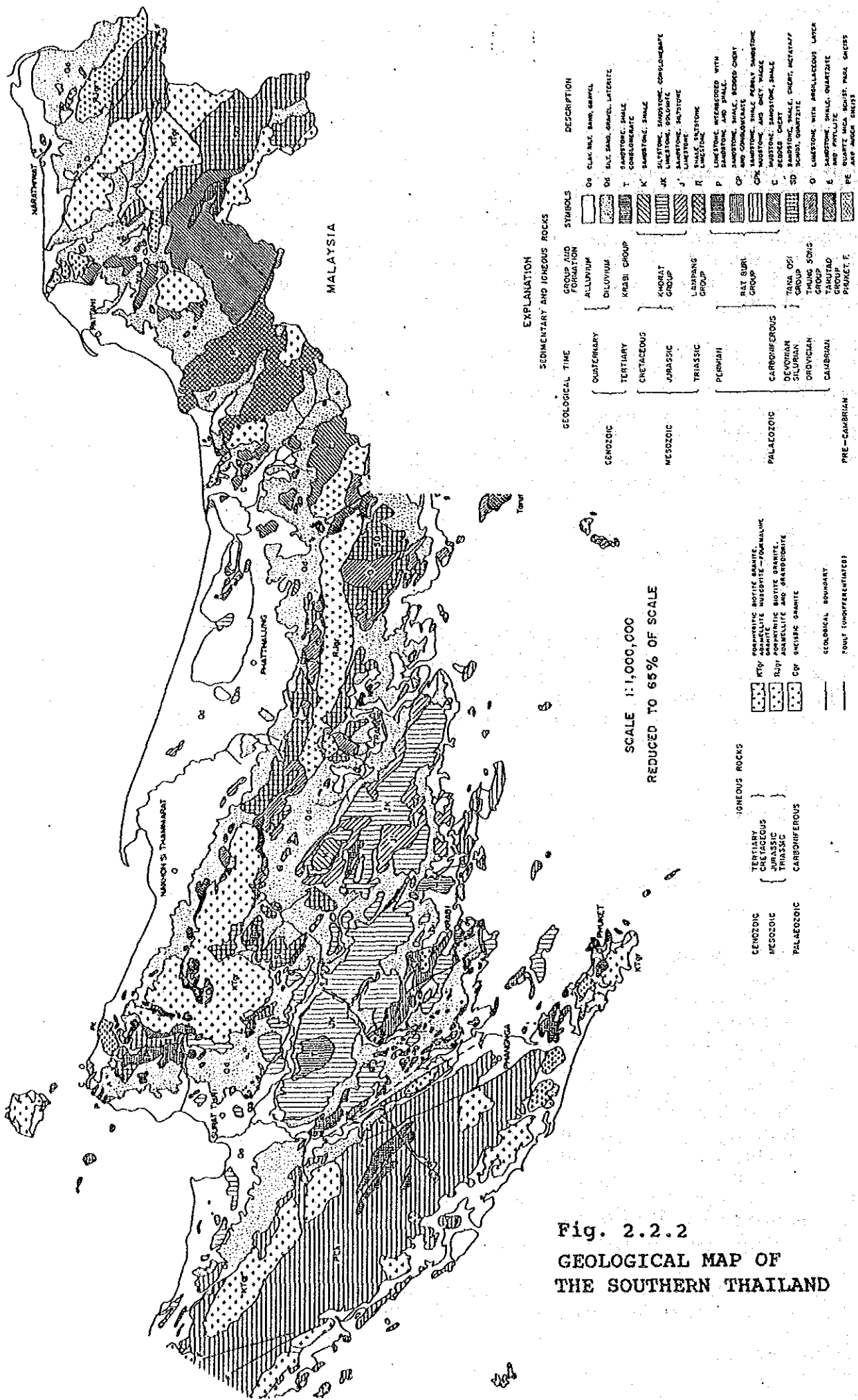
Table 2.2.1 shows climatological data observed by seven stations in the Southern Region during 1956 - 1985. Annual mean temperature is 27.1 C, mean maximum temperature 31.7 C, and the extreme maximum temperature over 39 C. Meanwhile, annual mean minimum temperature is 22 - 24 C, annual mean relative humidity is around 80 %.

Table 2.2.1 ANNUAL AVERAGE CLIMATOLOGICAL DATA  
( FOR THE PERIOD 1956 - 1985 )

	Rainfall (mm)	Rainy Days	Temperature ( C )	
			Mean	Max.
Chunmphon	1,985	173	26.7	31.3
Surat Thani	1,638	163	26.3	32.0
Ko Samui	1,848	159	27.7	30.9
Nakhon S.T.	2,382	172	27.4	31.9
Songkhla	2,079	157	27.7	31.4
Hat Yai	1,647	159	26.7	32.3
Pattani	1,877	145	26.9	32.0
Narathiwat	2,578	174	27.2	31.5
Ranong	4,198	199	26.6	31.6
Phuket	2,302	171	28.2	31.7
Trang	2,232	176	27.2	32.3
Average	2,252	168	27.1	31.7

Source; "Climatological Data of Thailand"  
Meteorological Dept. MOC.





As shown in Fig. 2.2.3, the region receives northeast and southwest monsoons in a year. The region has hot and rainy seasons. The annual average rainy days amount to 168 days, and annual average rainfall reaches 2,250 mm. On the east coast, the northeast monsoon from the South China Sea brings rainfall of 2,063 mm per year mostly during the period of November - May. On the west coast, the southwest monsoon from the Indian Ocean brings rainfall of 2,332 mm mostly during the period of May - October.

Fig. 2.2.4 illustrates mean annual rainfall in Thailand. The Southern Region belongs to the heaviest rainfall area in the country. It is conspicuous from the figure that the west coast has more rainfall than the east coast. Ranong has the heaviest rainfall of 4,000 mm.

### 2.2.3 Natural Environment

Natural environment of the Southern Region can be characterized by mangrove forest and para rubber plantation in terms of inter-regional comparison. Mangrove forest of the Southern Region covered the total area of 1,674 square kilometers in 1986 which accounted for 85 % of the total mangrove forest of the country. Para rubber planting area amounted to 15,200 square kilometers in 1982 which accounted for as high as 96 % of the total para rubber planting area of the country.

Forest area in the Southern Region has been decreasing. Forest area of 29,600 square kilometers in 1961 which was equal to 42 % of the region decreased to 14,600 square kilometers in 1988, accounting for as low as 21 % which was nearly half of that in 1961.

Table 2.2.2 shows transition of forest area in the Southern Region for the period of 1961 - 1988. Surat Thani had the largest forest area during the period although deforestation progressed faster than the regional average. Nakhon Si Thammarat, Chumphon, Ranong, Phangnga and Yala are the provinces of large forest area.

Fig. 2.2.5 and Table 2.2.3 show national conservation area including national reserve forest, national park and wildlife sanctuary. Agricultural statistics compiled by the Royal Forest Department (RFD) indicate that 28,200 square kilometers or about 40 % of the Southern Region was designated as the national reserve forest in 1988. It infers that almost all the mountain areas in the Southern Region are designated as reserve forest. There are sixteen (16) national parks in the Southern Region covering 2,690 square kilometers of land. Wildlife sanctuaries of 2,700 square kilometers are designated in Khlong Saeng, Khao Banthat, Ton Nga Chang and Khlong Phraya.

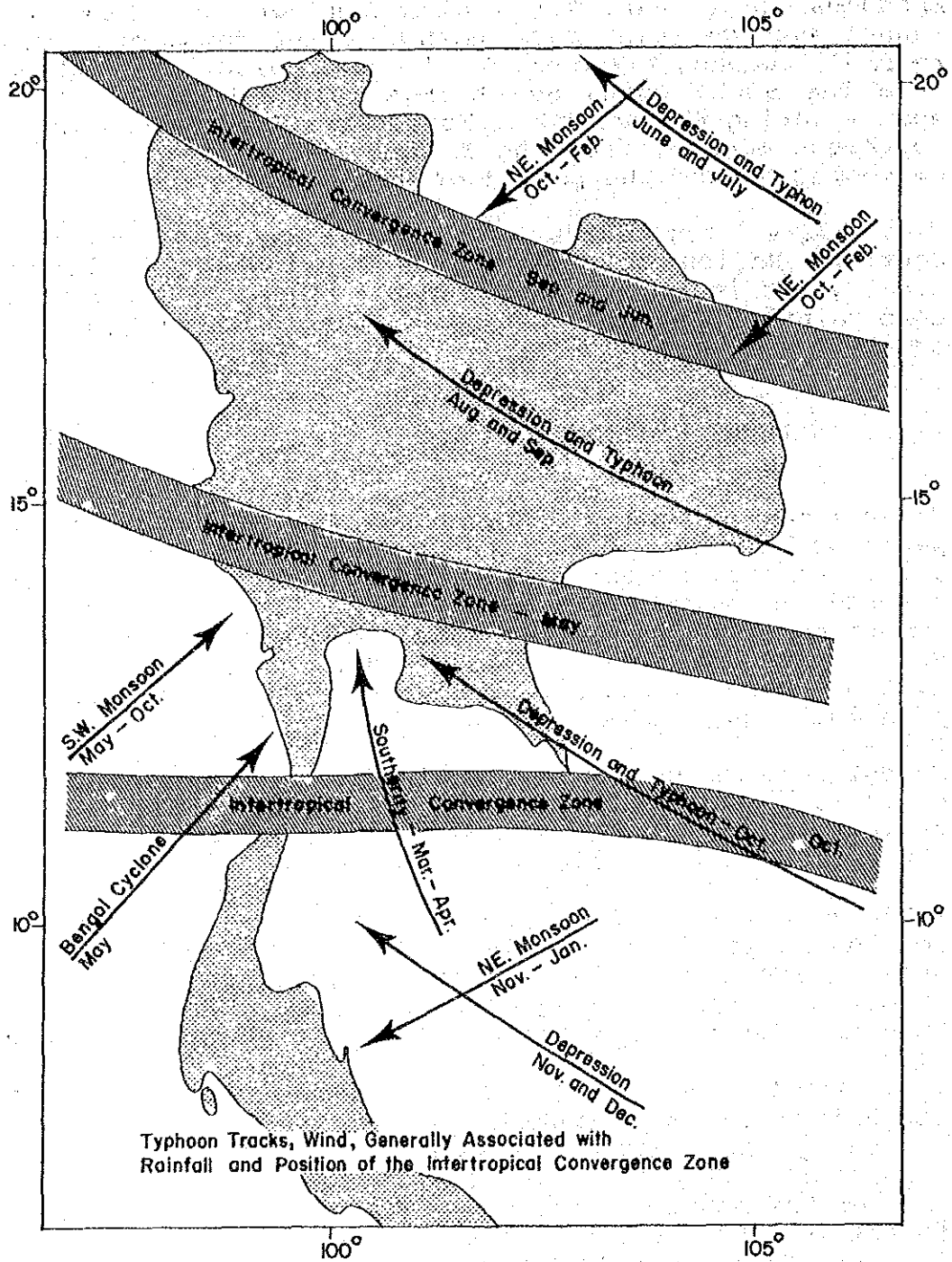


Fig. 2.2.3

MONSOON AND STORM TRACKS IN THAILAND  
( VONGVISESSOMJAI, 1989 )

