CHAPTER 2 PRESENT CONDITION OF MALAYSIA

2.1 Present Condition of Socio-Economy of Malaysia

2.1.1 Population

(1) Nation

Total population of Malaysia increased from 13.7 million to 23.3 million at the average annual growth rate of 2.67% during twenty years from 1980 to 2000. Malaysian people inhabit in the land area of 330 thousand km^2. Population density heightened from 41.6 person/km^2 to 82.1 person/km^2 in the same period which is almost two times increasing. Two states of Sabah and Sarawak occupy 60.1% of total land of Malaysia. Their population increased from 2,318.6 thousand (16.9%) to 5,123.5 thousand (22%) during the same period. In the Peninsular, the widest area is occupied by Pahang (10.89%) followed by Perak (6.36%), Johor (5.75%) and Kelantan (4.52%). (See Table 2.1.1)

(2) State

Comparing by State, Federal Territory of Kuala Lumpur has only 0.07% of land area but its population decreased from 7.1% to 6.1% in share. During last ten years from 1990 to 2000, most rapid annual growth rate of population is observed for Sabah as 6.01% followed by Federal Territory of Labuan as 4.03%, Selangor as 3.49% and Terrengganu as 3.10%. The most of these States expanded their shares. (See Table 2.1.1)

2.1.2 Gross Domestic Product

(1) Nation

The Malaysian economy performed better than expected during the Seventh Malaysian Plan period (1996-2000) despite the severe contradiction in 1998 arising from the East Asian financial crisis. The strong growth performance before the crisis, improved external demand and the recovery measures undertaken by the Government contributed to the overall economic performance. Prior to the crisis, growth was accelerated by domestic demand particularly private investment. With the influence of the crisis, the Government eased monetary policy and provided fiscal stimulus to reactivate domestic demand and strengthen the external sector (international trade). This resulted in the sharp economic recovery beginning 1999. At the end of the Plan Period, Gross Domestic Product (GDP) recovered above the pre-crisis level, while inflation and unemployment remained low as explained the following sections.

Table 2.1.1 Historical Performance of Population and Population Density

Name of State	Area (km^2)	Population (1,000 Person)		Population Density (Person/Km)		Average Annual Growth Rate of Population (%)
		1991	2000	1991	2000	1991/2000
Johor	18,986	2,162.4	2,731.5	113.9	143.9	2.63
Kedah	9,426	1,364.5	1,605.2	144.8	170.3	1.82
Kelantan	14,920	1,207.7	1,561.5	80.9	104.7	2.90
Melaka	1,651	529.2	598.9	320.5	362.7	1.38
Negri Sembilan	6,643	722.0	849.8	108.7	127.9	1.83
Pahang	35,965	1,081.1	1,319.1	30.1	36.7	2.24
Perak	21,005	1,974.9	2,130.1	94.0	101.4	0.84
Perlis	795	190.2	230.7	239.2	290.2	2.17
Pulau Pinang	1,030	1,116.8	1,259.4	1,084.3	1,222.7	1.34
Sabah	73,997	1,808.8	3,058.6	24.4	41.3	6.01
Sarawak	124,450	1,718.4	2,064.9	13.8	16.6	2.06
Selangor	7,955	2,413.6	3,287.8	303.4	413.3	3.49
Terengganu	12,955	808.6	1,064.0	62.4	82.1	3.10
Federal Territory Kuala Lumpur	243	1,226.7	1,423.9	5,048.1	5,859.7	1.67
Federal Territory Kuala Labuan	92	54.8	78.2	595.7	850.0	4.03
Total	330,113.0	18,379.7	23,263.6	55.7	70.5	2.65

Source: 1. Yearbook of Statistics, Malaysia, 2000. Department of Statistics, Malaysia
2. State District Data Bank, Malaysia, Department of Statistics, Malaysia

Table 2.1.2 shows the GDP and GNI (Gross National Income) performance during the Seventh Malaysian Plan period (1996-2000). GDP grew from RM 222,732 million to RM 339,420 million at the average annual growth rate of 8.82% in current prices, which includes inflation, and from RM 166,625 million to RM 209,269 million at the average annual growth rate of 4.66% at constant 1987 prices respectively. On the other hand, the per capita GDP rose from RM 10,753 to RM 14,951 in current prices at the growth rate of 6.29% and from RM 8,054 to RM 8,996 at the growth rate of 2.24% in constant 1987 prices). GNI is derived by subtracting the factor income payments from abroad and shows the less growth than GDP but almost the same performance as GDP.

The economic recovery from 1998 is observed obviously from the annual growth rate of GDP and per capita GDP in constant prices. The annual growth rate of GDP has drastically

Table 2.1.2 Historical Performance of GDP and GNI

	Unit	1995	1996	1997	1998	1999	2000	Average Annual Growth Rate (%) [1995/2000]
Gross Domestic Product (GDP)								
(at current prices)	RM million	222,472	253,732	281,795	284,472	300,349	339,420	8.82
(Constant 1987 prices)	RM million	166,625	182,392	196,714	182,231	192,794	209,269	4.66
Gross National Income (GNI)								
(at current prices)	RM million	212,095	241,931	266,699	269,151	279,461	310,814	7.94
(Constant 1987 prices)	RM million	155,204	170,104	182,297	172,770	179,165	190,492	4.18
Per Capita GDP								
(at current prices)	RM	10,753	11,986	13,006	12,826	13,224	14,591	6.29
(Constant 1987 prices)	RM	8,054	8,616	9,079	8,216	8,489	8,996	2.24
Per Capita GNI								
(at current prices)	RM	10,252	11,429	12,310	12,135	12,305	13,361	5.44
(Constant 1987 prices)	RM	7,502	8,036	8,414	7,789	7,889	8,189	1.77
Population (Mid-Year)	1,000 Person	20,689	21,169	21,666	22,180	22,712	23,263	2.37

Source : 1. Yearbook of Statistics, Malaysia, 2000. Department of Statistics, Malaysia
2. Annual National Product and Expenditure Accounts, 1987-1999, Department of Statistics, Malaysia
Note : 1. GNI is derived by subtracting the net factor income payments from abroad from GDP.

fallen down from 7.9% in 1997 to –7.4% in 1998, but rapidly recovered to 5.8% from economic crisis in 1999. The growth rate of GDP in current prices does not record the negative figure because the inflation is assumed to have cancelled the slow down of real growth rate of GDP. But GNI shows the negative growth rate even in current process. (See Table 2.1.3)

During the Eighth Plan period (2001-2005), it is expected that GDP will grow at 7.5% per annum and Per Capita GDP will grow at 5.6% per annum in constant prices respectively. (See Table 2.1.4)

The structure of GDP by origin of industry has been heightened (See in Appendix 2.1.1) and the improvement of the Malaysian quality of life index increased 12.0% (See Appendix 2.1.2). Achievement in the restructuring of society is shown in Appendix 2.1.3.

Table 2.1.3 Annual Growth Rate of GDP and GNI

(Unit %)

GDP & GNI	1996	1997	1998	1999	2000
Gross Domestic Product (GDP)					
(at current prices)	14.1	11.1	0.9	5.6	13.0
(Constant 1987 prices)	9.5	7.9	-7.4	5.8	8.5
Gross National Income (GNI)					
(at current prices)	14.1	10.2	0.9	3.8	11.2
(Constant 1987 prices)	9.6	7.2	-5.2	3.7	6.3
Per Capita GDP					
(at current prices)	11.5	8.5	-1.4	3.1	10.3
(Constant 1987 prices)	7.0	5.4	-9.5	3.3	6.0
Per Capita GNI					
(at current prices)	11.5	7.7	-1.4	1.4	8.6
(Constant 1987 prices)	7.1	4.7	-7.4	1.3	3.8
Population (Mid-Year)	2.3	2.3	2.4	2.4	2.4

(2) State

During the Seventh Plan period, the less developed states realized higher growth rate of GDP of 4.9% than the more developed states of 4.2%. Four states, namely Selangor, Pulau Penang, Johor as more developed states and Kedah as less developed state recorded GDP growth rate that were higher than the national average of 4.7% per annum. The major sources of growth in these states were from the manufacturing and services sectors. The per capita GDP in all states increased steadily during the Plan period. The highest growth rate was attained by Selangor of 5.6% followed by Pulau Penang of 5.4% and Johor of 5.2% in more developed states and by Kedah of 4.8%, Sarawak and Terrengganu of 4.2% in the less developed states respectively.