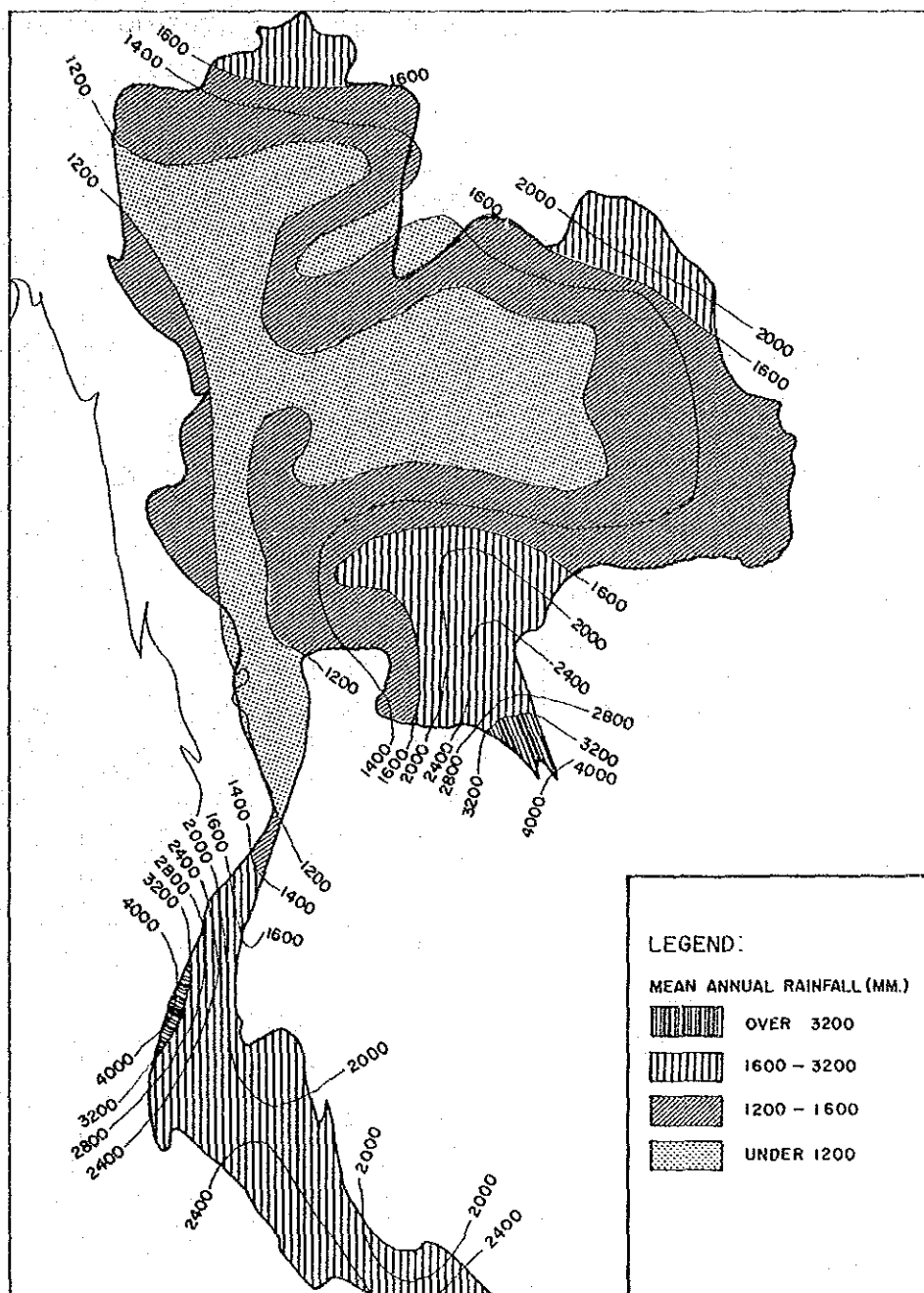


Fig. 2.2.4 MEAN ANNUAL RAINFALL IN THAILAND  
( VONGVISESSOMJAI, 1989 )

Table 2.2.2 FOREST AREA IN THE SOUTHERN REGION

Changwat	Total Area sq.km.	Forest Area						
		1961		1976		1988		1988
		sq.km.	%	sq.km.	%	sq.km.	%	1976
1. Chumphon	6,009.008	4,144	14.0	2,089	10.4	1,425	9.7	68.0
2. Ranong	3,298.045	3,008	10.2	2,079	10.3	1,393	9.5	67.0
3. Phangnga	4,170.895	3,005	10.1	1,623	8.1	1,339	9.2	82.5
4. Surat Thani	12,891.469	8,194	27.7	5,088	25.2	3,397	23.2	66.8
5. Phuket	543.034	273	0.5	84	0.4	40	0.4	47.6
6. Krabi	4,708.512	2,769	9.3	708	3.5	450	3.2	63.6
7. Nakhon Si Thammarat	9,942.502	3,368	11.4	1,745	8.7	1,438	9.8	82.4
8. Trang	4,917.519	2,449	8.4	1,205	6.0	1,010	6.9	83.8
9. Phatthalung	3,424.473	NA	-	593	2.9	512	3.5	86.3
10. Satun	2,478.977	2,128	7.3	921	4.6	680	4.6	73.8
11. Songkhla	7,393.889	NA	-	1,208	6.0	869	5.9	71.9
12. Pattani	1,940.356	288	1.1	80	0.4	49	0.3	61.3
13. Yala	4,521.078	NA	-	1,683	8.4	1,231	8.4	73.1
14. Narathiwat	4,475.430	NA	-	1,033	5.1	797	5.4	77.2
Total	70,715.187	29,626	100.0	20,139	100.0	14,630	100.0	72.6

Source : Royal Forest Department

Note: 1 sq.km. = 1,000,000 sq.m., 1 ha = 10,000 sq.m., 1 rai = 625,000,000 sq.m.

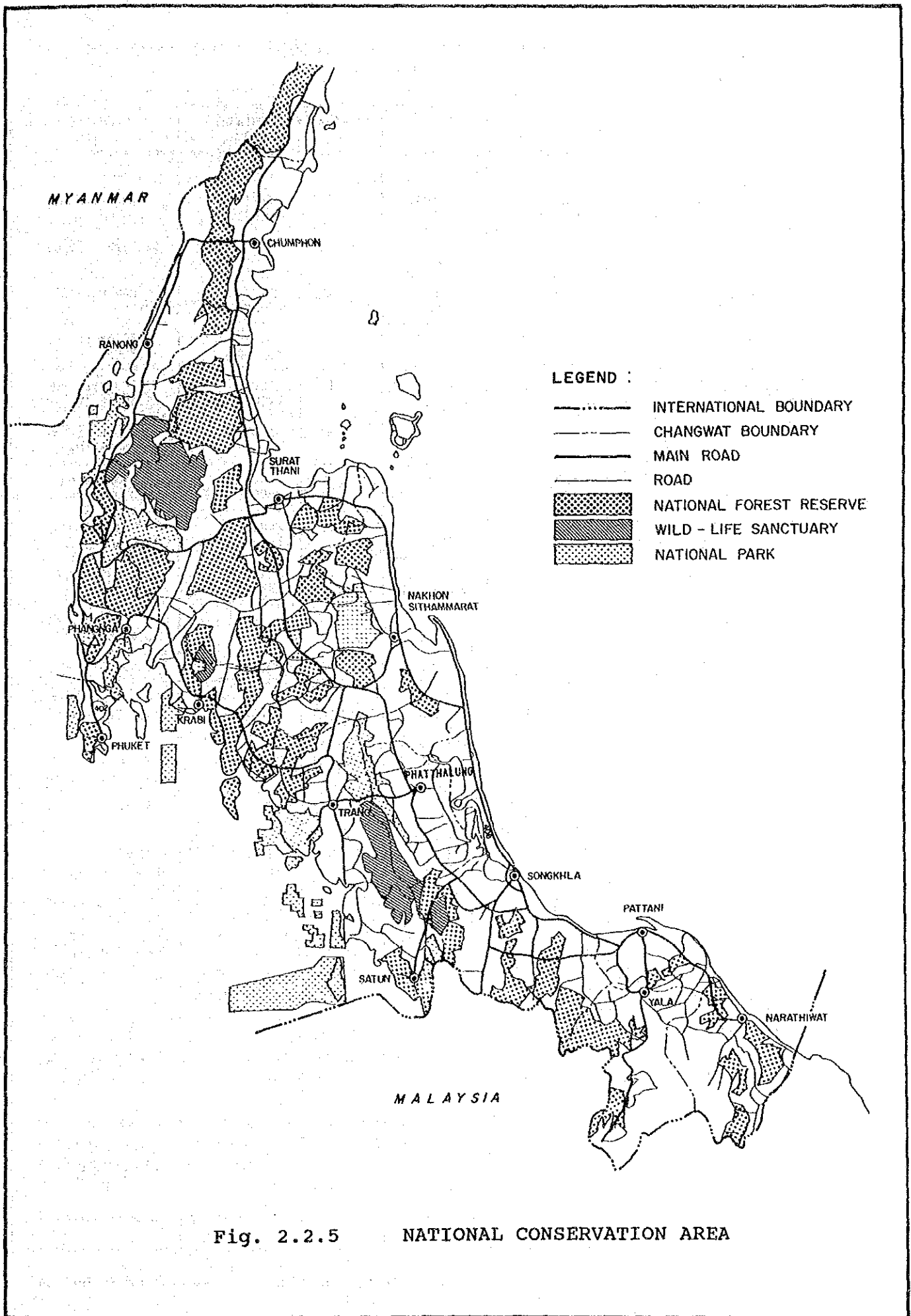


Fig. 2.2.5 NATIONAL CONSERVATION AREA

Table 2.2.3 THE NATIONAL PARKS AND WILDLIFE SANCTUARIES  
IN THE SOUTHERN REGION

NAME	PROVINCE	EST.	AREA(ha)	DOMINANT FOREST TYPE	REMARKS
<b>NATIONAL PARK</b>					
1. HAT LAEM SON	RANDING PHANG-NGA	19 AUG. 1983	31,500	MOIST EVERGREEN	4,800ha (Land)
2. RHAO SOK	SURAT THANI	1980	64,552	-	64,552ha (Land)
3. KHAO LAMPI-HAT THAI MUANG	PHANG-NGA	14 APR. 1986	7,200	MOIST EVERGREEN	MARINE PARK
4. MUKO SURIN	PHANG-NGA	9 JULY 1981	13,500	MOIST EVERGREEN	3,300ha (Land) 10,200ha (Marine)
5. MUKO SIMILAN	PHANG-NGA	1 SEPT. 1982	12,800	SEMI EVERGREEN	1,400ha (Land) 11,400ha (Marine)
6. AO PHANG-NGA	PHANG-NGA	29 APR. 1981	40,000	MANGROVE	5,300ha (Land) 34,700ha (Marine)
7. HAT NAI YANG	PHUKET	13 JULY 1981	9,000	BEACH FOREST	2,200ha (Land) 6,800ha (Marine)
8. HAT NAPHARAT THARA-MUKO PEE PEE	KRABI	6 OCT. 1983	38,996	MANGROVE/ BEACH FOREST	6,400ha (Land) 32,596ha (Marine)
9. KHAO PHANOM BENJA	KRABI	9 JULY 1981	5,012	MOIST EVERGREEN	5,012ha (Land)
10. MUKO ANGTHONG	SURAT THANI	1980	10,200	-	1,800ha (Land) 8,400ha (Marine)
11. KHAO LUANG	NAKHON SI THAMMARAT	18 DEC. 1974	57,000	MOIST EVERGREEN	57,000ha (Land)
12. KHAO PU-PHAO YA	PHATTA LUNG, TRANG	27 MAY 1982	69,400	MOIST EVERGREEN	69,400ha (Land)
13. HAT CHAOMAI	TRANG	14 OCT. 1981	23,088	MANGROVE	9,366ha (Land) 13,722ha (Marine)
14. TALEBAN	SATUN	1980	10,168	-	10,168ha (Land)
15. TARUTAO	SATUN	19 APR. 1974	149,000	MOIST EVERGREEN	26,000ha (Land) 123,000ha (Marine)
16. MUKO PHETRA	SATUN	13 DEC. 1984	49,438	MOIST EVERGREEN	2,600ha (Land) 46,838ha (Marine)
<b>TOTAL</b>	-	-	<b>590,854</b>	-	<b>269,298ha (Land) 321,556ha (Marine)</b>
<b>WILDLIFE SANCTUARY</b>					
17. KHLONG SAENG	SURAT THANI	1974	115,620	-	-
18. KHAO BANHAT	PHATTALUNG, TRANG, SATUN, SONGKHLA	1977	126,720	-	-
19. TON NGA CHANG	SATUN, SONGKHLA	1978	18,200	-	-
20. KHLONG PHRAYA	KRABI	1980	9,500	-	-
<b>TOTAL</b>	-	-	<b>270,040</b>	-	-

Source : - Assessment on National Parks, Wildlife Sanctuaries and others as Development in Thailand  
- Wildlife Conservation Division, RFO

Note: 1 sq.km. = 1,000,000 sq.m., 1 ha = 10,000 sq.m., 1 ref = 625,000,000 sq.m.

Under the circumstance, it is very important in the Southern Region to assess environmental impact which might be caused by highway projects, particularly new road construction into the mountain areas. In order to retard or prevent further deterioration of the natural environment of the region, attention should be paid to better use of the existing highways and rural roads instead of constructing new highways in the environmentally sensitive areas.

### 2.3 Socio-Economic Conditions

The Southern Region is administratively divided into 14 changwats, 112 amphoes, 18 king amphoes, 1,031 tambons and 7,206 mubans in 1988. The local administration consists of 27 municipalities and 120 sanitary districts.

#### 2.3.1 Land Use

The Southern Region covers an area of 70,700 square kilometers, accounting for about 13.8 % of the whole country. Farm holding land occupies the highest share of 43 % of the Southern Region, followed by unclassified land of 36 % and forest land of 21 % in 1988.

Land use of the Southern Region has the following characteristics compared with the other regions:

- the Southern Region has the highest percentage share of "unclassified land";
- the Southern Region has the highest percentage share of "under fruits tree crops & tree crops" of 27 %, followed by the Central Region of 7 %; and
- the Southern Region has the lowest percentage share of "paddy field" of 10 % and "under field crops" of 0 %.

Table 2.3.1 shows land use of the provinces in the Southern Region. In terms of forest land, Ranong, Phangnga, Yala, Satun, Surat Thani and Chumphon have higher percentage share than the Southern average. These provinces, at the same time, have lower percentage share of paddy field than the Southern average. This is because these provinces are situated along the mountain ranges passing through the Southern Region.

On the other hand, Pattani, Phuket, Krabi and Songkhla have lower percentage share of forest land than the Southern average. These provinces, at the same time, have higher percentage share of "under fruit tree & tree crops" than the Southern average.



Table 2.3.1 LAND UTILIZATION OF SOUTHERN REGION IN 1988

(Unit : Rai)

Province	Forest Land	Paddy Land	Under Fruit Tree & Tree Crops	Other Farm Holding Land	Unclassified Land	Total
1. Krabi	281,125 (10)	160,780 (5)	915,150 (31)	132,055 (5)	1,453,710 (49)	2,942,820 (100)
2. Chumphon	890,469 (24)	148,238 (4)	1,125,770 (30)	231,437 (6)	1,359,716 (36)	3,755,630 (100)
3. Trang	631,157 (20)	219,160 (7)	970,048 (32)	139,901 (5)	1,113,183 (36)	3,073,449 (100)
4. Nakhon Si Thammarat	898,705 (14)	1,149,673 (19)	1,520,789 (24)	614,386 (10)	2,030,511 (33)	6,214,064 (100)
5. Narathiwat	498,344 (18)	232,417 (8)	1,048,573 (37)	101,868 (4)	915,942 (33)	2,797,144 (100)
6. Pattani	30,536 (3)	327,804 (27)	403,963 (33)	153,268 (13)	297,151 (24)	1,212,722 (100)
7. Phangnga	836,719 (32)	43,952 (2)	575,923 (22)	71,251 (3)	1,078,964 (41)	2,606,809 (100)
8. Phatthalung	319,985 (15)	602,631 (28)	469,045 (22)	151,682 (7)	596,953 (28)	2,140,296 (100)
9. Phuket	25,313 (8)	7,767 (2)	126,095 (37)	30,540 (9)	149,681 (44)	339,396 (100)
10. Yala	769,719 (27)	95,263 (3)	950,880 (34)	72,158 (3)	937,654 (33)	2,825,674 (100)
11. Ranong	870,351 (42)	22,942 (1)	156,762 (8)	85,781 (4)	925,442 (45)	2,061,278 (100)
12. Songkhla	543,281 (12)	650,357 (14)	1,537,727 (33)	262,716 (6)	1,627,100 (35)	4,621,181 (100)
13. Satun	424,844 (27)	155,064 (10)	298,392 (19)	55,960 (4)	615,101 (40)	1,549,361 (100)
14. Surat Thani	2,122,969 (26)	476,144 (6)	1,747,272 (22)	747,944 (9)	2,962,869 (37)	8,057,168 (100)
Total	9,143,517 (21)	4,292,162 (10)	11,846,389 (27)	2,850,947 (6)	16,063,977 (36)	44,196,992 (100)

Source : Agricultural Statistics of Thailand, Crop Year 1988/89

Note: 1 sq.km. = 1,000,000 sq.m., 1 ha = 10,000 sq.m., 1 rai = 625,000,000 sq.m.

### 2.3.2 Population

The country had a population of about 55 million with a population density of 107 persons per square kilometer in 1988. Table 2.3.2 shows population growth of the country and regions. The national average of population growth showed a declining trend from 2.5 % in 1975-1980 to 2.0 % in 1980-1985, and further to 1.8 % in 1985-1987.

The Southern Region had higher population growth rates during the same period: 2.6 % in 1975-1980; 2.5 % in 1980-1985; and 2.6 % in 1985-1987. Population in the Southern Region reached 6.9 million persons in 1988.

In terms of regional percentage share of population, Bangkok Metropolitan Region showed a constant increasing trend from 14.1 % in 1975 to 15.8 % in 1987. The Southern Region had a slightly increasing trend from 12.5 % in 1975 to 13.1 % in 1987.

Table 2.3.3 shows population and its growth rates by changwat in the Southern Region. Nakhon Si Thammarat had the largest population of 1.40 million in 1988, followed by Songkhla of 1.06 million and Surat Thani of 0.71 million. In recent years of 1985-1988, three changwats of Yala, Satun and Ranong attained a population growth rate of higher than 3 % although their size of population was still small.

Table 2.3.4 shows urban population ratios of the country. National average of urban population ratio showed a gradual increase from 16.7 % in 1975 to 18.1 % in 1988. Bangkok Metropolitan Region showed the highest urban population ratio of 72.3%, followed by the Southern Region of 12.8 % in 1988.

Of the changwats in the Southern Region, Phuket, as shown in Table 2.3.5, showed the highest urban population ratio of 30.1 % in 1988, followed by Yala of 26.0 %, Songkhla of 22.3 %, Ranong of 15.4 % and Trang of 14.0 %. Phuket and Pattani showed the highest population density of 286 and 267 persons per square kilometer, respectively.

Table 2.3.2 POPULATION BY REGION

Region	Population (thousand persons)						Annual Growth Rate (%)		
	1975	1980	1985	1987	1975-1980	1980-1985	1985-1987		
Southern	5,169 (0.125)	5,874 (0.126)	6,647 (0.129)	6,996 (0.131)	2.6	2.5	2.6		
Bangkok Metropolitan and the Vicinity	5,841 (0.141)	6,895 (0.148)	8,042 (0.156)	8,456 (0.158)	3.4	3.1	2.5		
Northeastern	14,539 (0.351)	16,434 (0.352)	18,024 (0.349)	18,622 (0.347)	2.5	1.9	1.7		
Northern	8,663 (0.209)	9,427 (0.202)	10,177 (0.197)	10,488 (0.196)	1.7	1.5	1.6		
Eastern	2,614 (0.058)	2,826 (0.060)	3,171 (0.061)	3,232 (0.060)	3.2	2.3	1.0		
Western	2,449 (0.059)	2,763 (0.059)	3,027 (0.059)	3,169 (0.059)	2.4	1.8	2.4		
Central	2,313 (0.056)	2,499 (0.053)	2,595 (0.050)	2,642 (0.049)	1.6	0.7	0.9		
Whole Kingdom	41,388 (1.000)	46,718 (1.000)	51,683 (1.000)	53,605 (1.000)	2.5	2.0	1.8		

Source : Gross Regional and Provincial Product, July 1987 (NESDB)

Remarks : The figures within parenthesis show the composition ratio/fs in the Kingdom

Table 2.3.3 POPULATION IN THE SOUTHERN REGION

Changwat	Population										Annual Growth Rate (%)				
	1970	1975	1980	1985	1988	1970-1975	1975-1980	1980-1985	1985-1988						
1. Krabi	144,609 (3.3)	180,325 (3.5)	218,814 (3.8)	257,505 (4.0)	280,818 (4.0)	4.5	3.9	3.3	2.9						
2. Chumphon	244,277 (5.6)	290,524 (5.6)	330,455 (5.7)	355,834 (5.5)	383,258 (5.6)	3.5	2.6	1.5	2.5						
3. Trang	338,453 (7.7)	389,267 (7.4)	427,055 (7.3)	469,263 (7.3)	502,968 (7.3)	2.8	1.9	1.9	2.3						
4. Nakhon Si Thammarat	939,470 (21.4)	1,193,608 (22.8)	1,261,408 (21.7)	1,352,237 (21.0)	1,396,209 (20.8)	4.9	1.1	1.4	1.1						
5. Narathiwat	334,601 (7.6)	394,129 (7.5)	441,803 (7.6)	493,089 (7.6)	536,782 (7.8)	3.3	2.3	2.2	2.9						
6. Pattani	352,339 (8.0)	413,333 (7.9)	457,760 (7.9)	483,782 (7.5)	518,079 (7.6)	3.2	2.1	1.1	2.3						
7. Phangnga	130,130 (3.0)	153,065 (2.9)	174,973 (3.0)	195,360 (3.0)	205,997 (3.0)	3.3	2.7	2.2	1.8						
8. Phatthalung	315,863 (7.2)	364,139 (7.0)	412,265 (7.1)	420,412 (6.5)	448,580 (6.5)	2.9	2.5	0.4	2.2						
9. Phuket	103,431 (2.4)	118,601 (2.3)	133,669 (2.3)	147,467 (2.3)	155,367 (2.3)	2.8	2.4	2.0	1.8						
10. Yala	204,405 (4.7)	228,448 (4.4)	273,866 (4.7)	306,362 (4.8)	339,221 (4.9)	2.2	3.7	2.3	3.5						
11. Ranong	57,132 (1.3)	71,122 (1.4)	83,707 (1.4)	98,152 (1.5)	107,808 (1.6)	4.5	3.3	3.2	3.2						
12. Songkhla	643,581 (14.7)	748,233 (14.3)	849,601 (14.6)	981,670 (15.2)	1,060,029 (15.5)	3.1	2.6	3.0	2.6						
13. Satun	109,000 (2.5)	137,519 (2.6)	164,740 (2.8)	192,406 (3.0)	212,446 (3.1)	4.8	3.7	3.2	3.4						
14. Surat Thani	464,964 (10.6)	543,343 (10.4)	593,095 (10.2)	677,602 (10.5)	713,528 (10.4)	3.2	1.8	2.7	1.7						
Total	4,382,255 (100.0)	5,225,656 (100.0)	5,823,211 (100.0)	6,441,186 (100.0)	6,861,090 (100.0)	3.6	2.2	2.0	2.1						