During the Eighth Plan period, the highest growth rate of GDP will be attained by Selangor and Johor of 7.7% in more developed states and by Pahang of 7.6% in the less developed states respectively. Perak is expected to grow most rapidly at 7.1% for the Per Capita GDP followed by Negri Sembilan of 6.5% and Melaka of 6.4% in more developed states. In the less developed states, Pahang and Perlis will grow with the highest rate of 7.0%. (See Table 2.1.4 and Figure 2.1.1 – 2.1.4)

The development composite index by state shows that Perak, Johor, Sarawak, Kedah has been highly developed states during ten years from 1990 to 2000. (See Appendix 2.1.4)

Table 2.1.4 Past and Future Performance of Gross Domestic Product by State
(in Constant 1987 Prices)

State	GDP (RM million)			Average Annual Growth Rate of GDP (%)		Per Capita GDP (RM)			Average Annual Growth Rate of Per Capita GDP (%)		Ratio of Per Capita GDP to Malaysian Average		
	1995	2000	2005	7MP	8MP	1995	2000	2005	7MP	8MP	1995	2000	2005
More Developed States	**111,352**	**141,492**	**203,545**	**4.9**	**7.5**	**12,940**	**17,410**	**22,777**	**6.1**	**5.5**	**1.20**	**1.19**	**1.19**
Johor	18,153	23,425	33,950	5.2	7.7	10,007	13,954	18,733	6.9	6.1	0.93	0.96	0.98
Melaka	5,080	6,148	8,743	3.9	7.3	11,305	15,723	21,410	6.8	6.4	1.05	1.08	1.12
Negri Sembilan	5,440	6,776	9,562	4.5	7.1	9,034	12,791	17,555	7.2	6.5	0.84	0.88	0.91
Perak	14,166	17,153	24,371	3.9	7.3	9,290	13,183	18,616	7.3	7.1	0.86	0.90	0.97
Pulau Pinang	13,293	17,314	24,904	5.4	7.5	15,054	21,469	28,581	7.4	5.9	1.40	1.47	1.49
Selangor	34,063	44,708	64,743	5.6	7.7	14,168	17,363	21,286	4.2	4.2	1.32	1.19	1.11
Federal Territory of Kuala Lumpur	21,157	25,968	37,272	4.2	7.5	22,799	30,727	39,283	6.1	5.0	2.12	2.11	2.05
Less Developed States	***55,272***	***67,776***	***96,240***	***4.2***	***7.3***	***8,027***	***10,893***	***14,394***	***6.3***	***5.7***	***0.75***	***0.75***	***0.75***
Kedah	7,185	9,087	13,041	4.8	7.5	6,391	8,918	12,132	6.9	6.3	0.59	0.61	0.63
Kelantan	4,319	5,061	6,987	3.2	6.7	4,484	6,241	8,638	6.8	6.7	0.42	0.43	0.45
Pahang	6,784	8,250	11,917	4.0	7.6	7,548	10,370	14,549	6.6	7.0	0.70	0.71	0.76
Perlis	1,126	1,362	1,940	3.9	7.3	7,634	10,802	15,166	7.2	7.0	0.71	0.74	0.79
Sabah	12,235	14,947	21,148	4.1	7.2	7,206	9,123	11,323	4.8	4.4	0.67	0.63	0.59
Sarawak	13,271	16,323	23,270	4.2	7.3	9,287	12,755	16,861	6.6	5.7	0.86	0.88	0.88
Terengganu	10,352	12,746	17,937	4.2	7.1	16,553	22,994	29,516	6.8	5.1	1.54	1.58	1.54
Malaysia	**166,624**	**209,268**	**299,785**	**4.7**	**7.5**	**10,756**	**14,584**	**19,189**	**6.3**	**5.6**	**1.00**	**1.00**	**1.00**

Source: "Eighth Malaysian Plan 2001-2005", 23 April 2001, Economic Planning Unit, Prime Minister's Department
Note: 1. 7MP stands for Seventh Malaysian Plan 1996-2000
2. 8MP stands for Eighth Malaysian Plan 2001-2005

2.1.3 International Trade

During the Seventh Plan period, total exports and imports grew by 15.1% per annum and 10.0% per annum respectively. The balance has been recovered very rapidly from deficits of 9,358 RM million to surplus of 60,943 RM million. (See Figure 2.1.5)

Machinery and transport equipment, and Manufactured goods have dominant shares both in the exports and imports, which are more than 70% in total respectively. (See Appendix 2.1.5-2.1.6)

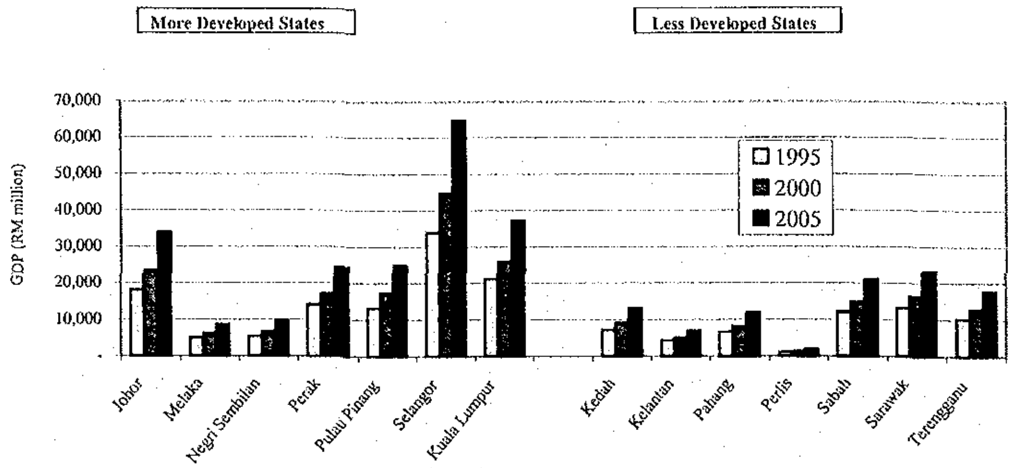


Figure 2.1.1 Past and Future of GDP by State

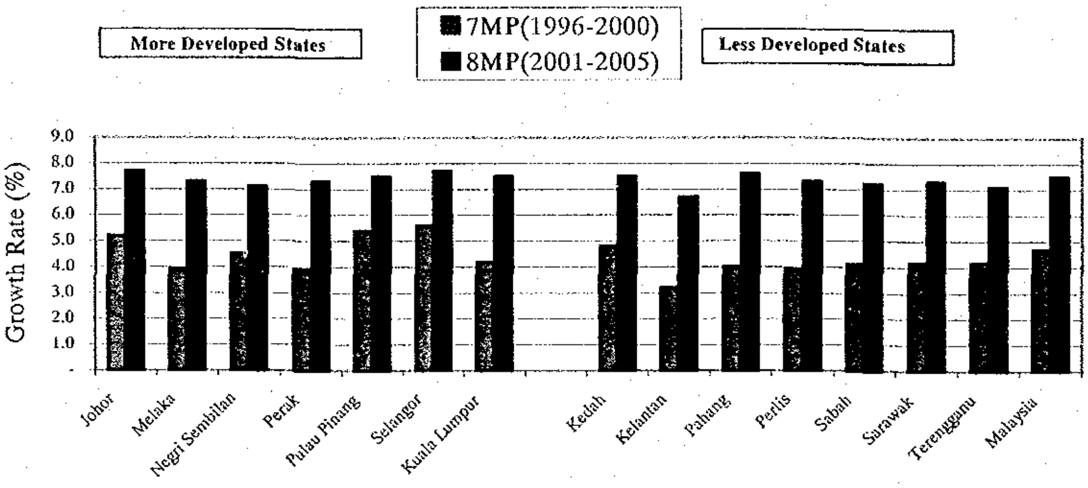


Figure 2.1.2 Past and Future of Average Annual GDP Growth Rate by State

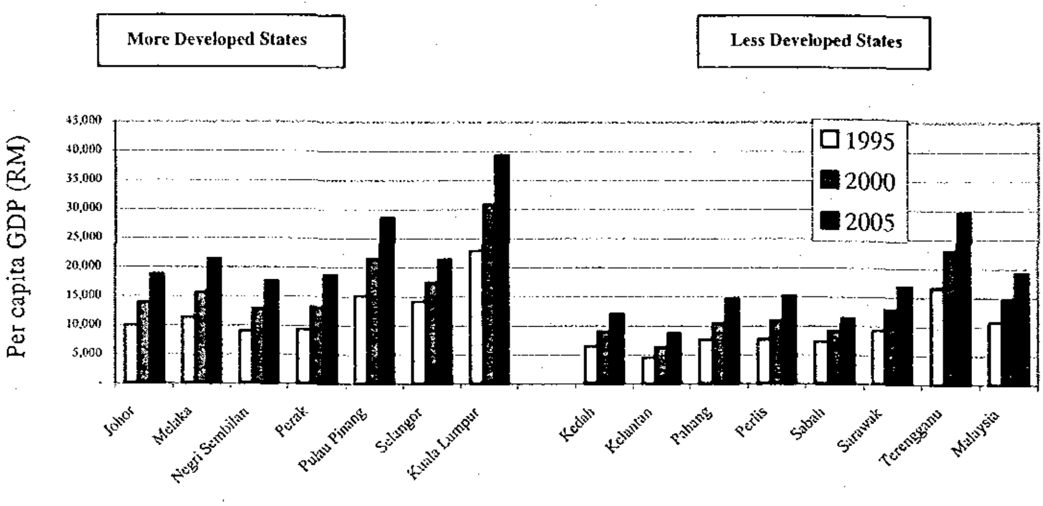


Figure 2.1.3 Past and Future of Per Capita GDP by State

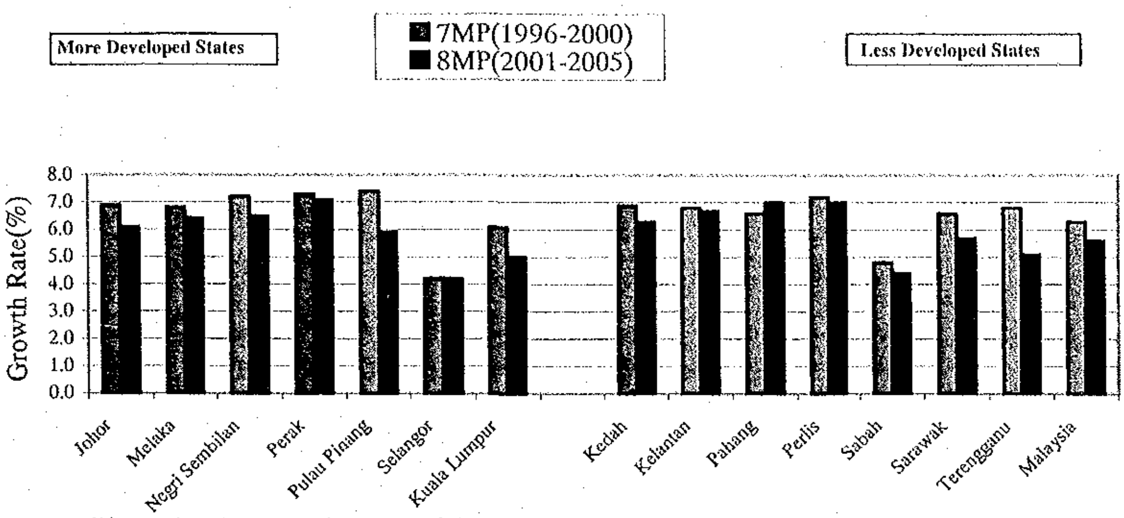
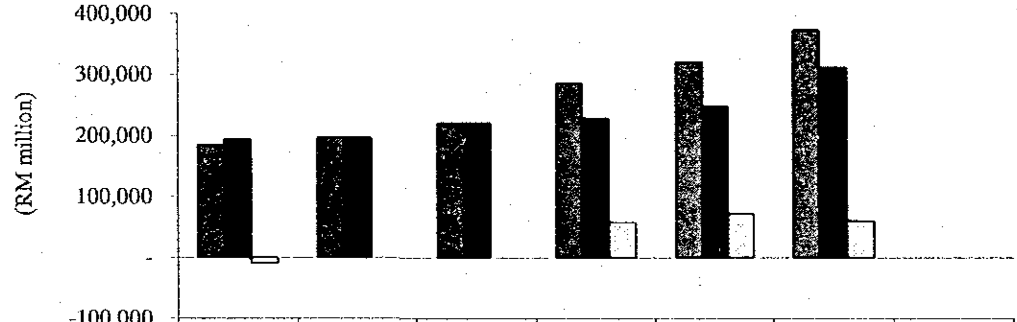


Figure 2.1.4 Past and Future of Average Annual Growth Rate of Per Capita GDP by State



	1995	1996	1997	1998	1999	2000	Growth Rate/Annu
Total Exports	184,986	197,026	220,890	286,563	321,181	373,307	15.1
Total Imports	194,344	197,280	220,935	228,124	248,870	312,364	10.0
Balance of Trade	-9,358	-254	-45	58,439	72,311	60,943	-

Source: Yearbook of Statistics, Malaysia. Department of Statistics, Malaysia

Figure 2.1.5 Historical Performance of International Trade

2.1.4 Prices

The consumer prices in total raised by 20.7% in 2000 since 1994 but the annual rate of raise decreased year by year from 5.5% in 1998 to 1.5% in 2000 respectively. Especially consumer price of food and beverage and tobacco show drastic decrease. (See Appendix 2.1.7)

2.1.5 Employment

The employed labour increased from 8,399 thousand labour in 1996 to 9,303 thousand in 2000. Unemployment rate rose from 2.5% in 1996 to 3.2% in 1998 but was fallen to 3.0% in 2000. (See Table 2.1.5) The employed labour by sector is shown in Appendix 2.1.8-2.1.9. Sectors of manufacturing, commercial service and community, social and personal service occupy about 20% in 2000 respectively. The most rapid growth rate per annum is recorded by sectors of construction and commercial service as 5.5% followed by community, social and personal service as 4.5%. (See Figure 2.1.6)

Table 2.1.5 Change of Principal Statistics on Employment and Unemployment

	1996	1997	1998	1999	2000 *2)
Labor Force (1,000) *1)	8,616.0	8,784.0	8,883.6	9,151.5	9,504.9
Employed (1,000)	8,399.3	8,569.2	8,599.6	8,837.8	9,303.2
Unemployment Rate (%)	2.5	2.5	3.2	3.4	3.0
Labor Force Participation Rate in All Persons in the Age-Group 15-64 Years Old (%)	66.3	65.6	64.3	64.2	66.0

Note : *1) excludes persons in the age-group (15-64 years old) reported as not at work, without jobs and not want to work.
*2) is figure for 1st quarter.

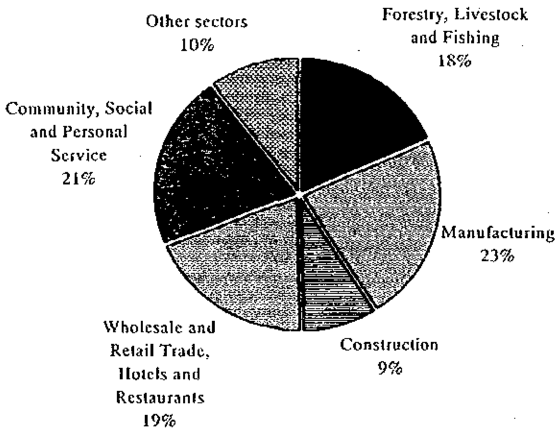


Figure 2.1.6 Employment by Sector (2000)

2.1.6 Finance

The situation of Government finance is in severe condition. The balance of the Government finance recorded the surplus of 517 RM million in 1999 but the deficits of 19,992 RM million were recorded in 2000. During four years, the Federal Government revenue increased only at the average annual growth rate of 7.6% but the expenditure recorded more rapid growth rate of 9.3%. Especially, the development expenditure grew at high rate of 14.4%. (See Appendix 2.1.10)

2.1.7 Road Transport

Total number of motor vehicles registered increased from 3.5 million to 9.9 million (about three times) in thirteen years from 1986 to 1999. The number of motor vehicles is assumed to reflect the development of road transportation including road network and the traffic volume. (See Table 2.1.6) The Federal Territory of Kuala Lumpur occupies the highest share of 20.2% of total number of motor vehicles followed by Johor of 13.9%, followed by Selangor of 12.4%, Pulau Penang of 10.5% and Perak of 10.3% respectively in 1999. The least shares are recorded by Perlis of 0.4% followed by Terrungganu of 2.3%, Kelantan of 3.3% and Melaka of 3.5% respectively. These structures have been no drastically changed for these thirteen years. (See Figure 2.1.7)

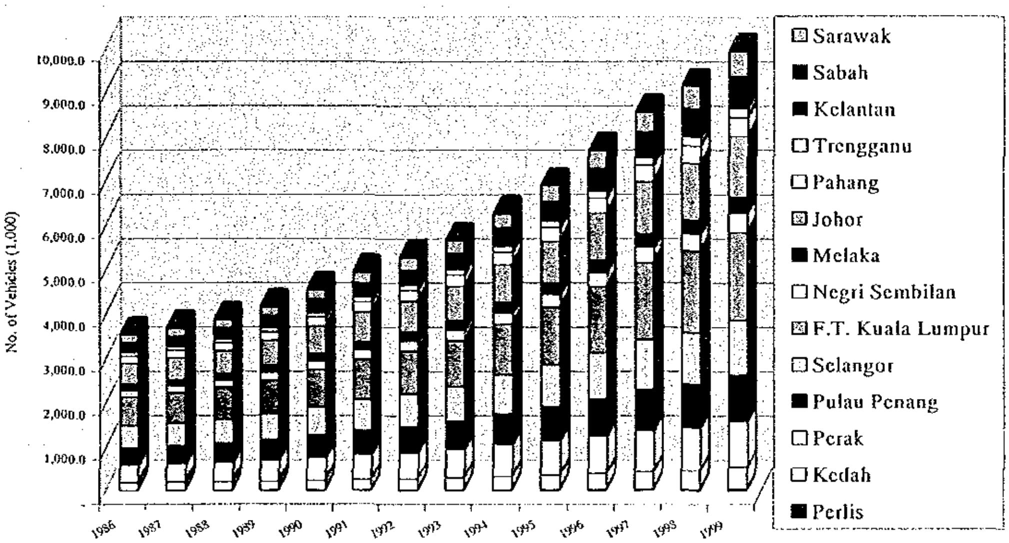


Figure 2.1.7 Historical Performance of Motor Vehicles by State

Table 2.1.6 Historical Performance of Motor Vehicle Registered by Vehicle Type and by State