Source : Statistical Yearbook, Thailand No. 33 & No.36

Remarks : The figures within parenthesis show the composition ratio in percent in the Southern Region

Table 2.3.4 URBAN POPULATION IN THE KINGDOM

Region	Urban Population Ratio *1 (%)		Population Density (person/Sq.Km) in 1988
	1975	1980	
Southern	11.3	12.3	97
Bangkok Metropolitan and the Vicinity	-	-	1,097
Northeastern	4.3	4.3	114
Northern	6.6	7.0	63
Eastern	10.0	10.9	98
Western	10.3	10.5	75
Central	(62.3)*2	(64.8)*2	168
Whole Kingdom	16.7	17.6	107

Source : Statistical Yearbook, Thailand, No.32 & No.36

Remarks : \*1. Population in Municipal area / Population in Region  
 \*2. The figures within parenthesis include Bangkok Metropolitan and the vicinity

Table 2.3.5 URBAN POPULATION IN THE SOUTHERN REGION

Changwat	Urban Population Ratio * (%)		Population Density (persons/Sq.Km)	
	1980	1988	1980	1988
1. Krabi	6.2	6.1	46	60
2. Chumphon	6.0	5.0	55	64
3. Treng	13.1	14.0	87	102
4. Nakhon Si Thammarat	8.4	7.8	127	140
5. Narathiwat	12.2	12.8	99	120
6. Pattani	9.0	9.7	236	267
7. Phangnga	9.9	8.6	42	49
8. Phatthalung	7.3	7.5	120	131
9. Phuket	33.8	30.1	246	286
10. Yala	24.3	26.0	61	75
11. Ranong	16.9	15.4	25	33
12. Songkhla	21.4	22.3	115	143
13. Satun	10.5	10.0	66	86
14. Surat Thani	8.9	11.4	46	55
Total	12.3	12.8	82	97

Source : Statistical Yearbook, Thailand, No.33 & No.36

Remarks : \*. Population in Municipal area / Total population in Changwat

### 2.3.3 Production

Gross domestic product (GDP) of the country in 1987 amounted to 1,234 billion baht at current prices which was as large as 4.1 times of that of 1975. The annual growth rate during 1975-1987 accounted for as high as 12.4 % in nominal terms. The strong economic performance has been extended to 1990: 11.0 % in 1988; 11.0 % in 1989 (estimated); and 9.5 % in 1990 (projected) in real terms. It is reported that the factors contributing to the high rate of economic growth in recent years were attributable to the boom in exports of both goods and services as well as a high influx of foreign capital.

Through the economic growth, sectoral composition of the economy had been shifting toward manufacturing industry orientation. Percentage share of agriculture, in consequence, had decreased to 16.1 % in 1987 from 23.2 % in 1980.

Table 2.3.6 shows Gross Regional Product (GRP) by region for the period of 1975-1987. In 1987, the BMR accounted for as high as about a half (49.0 %) of the country's GDP although it had a lower percentage share of 38.0 % in 1975. This infers that most of the economic development had been concentrated on the BMR throughout the last decade.

The GRP of the Southern Region was 122.5 billion baht in 1987 at current prices, which accounted for 9.9 % of the country's GDP. The GRP of the region showed a growth rate of 12.2 % for the period 1975-1987 which was almost equal to the national average. In case of excluding the BMR, the GRP growth rate of the Southern Region was the second highest, next to the Eastern Region of 13.1 %.

Percentage share of the agricultural GRP of the Southern Region accounted for 35.3 % of the total GRP in 1987 which was the highest of all the regions. The share of the agricultural GRP of the region showed a slight increase from 1980 to 1987 mainly due to the significant decline of tin mining activities.

Table 2.3.7 shows GRP by changwat in the Southern region. Average GRP of the changwats amounted to 8.75 billion baht in 1987. Songkhla attained the highest GRP of 21.8 billion baht, followed by Nakhon Si Thammarat of 16.8 billion baht and Surat Thani of 15.1 billion baht. On the other hand, Ranong and Satun had the lowest and the second lowest GRP of 4.0 and 4.6 billion baht respectively.

Table 2.3.6 GROSS REGIONAL PRODUCT (GRP) AT CURRENT MARKET PRICE  
BY REGION

Region	G.R.P. (Million Baht)						Composition Ratio (Annual Growth Rate)				
	1975	1980	1985	1987	1975	1980	1985	1987	1980	1985	1987
Northeastern	50,324	93,123	144,214	155,367	16.6	14.1 (13.1)	14.2 (9.1)	12.6 (3.8)			
Northern	46,062	83,608	127,394	138,283	15.2	12.7 (12.7)	12.6 (8.8)	11.2 (4.2)			
Southern	30,760	76,000	106,565	122,471	10.1	11.5 (19.8)	10.5 (7.0)	9.9 (7.2)			
Eastern	22,942	51,951	86,318	100,497	7.6	7.9 (17.8)	8.5 (10.7)	8.2 (7.9)			
Western	22,836	41,391	57,694	62,731	7.5	6.3 (12.6)	5.7 (6.9)	5.1 (4.3)			
Central	15,084	29,097	45,655	49,516	5.0	4.4 (14.0)	4.5 (9.4)	4.0 (4.1)			
Bangkok Metropolitan and the Vicinity	115,311	283,340	446,558	605,165	38.0	43.0 (19.7)	44.0 (9.5)	49.0 (16.4)			
Whole Kingdom (GDP)	303,319	658,509	1,014,398	1,234,030	100.0	100.0 (16.8)	100.0 (9.0)	100.0 (10.3)			

Source : Gross Regional and Provincial Product, New Series 1975-1987, NESDB, July 1989

Remarks : The figures within parenthesis shows the annual growth rates during previous 5 years and 2 years period.



Table 2.3.7 COMPOSITION RATIO OF GPP BY SECTOR IN THE SOUTHERN REGION

(Unit : %)

Province	*1 Agriculture & Mining		*2 Manufacturing		*3 Service		GPP (Thousand Bahts)		Growth Rate (%) 1975-1987
	1975	1987	1975	1987	1975	1987	1975	1987	
	1. Krabi	46.5	52.5	10.6	7.8	42.9	39.7	1,060,437	
2. Chumphon	41.2	44.8	12.0	6.5	46.8	48.7	1,721,499	8,114,783	13.8
3. Trang	42.6	41.8	7.4	7.4	50.0	50.8	2,384,456	8,349,756	11.0
4. Nakhon Sri Thammarat	32.5	33.1	18.4	13.2	49.1	53.7	3,849,243	16,789,396	13.1
5. Narathiwat	52.4	44.7	6.3	11.1	41.3	55.8	2,248,184	7,789,485	10.9
6. Pattani	32.4	29.3	7.4	10.3	60.2	60.4	1,388,805	6,151,106	13.2
7. Phangnga	40.4	45.8	22.6	12.7	37.0	41.5	1,732,812	6,659,483	11.9
8. Phatthalung	38.9	40.6	15.2	12.1	45.9	47.3	1,436,055	5,318,045	11.5
9. Phuket	7.4	12.6	60.8	20.1	31.8	67.3	2,185,881	5,549,135	8.1
10. Yala	30.7	35.5	20.7	18.2	48.6	46.3	1,392,589	6,134,125	13.2
11. Ranong	35.0	38.7	20.6	10.5	44.4	50.8	1,463,404	4,024,938	8.8
12. Songkhla	32.3	26.5	13.6	13.8	54.1	59.7	4,980,617	21,828,887	13.1
13. Satun	46.2	38.1	7.9	6.6	45.9	55.3	890,767	4,590,123	14.6
14. Surat Thani	35.3	32.6	30.7	21.7	34.0	45.7	4,024,946	15,122,992	11.7
Southern Region	35.4	35.3	19.4	13.1	45.2	51.6	30,759,695	122,470,985	9.3

Source : Gross Regional and Provincial Product, New Series 1975-1987, NESDB, July 1989

Remark : \*1. including Agriculture and Fishery  
 \*2. including Mining & Quarrying, Manufacturing and Construction  
 \*3. including all other branches

#### 2.3.4 Per Capita Production

Table 2.3.8 shows per capita GRP by region. During the period 1975-1987, per capita GRP of the country increased from 7,330 baht in 1975 to 23,020 baht in 1987 by 3.1 times. Imbalance of per capita GRP between the BMR and the other regions, however, expanded substantially. Per capita GRP of the Southern Region declined from 30 % in 1975 to 24 % in 1987 in relative terms with that of the BMR.

Per capita GRP of the Southern Region was 17,510 baht in 1987. Phatthalung showed the lowest per capita GRP of 11,560 baht, followed by Nakhon Si Thammarat of 11,660 baht and Pattani of 11,670 baht, as shown in Table 2.3.9.

#### 2.3.5 Vehicle Registration

Registered number of vehicles of the country followed a steady increasing trend: 1.03 million in 1975; 1.74 million in 1980; and 6.38 million in 1988 including motorcycle. Average annual growth rate during the period of 1980 - 1988 reached as high as 17.7 %.

Registered number of vehicles of the Southern Region increased as well during the same period: 126 thousand in 1975 (12.2 % of the country); 174 thousand in 1980 (10.0 %); and 801 thousand in 1988 (12.5 %). Average annual growth rate during the period of 1980 - 1988 was 21.1 % which was higher than the national average by 3.4 %.

Table 2.3.10 shows the registered number of vehicles of the provinces in the Southern Region. Of 801 thousand vehicles in 1988, number of motorcycle amounted to 659 thousand, accounting for as high as 82.3 % of the total. This fact suggests that motorcycle should be fully taken into account in developing and improving the existing highway network in the Southern Region.

Songkhla had the largest number of vehicles of 138 thousand in 1988, followed by Nakhon Si Thammarat of 103 thousand, Surat Thani of 87 thousand, and Phuket of 76 thousand.

Table 2.3.8 REGIONAL COMPARISON OF PER CAPITA GRP

Region	Per Capita GRP (Baht)				Grow Rate		
	1975	1980	1985	1987	1975-80	1980-85	1985-87
Northeastern	3,461 (18)	5,666 (14)	8,001 (14)	8,343 (11)	10.4	7.1	2.1
Northern	5,317 (27)	8,869 (22)	12,518 (23)	13,185 (18)	10.8	7.1	2.6
Southern	5,951 (30)	12,938 (31)	16,032 (29)	17,506 (24)	16.8	4.4	4.5
Eastern	9,504 (48)	18,383 (45)	27,221 (49)	31,094 (43)	14.1	8.2	6.9
Western	9,325 (47)	14,980 (36)	19,060 (34)	19,795 (28)	9.9	4.9	1.9
Central	6,521 (33)	11,649 (28)	17,593 (32)	18,742 (26)	12.3	8.6	3.2
Bangkok Metropolitan and the Vicinity	19,742 (100)	41,094 (100)	55,528 (100)	71,566 (100)	15.8	6.2	13.5
Whole Kingdom (GDP)	7,329	14,095	19,627	23,021	14.0	6.8	8.3

Source : Gross Regional and Provincial Product, New Series 1975-1987, NESDB, July 1989

Remarks : The figures within parenthesis show index (Bangkok = 100) in the fiscal years

Table 2.3.9 PER CAPITA GRP IN THE SOUTHERN REGION

Changwat	1975	1980	1985	1987
1. Krabi	5,991	9,498 (9.7)	17,594 (13.1)	21,374 (10.2)
2. Chumphon	5,977	11,859 (14.7)	18,938 (9.8)	20,914 (5.1)
3. Trang	6,193	13,245 (16.4)	14,908 (2.4)	16,534 (5.3)
4. Nakhon Si Thammarat	3,248	6,863 (16.5)	10,261 (8.4)	11,659 (6.6)
5. Narathiwat	5,809	10,441 (12.4)	11,648 (2.2)	14,345 (11.0)
6. Pattani	3,412	7,350 (16.6)	11,047 (8.5)	11,672 (2.8)
7. Phangnga	11,476	53,795 (36.2)	37,164 (-7.1)	31,562 (-7.8)
8. Phatthalung	3,978	7,152 (12.4)	11,511 (10.0)	11,561 (0.2)
9. Phuket	18,683	39,954 (16.4)	38,014 (-1.0)	34,900 (-4.2)
10. Yala	6,162	13,097 (16.3)	15,804 (3.8)	17,936 (6.5)
11. Ranong	20,906	53,934 (20.9)	38,455 (-6.5)	36,926 (-2.0)
12. Songkhla	6,712	13,158 (14.4)	17,235 (5.5)	20,100 (8.0)
13. Satun	6,598	11,485 (11.7)	20,560 (12.4)	21,349 (1.9)
14. Surat thani	7,481	13,878 (13.2)	19,005 (6.5)	20,773 (4.5)
Southern Region	5,951	12,938 (16.8)	16,032 (4.4)	17,506 (4.5)

Source : Gross Regional and Provincial Product, July 1987 (NESDB)

Remarks : The figures within parenthesis shown average growth rate during the previous 5 years and 2 years period.