Year	Perlis	Kedah	Perak	Pulau Penang	Selangor	F.T. Kuala Lumpur	Negri Sembilan	Melaka	Johor	Pahang	Trengganu	Kelantan	Sabah	Sarawak	Total
1986	10.8	172.0	400.3	386.9	493.6	653.3	150.7	126.3	485.0	159.0	76.1	113.3	109.9	186.6	3,523.7
1987	11.2	179.4	417.4	403.4	514.8	681.2	157.1	131.7	505.8	165.8	79.3	118.1	114.6	194.6	3,674.5
1988	11.8	188.7	439.2	424.4	541.6	716.7	165.3	138.5	532.1	174.4	83.5	124.2	120.6	204.7	3,865.7
1989	12.7	202.8	472.1	456.2	582.1	770.3	177.7	148.9	571.9	187.5	89.7	133.6	129.6	220.0	4,155.2
1990	13.9	222.0	516.6	499.2	637.1	843.1	194.4	163.0	625.9	205.2	98.2	146.2	141.9	240.8	4,547.4
1991	15.1	241.3	561.4	542.6	692.4	916.2	211.3	177.1	680.2	223.0	106.7	158.8	154.2	261.7	4,942.0
1992	16.1	256.8	597.6	577.5	736.9	975.1	224.9	188.5	724.0	237.3	113.6	169.1	164.1	278.5	5,259.8
1993	17.3	276.1	642.6	621.0	792.4	1,048.6	241.8	202.7	778.5	255.2	122.1	181.8	176.5	299.5	5,656.0
1994	18.7	307.7	717.5	686.5	882.9	1,141.6	268.7	225.4	857.9	284.8	135.2	204.0	192.6	329.7	6,253.3
1995	21.6	334.0	775.7	757.3	958.7	1,298.3	293.4	245.7	952.5	308.4	148.8	218.4	217.9	366.8	6,897.4
1996	25.5	366.0	845.7	837.0	1,036.6	1,502.9	325.4	269.6	1,064.1	334.9	166.6	239.4	257.8	415.1	7,686.7
1997	29.5	404.4	922.1	925.7	1,116.8	1,739.4	361.6	294.5	1,188.4	363.7	185.8	258.2	294.0	466.3	8,550.5
1998	32.6	425.7	969.2	976.1	1,158.9	1,857.1	388.3	308.8	1,285.0	388.5	203.2	319.1	319.1	509.9	9,141.4
1999	38.8	501.4	1,025.1	1,047.1	1,228.8	2,001.4	436.9	348.5	1,383.3	408.9	224.6	331.8	376.2	577.1	9,930.0
Average Annual Growth Rate (%)	10.4	8.6	7.5	8.0	7.3	9.0	8.5	8.1	8.4	7.5	8.7	8.6	9.9	9.1	8.3

(Unit: 1,000 Vehicles)

Source: Road Transport Department

According to the 1999 statistics, motorcycles and scooters has the largest share of all types of vehicle in Malaysia by 51.2% followed by motorcars of 38.1%, lorries and vans (goods vehicles) of 6.5%. Through comparison of the structure of number of motor vehicles by type, the structure of industrial activity of each state could be estimated. In this context, Sabah assumed to be active in industrial production because the share of lorries and vans has the largest share of all states as 21.4% followed by Sarawak of 7.7%, Pahang and Federal Territory of Kuala Lumpur of 7.0%, Terrunggantu of 6.9%, Selangor of 6.5% respectively. The highest shares of motorcars are recorded by Federal Territory of Kuala Lumpur of 52.2% followed by Sabah of 49.1%, Selangor of 43.8%. (See Table 2.1.7 and Figure 2.1.8) These states are considered to be relatively higher concentration of population and more aggressive in business activity.

Table 2.1.7 Motor Vehicles Registered by State and Vehicle Type in 1999

State	Total	Motor-cars	Motor-cycles and Scooters	Taxis and Hired Cars	Buses	Lorries and Vans (Goods Vehicles)	Other Vehicles
Malaysia	9,929,951	3,787,047	5,082,473	65,646	47,674	642,976	304,135
Johor	1,383,339	483,522	772,211	10,290	6,753	80,350	30,213
Kedah	501,430	118,215	338,189	2,891	2,533	26,265	13,337
Kelantan	331,828	96,579	205,285	1,997	1,536	19,835	6,596
Melaka	348,520	109,931	214,483	1,432	1,663	16,951	4,060
Negri Sembilan	436,850	133,250	265,489	1,677	2,161	27,943	6,330
Pahang	408,936	135,541	230,956	2,401	1,668	28,828	9,522
Perak	1,025,122	295,010	650,864	3,874	3,675	45,704	25,995
Perlis	38,833	7,732	28,155	162	156	1,551	1,077
Pulau Penang	1,047,076	354,374	639,554	2,718	3,744	35,281	11,405
Sabah	376,176	184,523	68,983	5,311	5,785	80,655	30,919
Sarawak	577,091	220,024	275,705	1,950	2,372	44,429	32,611
Selangor	1,228,782	537,658	574,080	4,268	4,222	80,185	28,369
Trengganu	224,562	66,031	135,769	1,008	863	15,448	5,443
Federal Territory of. Kuala Lumpur	2,001,406	1,044,657	682,750	25,667	10,523	139,551	98,258

(Unit : Vehicle)

Source: Road Transport Department, Malaysia

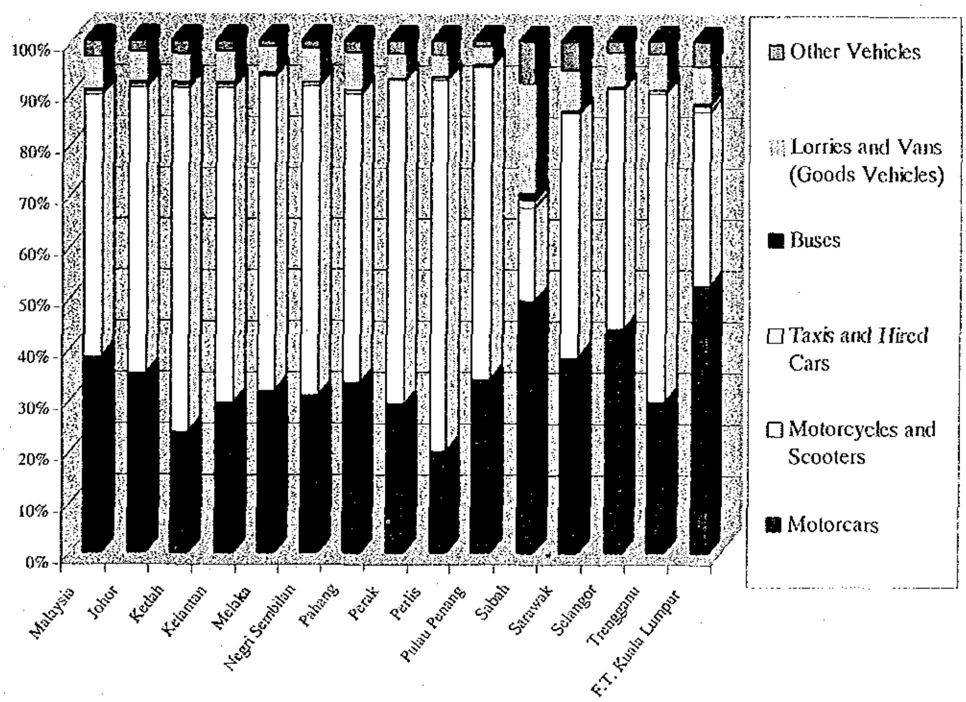


Figure 2.1.8 Structure of Vehicle Type by State (1999)

2.2 Present Conditions of Road Network

2.2.1 *Progress of Road Development in Malaysia*

(1) Sixth Development Plan

During the Sixth Plan (1991-1995) period, emphasis was placed on further expansion, upgrading and improvement of the country's network of infrastructure. In addition, the expansion of infrastructure network into rural areas also provided the rural people with increasing opportunities to participate in the process of development. During this period, road development was to increase road network particularly to improve interurban linkages, alleviate capacity constraints and increase road network to open up new growth centres and rural areas.

In line with efforts to improve existing linkages and increase road network, several major projects were completed and a few more were at various stage of construction. Construction of three major projects along the East-West corridor were initiated, namely, the western segment of the East-West Highway, the Simpang Pulai-Lojing-Kuala Berang Highway to dual carriage expressway.

(2) Seventh Development Plan

During the Seventh Plan (1996-2000) period, road development was guided by the need to expand capacity and upgrade existing road. The road sub sector accounted for nearly 59.8 percent of the total allocation for infrastructure sector with total expenditure of RM 12.3 billion. In addition, the private sector also expended a total of RM7.9 billion for the development of privatised highways compared with RM15.2 billion during the Sixth Plan period. The slowdown in private investment in the road sub sector, mainly due to the financial crisis, was mitigated by increased Government expenditure on road construction and improvement projects during the last two years of the Seventh Plan period.

In line with efforts to improve inter-urban linkages and provide better transport facilities, several new road construction projects were completed, as shown Table 1. The completion of the Kuala Perlis-Changloon Highway provided a direct access from the North-South Expressway provided a faster access from the North-South Expressway to Kuala Perlis, which has a ferry link to Langkawi Island. The complete of the Seremban-Port Dickson Highway provided a faster access to the tourist spots in Port Dickson. Concurrent to efforts to expand and provided new linkages, emphasis was also placed on improving road safety as well as ensuring pleasant and stress-free travel. In this respect, 153 accident-prone spots were improved and upgraded while eight-rest and service area was constructed along the federal roads.

Table 2.2.1 Major Road Projects Implemented, 1995-2005

Project	Length (Km)	Completion (Year)
Completed Projects		
1.Government-Funded Projects		
Access Road to Kulim Hi-Tech Industrial Park	9	1996
Kota Tinggi Bypass	10	1997
Eastern Access to KLIA	17	1998
Berungis-Kota Belud Highway	38	1998
Middle Ring Road II (Phase I)	35	1998
Access Road to Belaga, Sarawak	126	1998
Kuala Perlis-Changloon Highway	36	2000
Access Road to Port of Tanjung Pelapas, Johor	8	2000
Sungai Dinding Bridge	10	2000
Upgrading of B15	10	2000
South Klang Valley Expressway Section 1A	11	2000
Access Road to Toxic Waste Plant in Bukit Nenas, Negri Sembilan	17	2000
2. Privatized Projects		
Butterworth-Kulim Highway	17	1996
Seremban-Port Dickson Highway	22	1997
North-South Expressway Central Link	48	1997
Shah Alam Expressway	35	1998
Second Link to Singapore	45	1998
Kuala Lumpur-Karak Highway	60	1998
Cheras-Kajang Highway	12	1998
Damansara-Puchong Highway	40	1998
Upgrading Sungai Besi Road	16	1999
Under Construction		
1. Government Funded Projects		
Upgrading Beaufort-Sindumin Road	65	2001
Beaufort-Mumpakul Road	2	2001
Lipat Kajang (Melaka) Interchange to North-South Expressway	7	2001
Sungai Rejang Bridge	22	2001
Brinchang-Lojing Road	169	2003
2. Privatized Projects		
New North Klang Straits Bypass	18	2001
Western Kuala Lumpur Traffic Dispersal Schemed	26	2001
New Pantai Highway	20	2003
Kajang-Seremban Highway	48	2004
Butterworth Outer Ring Road	19	2004
Ipoh-Lumut Highway	70	2004
Kajang Traffic Dispersal Highway	37	2004

Source: Eighth Malaysia Plan 2001-2005, Economic Planning Unit, and Prime Minister's Department.

Various roads were constructed or upgraded to alleviate traffic congestion on roads that lead to ports and growth centers as well as to support the industrial growth of the country. Among these roads were the upgrading of Road B15, South Klang Valley Expressway (SKVE) Section 1A and the access roads to the Port of Tanjung Pelepas and Kulimi Hi-Tech Industrial Park. The completion of the upgrading of Road B15 and the SKVE Section 1A provided a vital link to Putrajaya and Cyberjaya. The completion of the access road to Kulim Hi-Tech Industrial Park provided the impetus for the growth of the park.

To stimulate economic growth while maintaining Government expenditure within prudential limits, the Government initiated the deferred payment scheme to implement road projects. Under this scheme, the private sector finances the project and payment is made at an agreed period after completion of works. Most of these projects involved the upgrading of existing roads, which were delayed as a result of the economic crisis. A total of 20 projects were awarded under this scheme.

Under the rural roads programme, a total of 3,214 kilometers of new roads was constructed, thereby improving accessibility and enabling greater participation of the rural people in socio-economic development. This programme included the Kanibongan-Nangoh Road in Sabah and Triso-Melebu-Pusa Coastal Road in Sarawak.

Table 2.2.2 and Figure 2.2.1 show the historical performance of development of roads in Malaysia. Total length of roads of Federal and State have been extended from 21,914 km in 1980 to 67,627 km in 1998 with 6.46 % of average annual growth rate which means about three times increase during eighteen years. During the same period, the Federal Roads have extended from 6,377 km to 16,081 km with the average growth rate of 5.27% and State Roads have extended from 15,538 km to 51,546 km with the average growth rate of 6.89%. In 1998, the shares of the Federal Roads and State Roads are 23.8% and 76.2% respectively of total length of roads. The share of the Federal Roads has been slightly decreased while the one of the State Roads has been increased.

On the other hand, with regard to the road surface condition, the paved roads have increased almost with the same average growth rate at 6% for Federal Roads and State Roads. On the contrary, the composition of the paved roads of Federal Roads has been increased from 82.6% in 1980 to 94.2% in 1998, while the one of State Roads has been slow down from 81.0% to 70.4%. This means that the unpaved roads have been decreased for Federal Roads and increased for State Roads.

Figure 2.2.2 to 2.2.4 show historical performance of road surface condition of Federal Roads, State Roads and Total Roads of these two roads respectively.

Table 2.2.2 Historical Performance of Road Development in Length in Malaysia

(Unit: km)

Year	Federal Road			State Road			Total		
	Paved	Unpaved	Total	Paved	Unpaved	Total	Paved	Unpaved	Total
1980	5,269	1,108	6,377	12,587	2,951	15,538	17,856	4,059	21,914
1981	5,386	1,264	6,650	12,817	3,319	16,136	18,203	4,583	22,786
1982	6,484	1,622	8,106	13,635	3,801	17,436	20,119	5,422	25,542
1983	6,506	1,895	8,400	13,929	4,225	18,154	20,434	6,120	26,554
1984	7,060	2,117	9,177	14,059	3,997	18,056	21,119	6,114	27,234
1985	7,231	2,299	9,531	17,867	11,472	29,339	25,098	13,772	38,870
1986	8,532	3,632	12,164	22,764	4,142	26,905	31,296	7,774	39,069
1987	9,994	2,331	12,325	22,973	4,035	27,007	32,967	6,366	39,332
1988	9,437	3,729	13,166	25,624	13,799	39,423	35,061	17,528	52,589
1989	10,310	2,750	13,060	24,294	13,761	38,055	34,604	16,511	51,115
1990	10,330	2,731	13,061	27,448	13,475	40,924	37,779	16,206	53,984
1991	12,623	1,640	14,263	27,448	14,027	41,475	40,071	15,666	55,738
1992	12,972	1,369	14,341	29,163	13,988	43,150	42,135	15,357	57,492
1993	13,590	960	14,550	30,710	14,497	45,207	44,300	15,457	59,758
1994	13,760	991	14,750	31,743	14,714	46,457	45,503	15,704	61,207
1995	13,847	991	14,837	31,743	14,714	46,457	45,590	15,704	61,294
1996	14,424	961	15,385	32,732	15,266	47,998	47,155	16,228	63,383
1997	14,749	961	15,711	33,921	15,349	49,270	48,670	16,311	64,981
1998	15,142	939	16,081	36,263	15,283	51,546	51,405	16,222	67,627
Average Annual Growth Rate (%)									
1980-1990	**6.96**	**9.44**	**7.43**	**8.11**	**16.40**	**10.17**	**7.78**	**14.85**	**9.43**
1990-1998	**4.90**	**-12.49**	**2.63**	**3.54**	**1.59**	**2.93**	**3.92**	**0.01**	**2.86**
1980-1998	**6.04**	**-0.92**	**5.27**	**6.05**	**9.57**	**6.89**	**6.05**	**8.00**	**6.46**

Source: Roads Branch of Public Works Department (JKR), Malaysia.