Table 2.3.10 REGISTERED NUMBER OF VEHICLES IN THE SOUTHERN REGION

	*1			*2			Total					
	4-Wheels Vehicle			Motorcycle			Others					
Changwat	1975	1980	1988	1975	1980	1988	1975	1980	1988	1975	1980	1988
1. Krabi	763	644	6,323	2,796	3,454	31,989	23	16	106	3,682	4,114	38,418
2. Chumphon	2,353	1,024	8,078	3,527	5,838	34,539	86	56	0	5,966	6,918	42,617
3. Trang	3,948	4,209	10,966	9,114	14,202	47,500	416	99	337	13,478	17,510	58,803
4. Nakhon Si Thammarat	3,994	2,370	22,520	7,088	13,465	80,000	57	52	229	11,139	15,887	102,749
5. Narathiwat	2,456	583	5,985	14,486	21,407	63,579	36	12	49	16,978	22,002	69,613
6. Pattani	2,464	896	8,755	7,885	9,290	36,505	56	28	43	10,405	10,214	45,303
7. Phangsa	1,151	513	6,140	2,597	2,419	14,754	24	12	54	3,772	2,944	22,358
8. Phatthalung	1,426	457	3,090	2,868	3,249	27,084	122	74	235	4,416	3,780	30,409
9. Phuket	2,375	2,396	12,401	4,501	16,034	63,896	9	2	48	6,885	18,432	76,345
10. Yala	2,847	1,457	7,531	10,862	16,554	48,009	136	114	88	13,845	17,925	55,628
11. Ranong	1,137	651	3,312	1,866	2,450	11,906	44	22	88	3,162	3,123	15,306
12. Songkhla	6,751	5,004	25,422	14,711	24,185	112,161	324	158	339	21,766	29,347	137,922
13. Satun	479	346	2,742	2,119	3,651	16,011	1	0	46	2,599	3,997	18,799
14. Surat thani	1,684	1,512	14,925	5,905	15,869	71,256	70	24	334	7,659	17,405	86,515
Southern Region	34,023	34,202	129,600	90,325	151,867	659,189	1,404	669	1,996	125,752	173,598	800,785

Source : Statistical Reports of Region, Southern Region, National Statistic Office, 1988  
 Statistical Yearbook, Thailand No.36.1989

Remarks : \*1. including passenger vehicle, personal van & truck, taxi and service vehicle  
 \*2. including tractor, agricultural uses vehicle and others

## 2.4 Transport Network

### 2.4.1 General

The transport network in the Southern Region comprises four transport means of water, air, railway and road as shown in Fig. 2.4.1. Water transport has been developed for exporting such resource based products as rubber and tin to international market. Air transport of the Region has been developed to shorten the traveling time to and from Bangkok, by far the largest metropolis of the country.

The Southern Region is connected to overseas as well as neighboring countries through water, air, railway and road transport network. Foreign trade of the country is largely dependent on Bangkok and Sattahip ports, total of these two ports accounting for 99 percent of total import and 95 percent of total export in 1988 in terms of value. In case of excluding import and export through these ports, import through Sadao, Sungai Kolok and Betong in the Southern Region accounts for 43 percent of the remaining total import. Export through Songkhla accounts for 39 percent of the remaining total export, Phuket for 19 percent, and total of Sadao, Sungai Kolok and Betong for 18 percent.

Transport network of the Southern Region has been improved and developed to strengthen linkage with overseas countries. New deep seaports of Songkhla and Phuket were constructed with a capacity of accommodating ocean going vessels of as large as 15,000 - 20,000 GRT.

Hat Yai and Phuket airports have been operated as international airports under the Airport Authority of Thailand (AAT). Hat Yai airport receives scheduled international flights from Penang, Kuala Lumpur and Singapore while Phuket airport those from Hongkong and Singapore.

The southern railway line from Bangkok is connected to Singapore through Malaysia. One express train is operated daily from Bangkok to Singapore with the traveling time of about 40 hours. From Hat Yai, it takes about 16 hours to Bangkok and 13 and 24 hours to Kuala Lumpur and Singapore, respectively. The "Orient Express" train is scheduled to be introduced between Bangkok and Singapore by the end of June 1991 with a view to boosting tourism on the Malay Peninsula.

Highway network in the Southern Region is connected to Malaysian highway system at Sungai Kolok to the east coast of Malaysia, and at Betong and Sadao to the west coast. The Malaysian government has started development of the Trans Malaysian Highways along the west coast from Johor Bahru to the Thai border near Khlong Phruang. It is expected that road transport between Thailand and Malaysia will substantially be increased by the highway development.

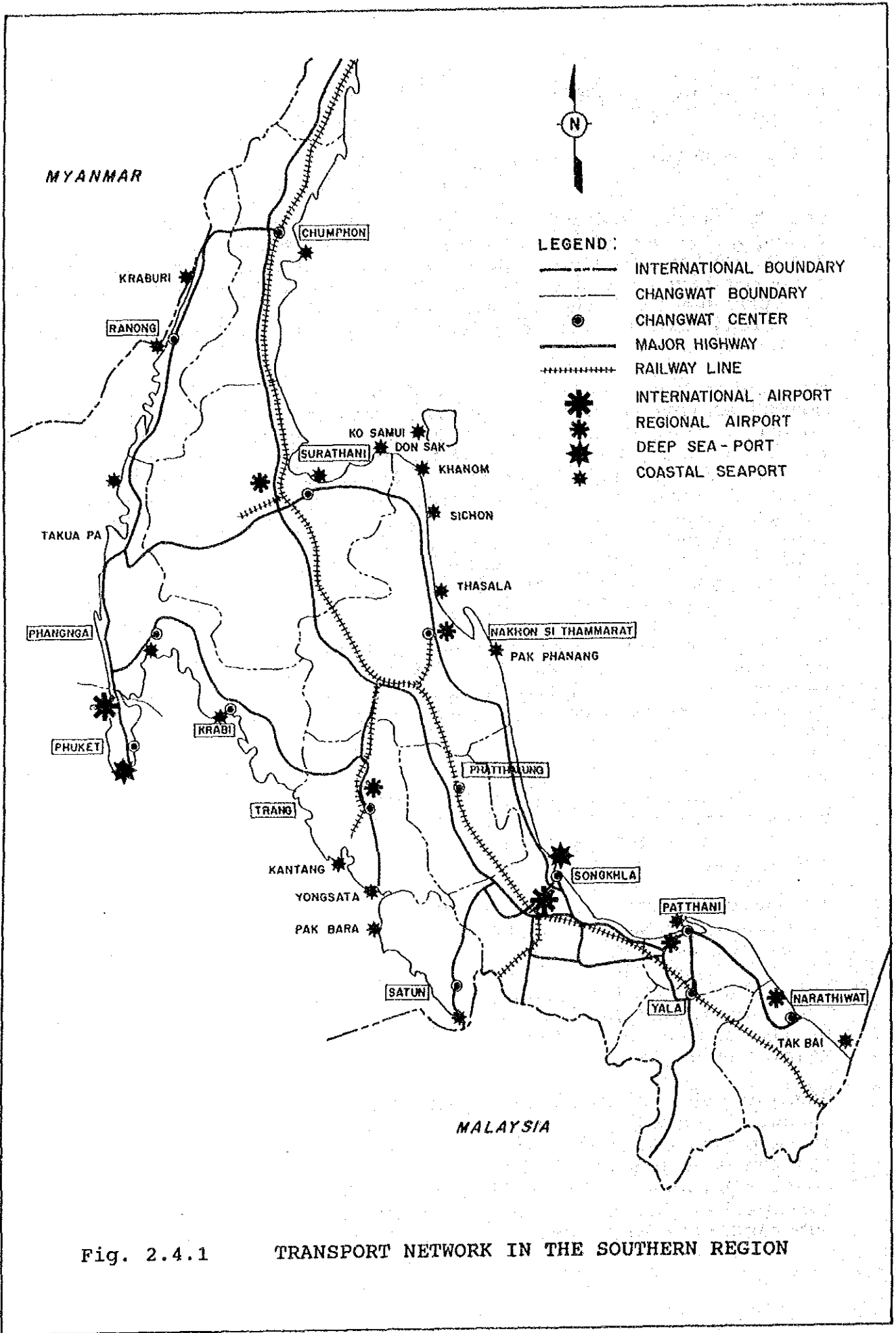


Fig. 2.4.1

TRANSPORT NETWORK IN THE SOUTHERN REGION

The Southern Region is connected only to the Central Region, particularly to the Bangkok Metropolitan Region (BMR). Four modes of transport services are available to and from BMR. Direct aviation services are provided from Bangkok to Hat Yai, Phuket, and Surat Thani. National Highway Route No. 4 connects the Southern Region with BMR: 463 km from Chumphon, 644 km from Surat Thani, 862 km from Phuket, 933 km from Hat Yai, and 1,149 km from the southmost Narathiwat. The Southern Railway Line connects the east coast of the Southern Region with Bangkok: 7.4 hours from Chumphon, 10.6 hours from Surat Thani, and 15.8 hours from Hat Yai.

Coastal ports along the east coast have shipping services to and from BMR, mainly transporting oil products from BMR to these ports. Furthermore, the passenger service from Bangkok to Ko Samui and Songkhla by hydrofoil and ferry have been introduced recently.

Highway network plays the most important role in inter-provincial transport in the Southern Region. Highway Route No. 4, 41, 42 and 43 connect major cities, mainly to the north-south direction as detailed in the later sections.

#### 2.4.2 Sea Transport

The port structure of the country can be classified into two groups: coastal ports along the Gulf of Thailand and the Andaman Sea; and river ports along the Chao Praya River. Major ports are Bangkok Port on the Chao Praya River, Sattahip and Songkhla ports on the Gulf of Thailand, and Phuket Port facing to the Andaman Sea. Laem Chabang and Map Ta Phut Ports are scheduled to be constructed as an important transport node in the Eastern Seaboard Development Program.