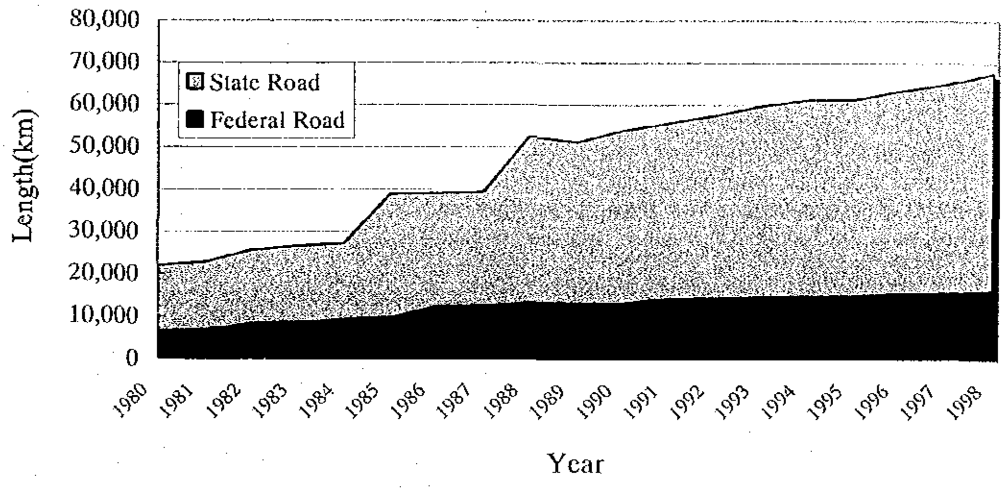


Figure 2.2.1 Historical Performance of Road Length in Malaysia

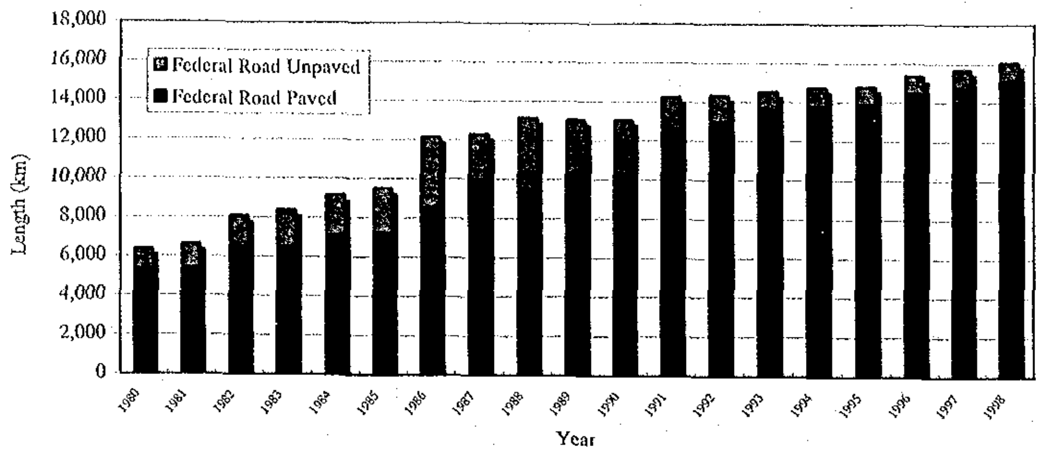


Figure 2.2.2 Historical Performance of Road Surface Condition of Federal Roads

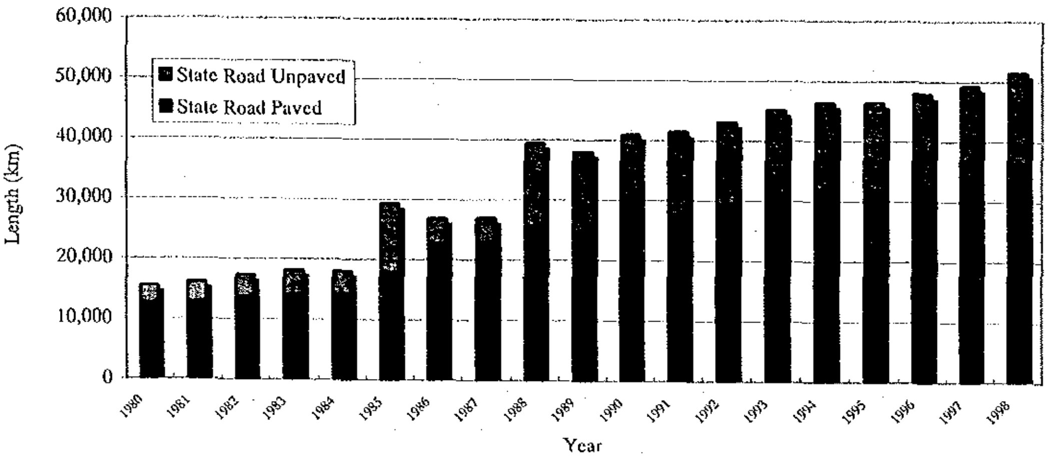


Figure 2.2.3 Historical Performance of Road Surface Condition of State Road

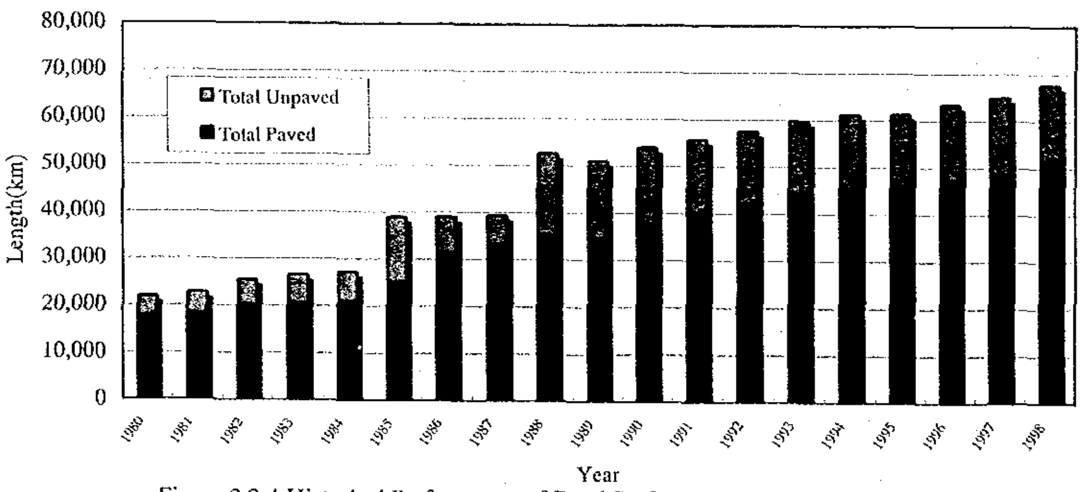


Figure 2.2.4 Historical Performance of Road Surface Condition of Roads in Malaysia

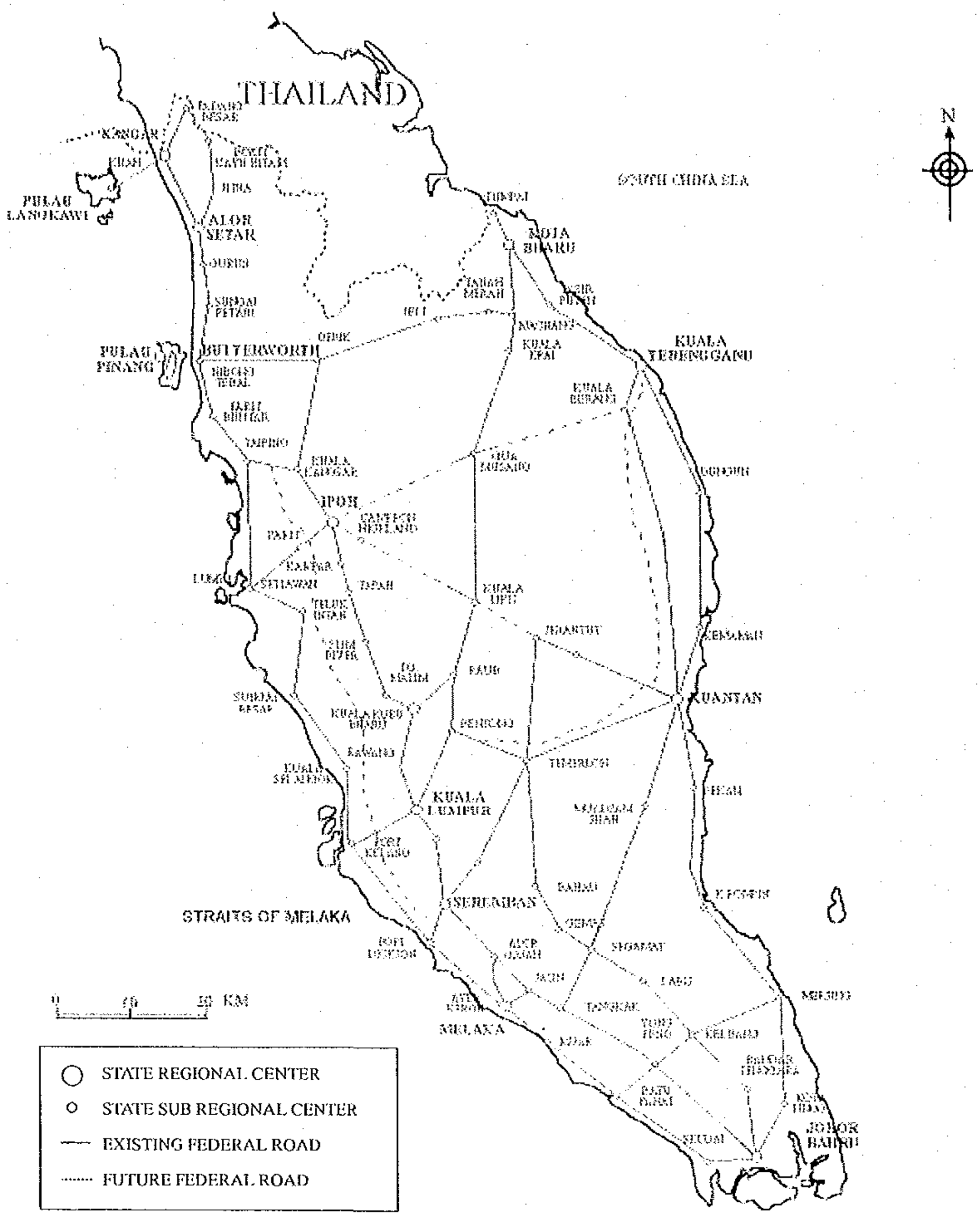
The development of new roads resulted in the improvement of the various roads development indicators, as shown in Table 2.2.3. Road Density, which measures road length over the total area, increased from 0.12 in 1985 to 0.20 in 2000, indicating a wider road coverage and greater accessibility. Road Density will increase to 0.21 in 2005. The Road Development Index which measures the level of road development taking into account of both area and population size of the country, also improved marginally from 0.54 in 1985 to 0.75 in 2000 and is expected to be higher to 0.76 in 2005.

Table 2.2.3 Road Development Indicators, 1985-2005

Indicator	1985	1990	1995	2000	2005
Road Density	0.12	0.16	0.19	0.20	0.21
Road Development Index	0.54	0.70	0.74	0.75	0.76
Road Service Level	2.46	3.02	2.96	2.98	3.02

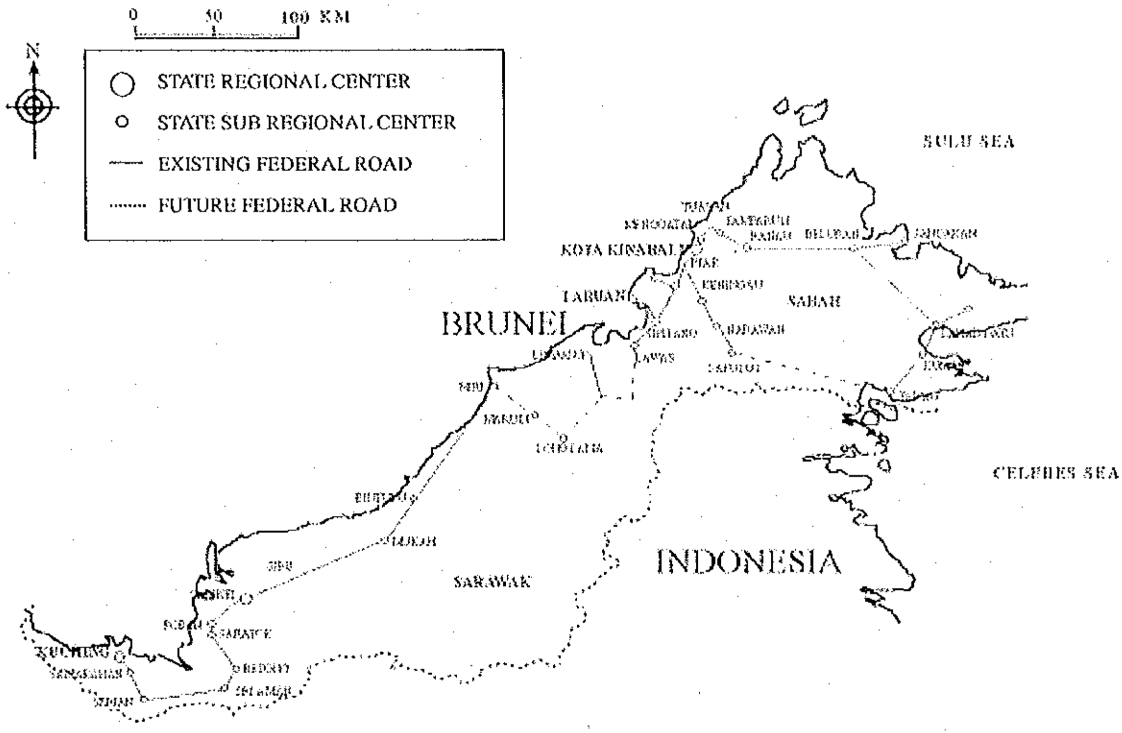
Source: 1. Malaysian Roads General Information, 1999. Road Brach, Public Works Department Malaysia.
2. Eighth Malaysia Plan (2001-2005), Economic Planning Unit, Prime Minister's Department
Note: 1. Road Density measures road length over the total area.
2. Road Development Index measures the level of road development taking into account both area and population size of the country
3. Road Service Level measures total length per 1,000 populations.