In the Southern Region, there are two deep sea ports of Songkhla and Phuket and eighteen coastal ports: Chumphon, Surat Thani, Ko Samui, Khanom, Sichon, Tha Sala, Pak Phanang, Pattani, and Narathiwat on the east coast, and Ranong, Kraburi, Phangnga, Takua Pa, Krabi, Yongsata, Kantang, Pakbara, and Satun on the west coast, as shown in Fig. 2.4.1.

Songkhla Deep Sea Port is designed to accommodate 20,000 GRT vessels with total berth length of 510 meters (-9 m, 3 berths). The port has been open to traffic. Phuket Deep Sea Port is designed to accommodate 15,000 GRT with total berth length of 360 meters (-10 m, 2 berths). The port has also been open to traffic.

The other ports in the Southern Region are of shallow draught, mostly consisting of small wharves or jetties. Surat Thani Port is designed to accommodate two cargo vessels of 1,000 GRT, Krabi Port up to 1,000 GRT, Pattani Port up to 400 GRT.



Major cargoes handled at ports in the Southern Regions are oil/fuel and fish catches for inbound cargo, and rubber, tin and other miscellaneous products for outbound cargo.

Long distance passenger vessels have been introduced between Bangkok and the Southern Region since 1990: one ferry boat with a carrying capacity of 150 vehicles and 800 passengers including amenity and recreation facilities; and one hydrofoil. The former is operated among Bangkok, Ko Samui and Songkhla once a week (15 hours from Bangkok to Ko Samui and 10 hours from Ko Samui to Songkhla). The service would be increased twice a week by the end of 1990. The latter was scheduled to be in service by the end of 1990 for Bangkok - Ko Samui - Songkhla route. The number of passengers transported by sea was far smaller than that of the other modes of transport.

#### 2.4.3 Air Transport

The Department of Aviation (DOA) is responsible for twenty-one (21) regional airports while the Airport Authority of Thailand (AAT) is responsible for four (4) international airports of Don Muang, Chiang Mai, Hat Yai and Phuket.

In the Southern Region, there are seven airports which have regular flight services: Hat Yai, Nakhon Si Thammarat, Narathiwat, Pattani, Phuket, Surat Thani, and Trang.

Hat Yai airport has a runway of 45 meters in width and 3,050 meters in length which can serve all types of commercial aircraft with necessary facilities up to international standard. Hat Yai airport is located on Route No. 4135, about 10 kilometers southwest of Hat Yai city. Two airline companies of Thai Airways(TG) and Malaysian Airways System(MAS) offered eight regular services to Bangkok, Phuket, Narathiwat, Pattani, Penang, Kuala Lumpur and Singapore in 1988.

Phuket airport was improved and expanded recently: a runway of 45 meters in width and 3,000 meters in length, international passenger facilities to serve 1,750 passengers, and domestic passenger facilities to serve 1,950 passengers at peak hour. It is located on Route No. 4031, 32 kilometers north of Phuket city. There are 11 regular flights in services by 3 airlines; Thai Airways(TG), Malaysian Airways System(MAS) and Dragon Air(DA) of Hongkong as of 1988. Destinations are Bangkok, Hat Yai, Surat Thani, Trang, Lankawi, Penang, Kuala Lumpur, Singapore and Hongkong.

Surat Thani airport has a runway of 45 meters in width and 2,500 meters in length and a passenger terminal to accommodate passengers carried by Thai Airways' B737s. Eighty-four (84) percent of the passengers at this airport is to and from Bangkok, 10 percent to and from Phuket, and 6 percent to and from Nakhon Si Thammarat. The airport is located on Route No. 41, 30 kilometers west of Surat Thani city.

Nakhon Si Thammarat airport has a runway of 35 meters in width and 1,100 meters in length which can accommodate Short 330. Air transport service is available only to and from Surat Thani. It is located on Route No. 401, 6 kilometers east of the city.

Pattani airport has a runway of 40 meters in width and 1,400 meters in length which caters for Short 330 and 360. Air transport service is available to and from Hat Yai and Narathiwat. The airport is located on Route No. 42, 15 kilometers west of the city.

Narathiwat airport has a runway of 45 meters in width and 2,000 meters in length. Air transport service is available to and from Hat Yai and Pattani. The airport is located on Route No. 4136, 13 kilometers northwest of the city.

Trang airport has a runway of 30 meters in width and 1,500 meters in length. Air transport service is available to and from Phuket. The airport is located on the west side of Route No. 404, 4 kilometers south of the city.

Krabi airport has a runway of 12 meters in width and 1,200 meters in length. Presently no regular flight is in service.

#### 2.4.4 Railway Transport

The State Railway of Thailand (SRT) had a total network of 3,728 route kilometers (excluding Mae Klong Line) open to traffic in 1988. The railway system of a meter gauge radiates from Bangkok to Chiang Mai (751 km), Nong Khai (642 km), Ubon Ratchathani (575 km), Aranyaprathet (255 km), Padan Besar (990 km), and Sungai Kolok (1,199 km). The SRT system connects with Malaysian Railway at Padan Besar and Sungai Kolok.

The SRT system serves 41 provinces out of the total 73. In the Southern Region, there are 9 provinces which have railway services: Chumphon, Surat Thani, Phatthalung, Nakhon Si Thammarat, Trang, Songkhla, Yala, Pattani, and Narathiwat. The total route kilometers in the region amounts to 946 kilometers, accounting for 25.4 percent of the total SRT system. There are 107 stations in the region.

Table 2.4.1 compares fare and traveling time of railway with those of bus, air and sea. Between Bangkok and Hat Yai (Songkhla for sea), an express railway takes three and a half hours more than bus while the 2nd class fare of railway is almost similar to that of bus. Though the 1st class fare of the express railway is as low as one third of the air fare, air transport service provide shorter traveling time of less than one tenth of that of railway. In case of sea transport by ferry, although the destination is slightly different, the 1st class fare of express train is almost same as Y class fare of ferry while the traveling time is only 65 to 80 percent of ferry.

Table 2.4.1 COMPARISON OF FOUR TRANSPORT MODES

from Bangkok		to Surat Thani	to Hat Yai
Railway:	Distance (km)	651	945
	Fare 1st class (baht)	470	664
	2nd class (baht)	224	313
	3rd class (baht)	107	149
	Time express (hour)	12.13	16.30
	rapid (hour)	12.26	18.40
Bus:	Distance (km)	668	1,013
	Fare Aircon (baht)	225	339
	No Aircon (baht)	125	187
	Time (hour)	8.20	13.00
Air:	Distance (km)	612	782
	Fare (baht)	1,445	1,850
	Time (hour)	1.00	1.15
Sea:	Fare Y class (baht)	550	650
(Ferry)	V.I.P.class	640	720
	Time (hour)	15.00*	25.00**

Source: Operation Schedule in 1990 for ferry and 1989 for other modes.

Note: \*to Ko Samui  
\*\*to Songkhla

## 2.4.5 Road Transport

Total road length of the country increased from 156,000 km in 1981 to 175,390 km in 1988 at an annual growth rate of as low as 1.7 percent as shown in Table 2.4.2. The road category of the highest growth rate was Expressway (ETA) of 17.2 percent, followed by Municipal Road (BMA) of 13.4 percent and Special Highway (DOH) of 12.7 percent. This implies that most of the road extension since 1981 has been concentrated in the Bangkok Metropolitan Region (BMR) to ease the traffic congestion there.

Table 2.4.2 ROAD LENGTH BY RESPONSIBLE AGENCIES

unit: 1,000 km

	1981	1985	1988	1981-1988 (% pa)
1. Expressway (ETA)	0.01	0.02	0.03	17.2
2. Special Highway (DOH)	0.08	0.19	0.19	12.7
3. National Highway (DOH)	15.17	15.51	16.50	1.2
4. Provincial Highway (DOH)	28.66	29.46	33.17	2.1
DOH Sub Total	43.92	45.16	49.87	1.8
5. Rural Roads:	103.53	108.72	110.79	1.0
- OARD	15.72	18.55	19.51	3.1
- RID	3.56	4.87	<u>1/</u> 5.20	5.5
- PWD	2.60	3.64	4.43	7.9
- Others	81.65	81.65	81.65	0.0
6. Municipal Roads:	8.54	8.54	14.71	8.1
- BMA	1.15	1.16	2.79	13.4
- Others	7.39	7.39	<u>1/</u> 11.92	7.1
<b>Total</b>	<b>156.00</b>	<b>162.44</b>	<b>175.39</b>	<b>1.7</b>

Source: DOH

Note: 1/ at the year 1986

Table 2.4.3 shows length of DOH highways by surface type. National Highways are mostly paved at the ratios of over 99 percent. Pavement ratio of provincial highways was improved from 67.3 percent in 1981 to 77.8 percent in 1985 but no significant improvement has been done since then.

Table 2.4.3 LENGTH OF DOH HIGHWAYS BY SURFACE TYPE

unit: km

		1981	1985	1988
National HWYs:	Total	15,256	15,701	16,698
	Paved	14,054	15,132	15,822
	(Paved %)	(99.1)	(99.4)	(99.5)
	Unpaved	121	86	77
	Under Con.	1,081	483	799
Provincial HWYs:	Total	28,660	29,457	33,170
	Paved	10,661	17,124	20,052
	(Paved %)	(67.3)	(77.8)	(77.4)
	Unpaved	5,180	4,893	5,843
	Under Con.	12,819	8,440	7,275
Total:	Total	43,916	45,337	49,868
	Paved	24,715	31,256	35,874
	(Paved %)	(82.3)	(86.3)	(85.8)
	Unpaved	5,301	4,979	5,920
	Under Con.	13,900	8,923	8,074

Source: Highway in Thailand, 1988 by DOH 08 4

Table 2.4.4 shows regional comparison of DOH highways in 1988. The Central Region has the highest road density of 0.128 in terms of road length per square kilometer including under construction highways, followed by the Southern Region of 0.110. In terms of road length per 1,000 population including under construction highways, the North Region has the highest figure of 1.386, followed by the Southern Region of 1.136. It could be inferred that the Southern Region has an extended DOH highway network when compared with other regions.

Table 2.4.4 REGIONAL COMPARISON OF DOH HIGHWAYS IN 1989

	North	Northeast	Central	South	Total
Area (km <sup>2</sup> )	169,644	168,854	103,902	70,715	513,115
Population (1,000)	10,731	19,254	18,115	6,861	54,961
Density (psn/km <sup>2</sup> )	63.2	114.0	174.3	97.0	107.1
National HWYS (km)					
Paved	3,366	4,597	4,933	2,926	15,822
(Paved %)	(99.5)	(99.3)	(99.5)	(100.0)	(99.5)
Unpaved	16	34	27	0	77
Under Con.	360	90	310	39	799
Sub Total	3,742	4,721	5,270	2,965	16,698
Provincial HWYS (km)					
Paved	6,117	5,538	5,354	3,043	20,052
(Paved %)	(81.1)	(72.9)	(80.3)	(74.4)	(77.4)
Unpaved	1,424	2,056	1,315	1,048	5,843
Under Con.	3,592	1,548	1,396	739	7,275
Sub Total	11,133	9,142	8,065	4,830	33,170
Total (km)					
Paved	9,483	10,135	10,287	5,969	35,874
(Paved %)	(86.8)	(82.9)	(88.5)	(85.1)	(85.8)
Unpaved	1,440	2,090	1,342	1,048	5,920
Under Con.	3,952	1,638	1,706	778	8,074
Grand Total	14,875	13,863	13,335	7,795	49,868
Density (km/km <sup>2</sup> )					
Existing	0.064	0.072	0.112	0.099	0.081
Total	0.088	0.082	0.128	0.110	0.097
Length (km/1,000psn)					
Existing	1.018	0.635	0.642	1.023	0.760
Total	1.386	0.720	0.736	1.136	0.907

Source: DOH

## 2.5 Highway Network

### 2.5.1 Highway Classification and Standard

#### 1) Highway Design Standard of DOH

Highway design standard of the DOH is based on the AASHTO practices (The American Association of State Highway and Transportation Officials). The DOH has three highway classifications in accordance with the defined functions of highways:

- (1) Primary Highways (single and double digit numbering);
- (2) Secondary Highways (three digit numbering); and
- (3) Provincial Highways (four digit numbering).