Figure 2.2.5 and 2.2.6 and show the highway network configuration for Peninsular Malaysia and Sabah & Sarawak respectively. A road network configuration for Peninsular Malaysia, Sarawak and Sabah are necessary to sustain the increasing demand for a good, reliable and efficient road network system in striving towards becoming an industrialized nation.



Source: MALAYSIAN ROADS General Information 1999, Road Branch, Public Works Department (JKR)

Figure 2.2.5 Highway Network Configuration in Peninsular Malaysia



Source: MALAYSIAN ROADS General Information 1999, Road Branch, Public Works Department (JKR)

Figure 2.2.6 Highway Network Configuration in Sabah & Sarawak

2.2.2 Road Development Plan

During the Eighth Plan (2001-2005) period, road development programme will be continued with emphasis on quality and safety. New roads construction will focus on opening up corridors for development as well as improving accessibility to rural areas. Construction of roads through privatization and deferred payment method will be continued on a selective basis, thereby sustaining road project implementation.

For the Eighth Plan period, a total of RM5.1 billion will be allocated for the development of new roads and RM8.9 billion for the improvement and upgrading of existing roads. The large allocation for upgrading of existing roads is in line with the efforts to improve safety, driving comfort and reduce travel time, including the provision of motorcycle lanes in identified dangerous stretches. Major projects that will be implemented during the Eighth Plan period are as shown in Table 2.2.4.

Emphasis will be placed on roads leading to and within the less developed areas, in order to provide better access and improve road system to these areas. In this regard, new rural road will be built to high geometric standards that will facilitate the movement of larger commercial and heavy vehicles to serve industries in these areas, thereby accelerating rural and regional development. Some of the major projects to be undertaken include the construction of Titi Karangan-Grik section of the Second East-West Highway, Sepulut to

Kalabakan Road in Sabah and the highway from Kuching to the new Federal Administrative Center in Rambungan in Sarawak. In addition to the Pan Borneo Highway linking Miri and Limbang and the Simpang Pulai-Lojing-Kuala Berang Road, the construction of the East Coast Expressway will be expedited through Government funding.

Various new projects are expected to be completed through privatization including the Senai-Desaru Highway, Kajang-Seremban Highway and the western Kuala Lumpur Traffic Dispersal Scheme (SPRINT) Highway. The completion of these highways will be adding about 100 kilometers of privatized highways to the total road network.

Table 2.2.4 Road Maps Indicating the Following Major Road Projects, 2001-2005

Project	Length (km)	Completion (Year)
1. Batang Rajang Bridge	1.5	2002
2. New Costal Road Triso-Pusa	51	2002
3. Urban Ring Road in Putrajaya	14	2002
4. Upgrading Road from Anak Bukit to Kepala Batas	5	2002
5. Kuala Kangsar-Grik Road	100	2003
6. Upgrading Bentong-Kual Lipis	109	2003
7. Road From Kuching to New Federal Administrative Center in Rambungan	26	2003
8. New Road From Kunak to Semporna	60	2003
9. Upgrading Federal Route 50 from Batu Pahat to Kluang	60	2003
10. Upgrading Route 98 from Temerloh to Jerantut	60	2003
11. East Coast Highway	169	2003
12. New Road From Kanibongan to Nangoh	160	2004
13. Upgrading Old Klang Road	4	2004
14. Upgrading Federal Road 65 from Lee Rubber to UIA	12	2004
15. Upgrading Federal Route 51 from Seremban to Kuala Pilah	35	2004
16. New Tenom-Beaufort Road	120	2005
17. Changloon-Padang Besar Highway	39	2005

Source: "Eighth Malaysian Plan (2001-2005)", Economic Planning Unit, and Prime Minister's Department

2.3 Natural Conditions of Malaysia

2.3.1 Location

Malaysia is located in the heart of Southeast Asia. Consisting of 329,735 km^2, Malaysia is divided into two main regions: Peninsular Malaysia and the Bornean states of Sabah and Sarawak. The Peninsula has a land area of 131,666 km^2, while Sabah and Sarawak together cover 198,069 km^2.

Peninsular Malaysia, which is the tail-end of the Asian continent, is attached to the Kingdom of Thailand in the north via a natural land bridge, and to the Republic of Singapore in the south via a three-quarter mile long causeway. The Indonesian island of Sumatra lies across the Straits of Melaka.

The states of Sabah and Sarawak, which occupy northern Borneo, share the island with the Indonesian territory of Kalimantan and the Sultanate of Brunei Darussalam.

2.3.2 Climate

(1) Introduction

The characteristic features of the climate of Malaysia are uniform temperature, high humidity and copious rainfall and they arise mainly from the maritime exposure of the country. Winds are generally light. Situated at the equatorial doldrums area, it is extremely rare to have a full day with a completely clear sky even in periods of severe drought. On the other hand, it is also rare to have a stretch of a few days with completely no sunshine except during the northeast monsoon seasons.

(2) Wind Flow

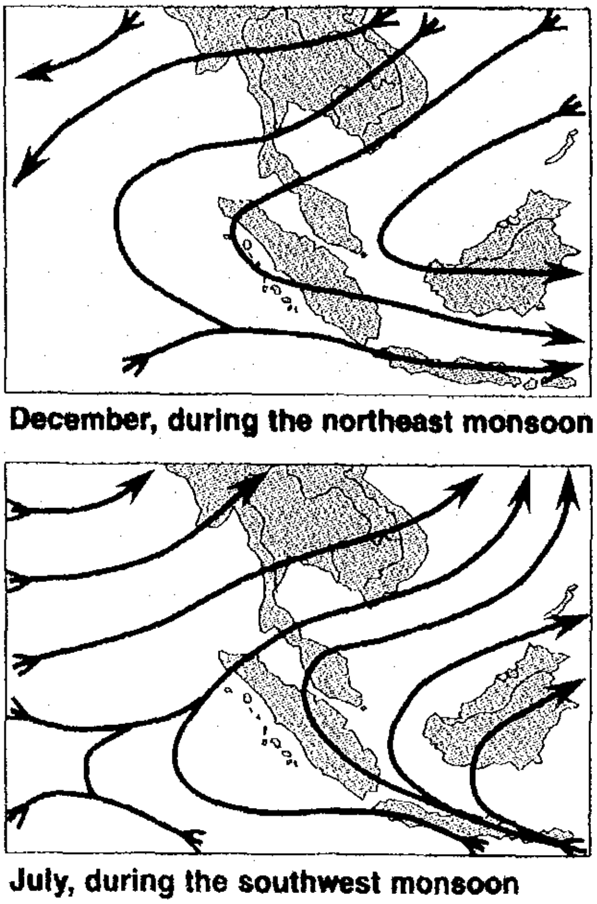
Though the wind over the country is generally light and variable, there are, however, some uniform periodic changes in the wind flow patterns. Based on these, four seasons can be distinguished, namely, the southwest monsoon, the northeast monsoon and two shorter inter-monsoon seasons.

The southwest monsoon is usually established in the later half of May or early June and ends in September. The prevailing wind flow is generally southwesterly and light, below 15 knots.

The northeast monsoon usually commences in early November and ends in March. During this season, steady easterly or northeasterly winds of 10 to 20 knots prevail. The more severely affected area are the east coast states of Peninsular Malaysia where the wind may reach 30 knots or more during periods of intense surges of cold air from the north (cold surges).

The winds during the two inter-monsoon seasons are generally light and variable. During these seasons, the equatorial trough lies over Malaysia.

From April to November, when typhoons frequently develop over the west Pacific and move westwards across the Philippines, southwesterly winds over the northwest coast of Sabah and Sarawak region may strengthen reaching 20 knots or more.