The three highway classifications are further sub-divided into several standards based on the annual average daily traffic (AADT) as shown below:

#### Highway Classification Standards

Primary Highway	4 Standards (PD, P1, P2 and P3)
Secondary Highway	5 Standards (SD, S1, S2, S3 and S4)
Provincial Highway	7 Standards (FD, F1, F2, F3, F4, F5 and F6)

In the standards, "D" represents divided carriageway of two lanes for each direction. The number of "1, 2, 3, ..." represents two lane highway with different width of carriageway based on the AADT. The number "3" and "4", for instance, indicate the width of carriageway of 6.0 meters and 5.5 meters, respectively.

Table 2.5.1 shows classification and standard of the DOH highways. Highways of standard "4" and above have paved surface while those of standard "5" and below have soil aggregate surface.

Fig. 2.5.1 - 4 show typical cross sections of primary, secondary and provincial highways.

In terms of highway planning, introduction of class "D" highways is planned on the basis of a 7 year AADT projection of over 8,000 or appropriate justification by economic feasibility calculations. Highway classes of "1" and below are determined on the basis of a 15 year AADT projection.

Table 2.5.1 DOH STANDARD FOR ROAD DESIGN

Road Class	PD (SD) <FD>	PI (S1) <F1>	P2 (S2) <F2>	P3 (S3) <F3>	(S4) <F4>	(S5) <F5,F6>
AADT (V/day)	8,000 4,000	8,000 4,000	4,000 2,000	2,000 1,000	1,000 300	300
Design Speed (km/h)	80-100	60-80*	50-60**	(70-90, 55-70*, 40-55**)	< 60-80 >	< 60 >
		< 70-90 >			< 45-60* >	< 45* >
		< 55-70* >			< 40-55** >	< 30-45** >
Width of C/W (m)	2@7.00 (2@7.00) <2@7.00>	7.00 ( 7.00 ) < 7.00 >	6.50 ( 6.50 ) < 6.50 >	6.00 ( 6.00 ) < 6.00 >	( 5.50 ) < 5.50 >	( 9.00 ) < 9.00 >
Width of Shoulder (m)	2.50 ( 2.50 ) < 2.50 >	2.50 ( 2.50 ) < 2.50 >	2.25 ( 2.25 ) < 2.25 >	2.00 ( 2.00 ) < 2.00 >	( 1.75 ) < 1.75 >	( T/W ) < T/W >
Surface Type	High ( High ) < High >	High ( High ) < High >	I/M ( I/M ) < I/M >	I/M ( I/M ) < I/M >	( I/M ) < I/M >	( S.A ) < S.A >
Max. Gradient (%)	4, 6*, 8**	4, 6*, 8**	( 6, 8*, 10** )		< 8 >	< 12 >
		< 6 >			< 10* >	< 12* >
		< 8* >				< 12** >
		< 10** >				

Note : Primary Highway (P) : Flat and Moderately Rolling I/M : Intermediate  
 ( ) : Secondary Highway (S) \* : Rolling and Hilly S.A : Soil Aggregate  
 < > : Provincial Road (F) \*\* : Mountainous T/W : Travelled Way



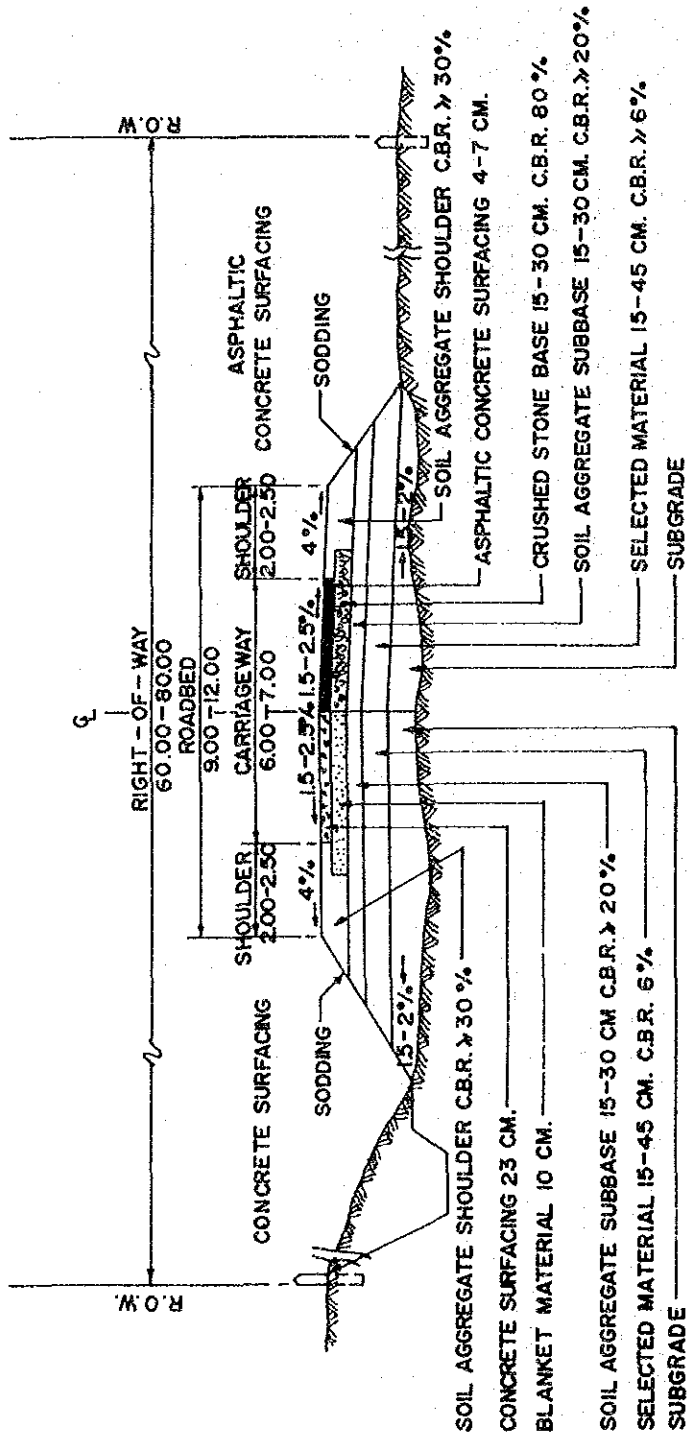


Fig. 2.5.1 TYPICAL CROSS SECTION OF PRIMARY HIGHWAY

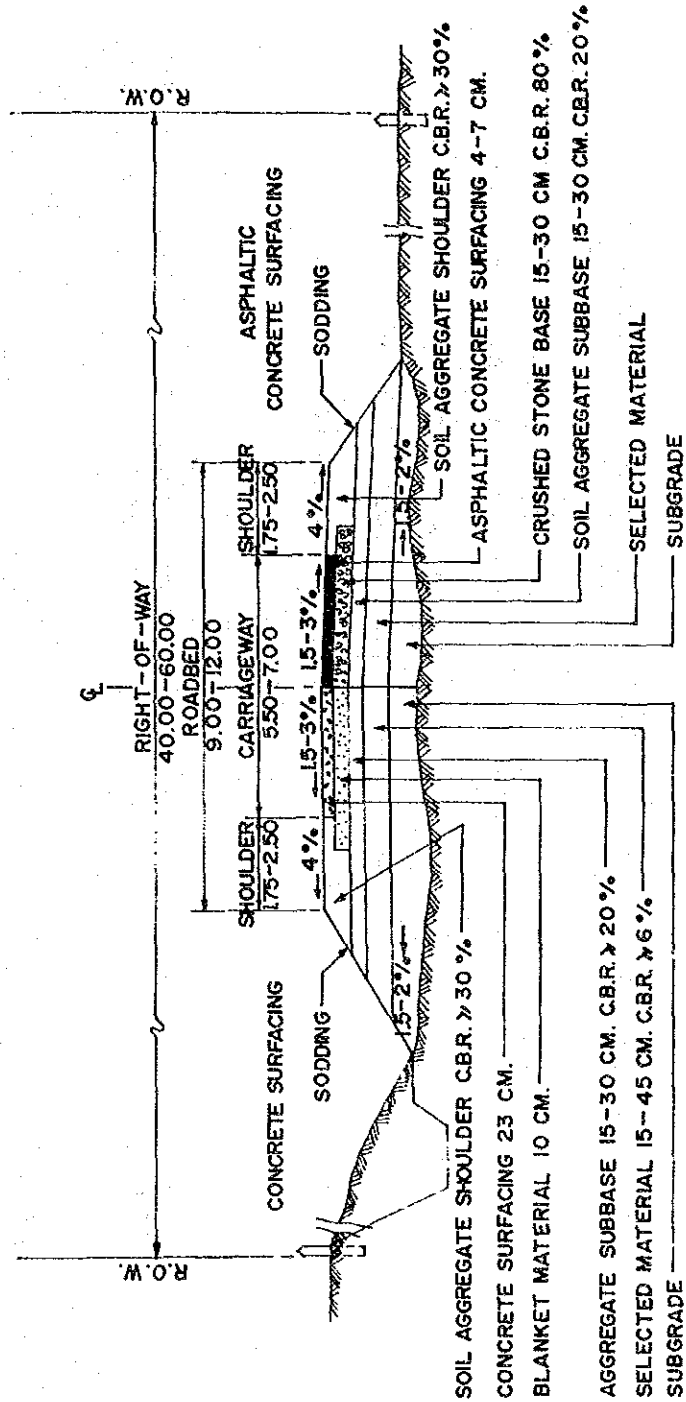


Fig. 2.5.2 TYPICAL CROSS SECTION OF SECONDARY HIGHWAY

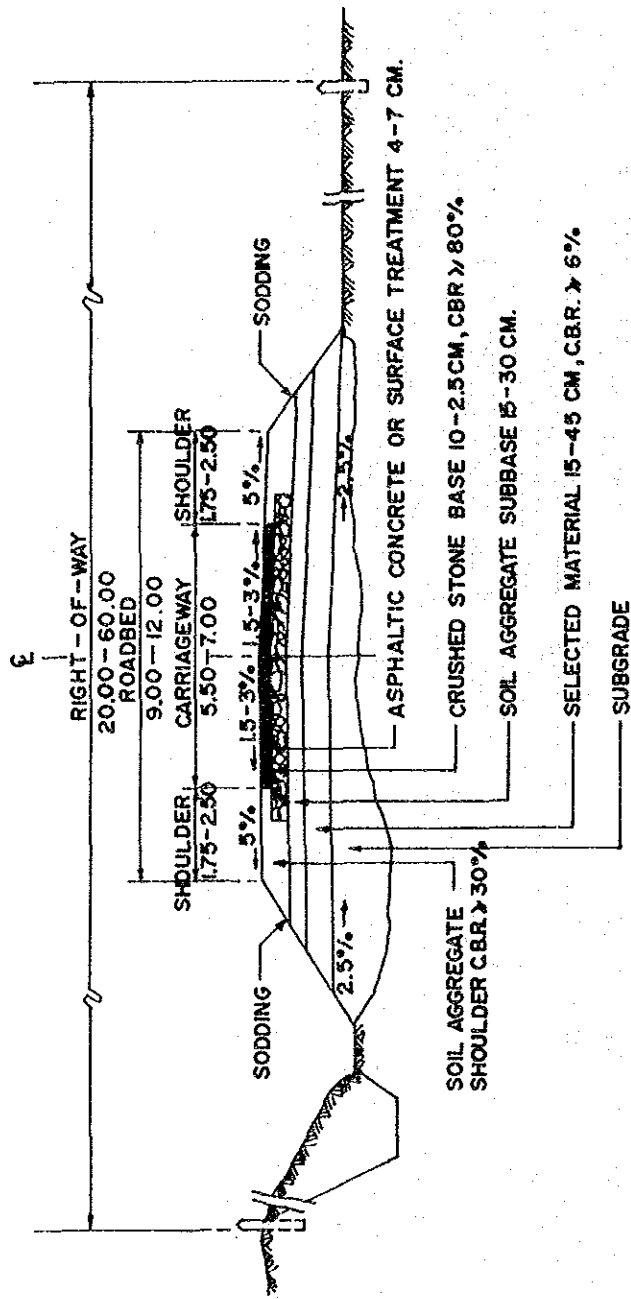


Fig. 2.5.3 TYPICAL CROSS SECTION OF PROVINCIAL HIGHWAY (PAVED)

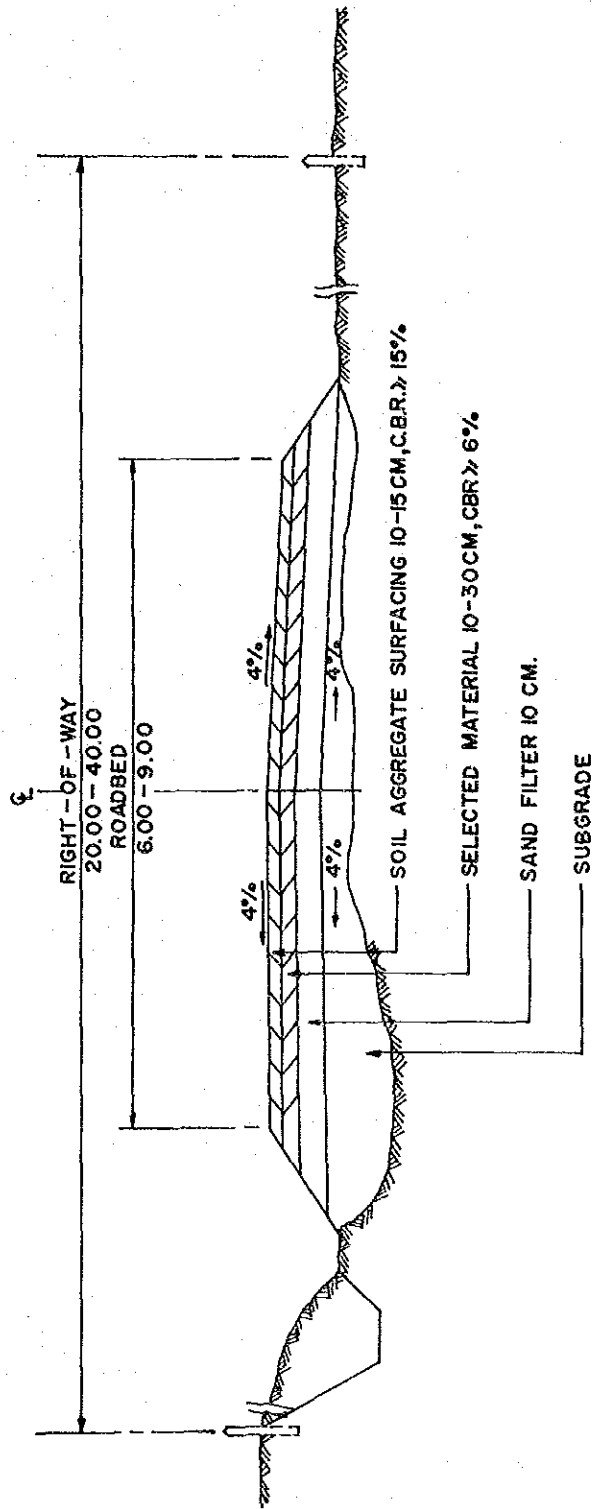


Fig. 2.5.4 TYPICAL CROSS SECTION OF PROVINCIAL HIGHWAY (UNPAVED)

2) Bridge Design Standard of DOH

Bridge design standard of the DOH is also based on AASHTO practices.

The DOH adopts the maximum loading in HS Loading system which has HS 20-44 (MS 18). The HS Loading system is based on a tractor truck with a semi trailer.

Bridges are designed to accommodate full roadway width or total width of carriageway plus 1.5 meters, whichever wider. Width of bridge for class "F6", however, is limited at 7.0 meters.

Width of sidewalk is defined based on location of bridge:

urban and suburban areas	1.50 m
rural areas	1.00 m
no pedestrian areas	0.50 m

3) Slope

Fig. 2.5.5 illustrates the standard gradient of slope. In order to prevent slope erosion, however, mortar spray of 3-5 cm thickness coupled with wire mesh covering is to be installed at the sections where slope gradient is steep and slope erosion is likely to occur. These sections are also to be equipped with drain pipes to lower the possible water pressure from behind the mortar spray. Bench cut is to be prepared to prevent slope failure.

4) Road Design Standard of Other Agencies

Office of the Accelerated Rural Development (ARD), Public Works Department (PWD) and Local Governments are the major agencies related to rural road development. These agencies, however, do not have their codified design standard, but follow AASHTO, DIN, Japanese Standard or their own usual practices depending on situations.

Table 2.5.2 shows an example of road design standard of ARD and Fig. 2.5.6 illustrates a typical cross section of ARD road.

Table 2.5.2 ROAD DESIGN STANDARD OF ARD

Terrain	Design Speed	Maximum Gradient
Flat	60 km/h	-
Hilly	45	-
Mountainous	30	12%

Source:ARD

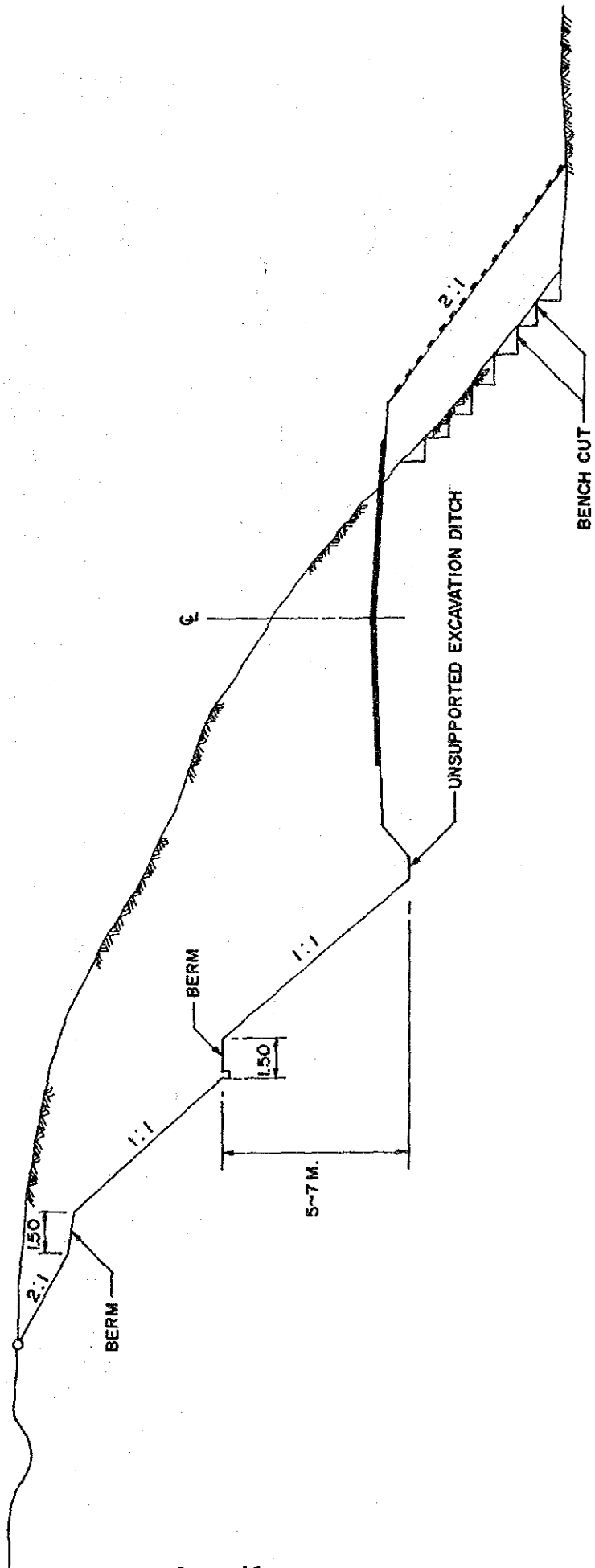


Fig. 2.5.5 STANDARD OF SLOPE GRADIENT

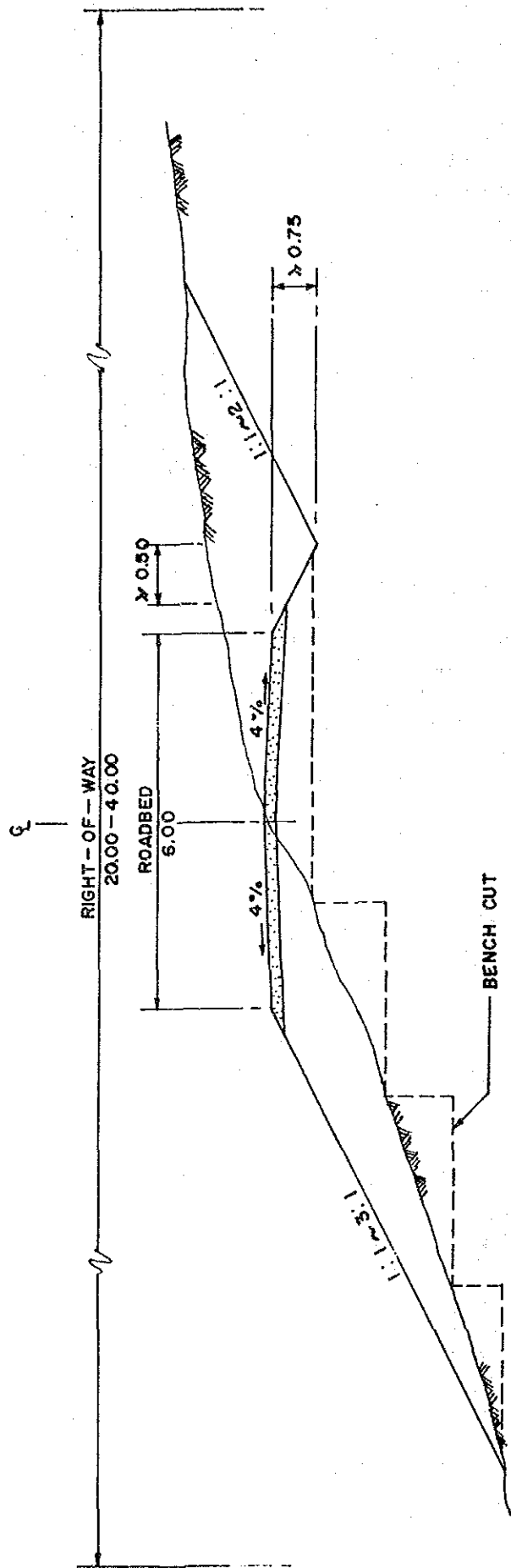


Fig. 2.5.6 TYPICAL CROSS SECTION