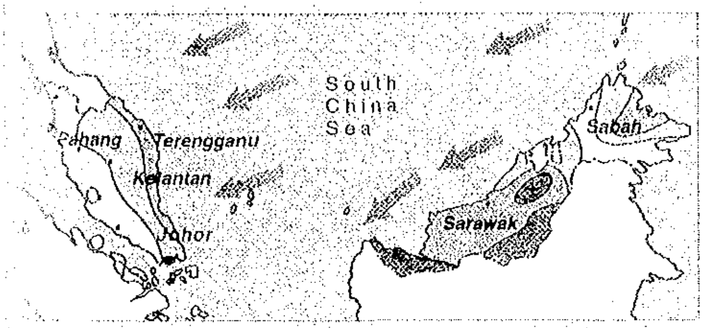


The northeast monsoon : November to early March
The southwest monsoon : June to September or early October
Source: Malaysian Meteorological Service

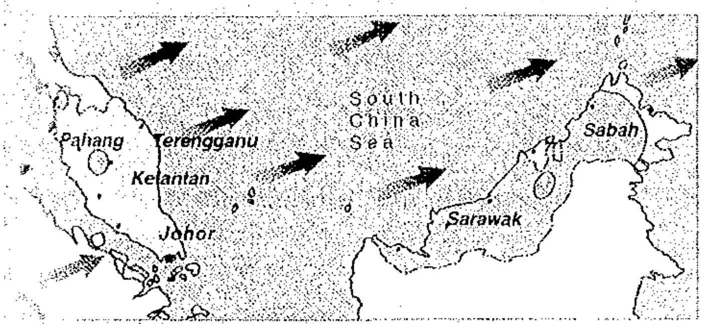
Figure 2.3.1 Wind Systems during The Monsoons

(3) Rainfall

As shown in Figure 2.3.2, the seasonal wind flow patterns coupled with the local topographic features determine the rainfall distribution patterns over the country. The northeast monsoon blows from approximately mid November till March, and the southwest monsoon between May and September. The inter-monsoons that are the periods of change between the two monsoons are marked by heavy rainfall accompanied by lightning and thunderstorms.



Malaysia receives most of its rainfall during the northeast monsoon which causes most of the floods.



Except for Sabah, Malaysia receives relatively less rain during the southwest monsoon.

Source: THE ENCYCLOPEDIA OF MALAYSIA, VOLUME 1 THE ENVIRONMENT

Figure 2.3.2 Rainfall Distribution during The Monsoons

The seasonal variation of rainfall in Peninsular Malaysia is of three main types:

(a) Over the Peninsula with the exception of the southwest and east coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The periods of maximum rainfall are generally April - May and October - November due to the influence of inter-monsoons, while the periods of minimum rainfall are January - February and June - July.

(b) The rainfall pattern over the southwest coastal area is much affected by shelter of the Sumatra landmass from May to August. With the result, the coupled maxima and minima pattern mentioned above is no longer discernible. October - November is the periods of maximum rainfall, and February is the one of minimum rainfall. The period of maximum rainfall in April - May and the one of minimum rainfall in June - July are absent or indistinct.

(c) Over the east coastal area, January - November is the period of maximum rainfall, while June - July is the driest period in most districts.

The seasonal variation of rainfall in Sabah and Sarawak can be divided into five main types:

(a) The northwest coast of Sabah has a rainfall regime with two maxima and two minima. The maxima occur in June and October, and the minima occur in

February and August. In some areas, difference of the two minima in February and August is as much as four times.

(b) In the central part of Sabah where the land is hilly and sheltered by mountain ranges, rainfall is relatively lower than the one in other regions and is evenly distributed. However, two maxima and two minima can be identified though somewhat are less distinct. In general, the two maxima occur in May and October while the two minima occur in February and August.

(c) Southern Sabah has evenly distributed rainfall. The annual rainfall in the area is comparable to the one in central part of Sabah. The period from February to April is, however, slightly drier than the rest of the year.

(d) Over the northeast Sabah and coastal areas of Sarawak, the monthly rainfall pattern shows one period of maximum and minimum rainfall respectively. While the maximum occurs during January in both areas, period of the minimum is variable. In the coastal areas of Sarawak, the minimum occurs in June or July, while the one in the northeast coastal areas of Sabah occurs in April. Under this regime, much of the rainfall is received during the northeast monsoon periods from December to March. In fact, it accounts for more than half of the annual rainfall in the western part of Sarawak.

(e) Inland areas of Sarawak generally experience quite evenly distributed annual rainfall. Nevertheless, slightly less rainfall is received during the period from June to August that corresponds to the occurrence of prevailing southwesterly winds. It could be pointed out that the highest annual rainfall area in Malaysia might be found in the hill slopes of inland Sarawak areas. Long Akah, receives a mean annual rainfall of more than 5,000 mm due to the virtue of its location.

Figure 2.3.3 shows the features of rainfall in the Study area that is located in the northwest Peninsular and the west Sabah.

(a) There are two periods of maximum rainfall throughout the year with the exception of Jeli located in the northeast Peninsular, Kota Kinabaru and Apin-Apin in the west Sabah. The two maxima occur in April - May and October - November.

(b) In Jeli, there are also two peaks of rainfall throughout the year. The one peak is from March to May similarly to the other areas in the northwest Peninsular, however, the other peak has prominent increase in November and December.

(c) In Kota Kinabaru and Apin-Apin, those have scarcely any rainfall from January to April. Afterwards, there are one big peak of rainfall in July - August and the other small peak in September - October.

(d) In Cameron Highlands and Fraser's Hill located in plateau area of the northwest Penisular, annual rainfall is less than the one in lowland area even though the tendency of monthly rainfall throughout the year is almost the same.

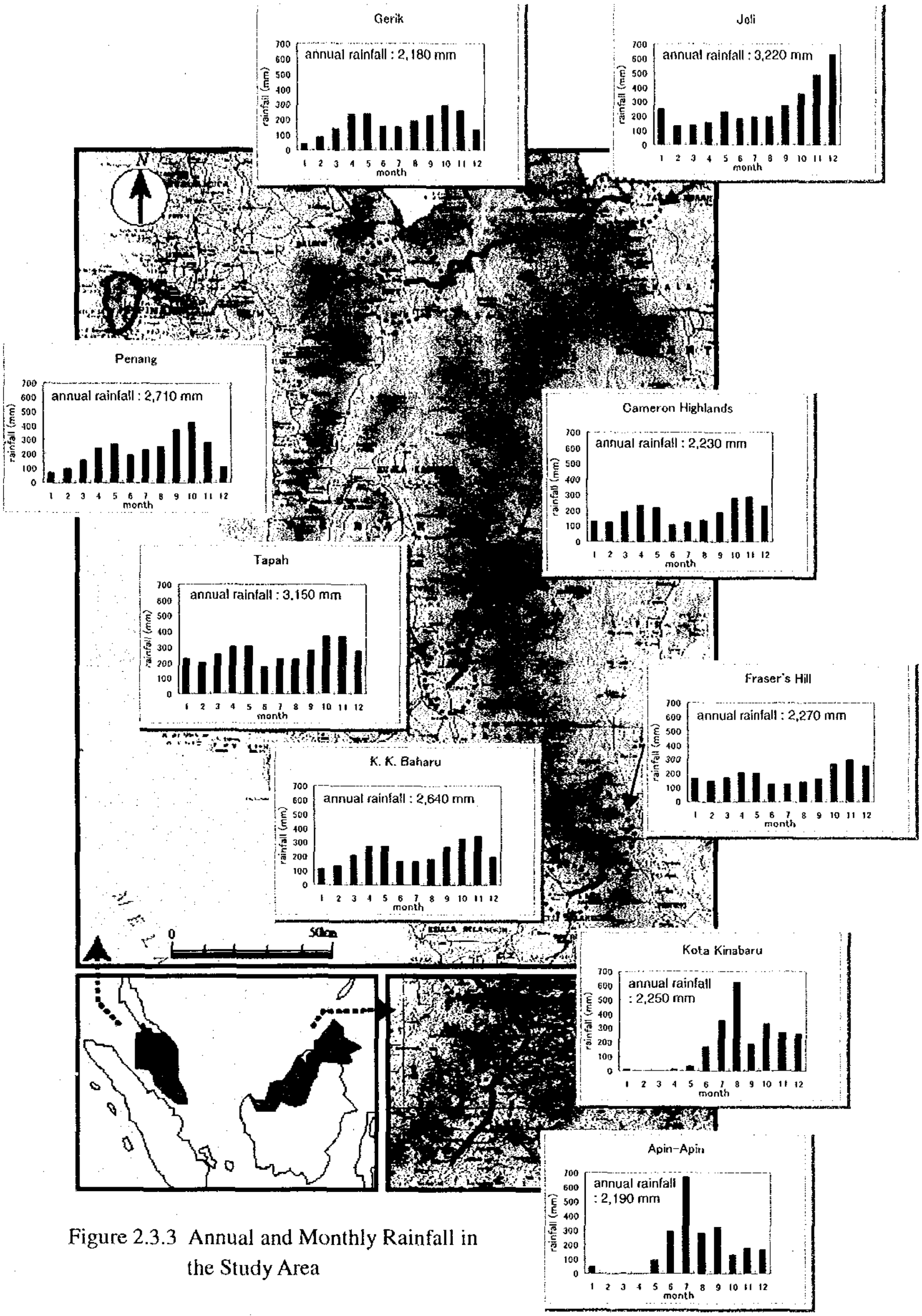


Figure 2.3.3 Annual and Monthly Rainfall in the Study Area

(4) Temperature Distribution

Being an equatorial country, Malaysia has uniform temperature throughout the year. The annual variation is less than 2°C except for the east coastal areas of Peninsular Malaysia which are often affected by cold surges originating from Siberia during the northeast monsoon. Even there, the annual variation is below 3°C.

The daily range of temperature is large, being from 5°C to 10°C at the coastal stations and from 8°C to 12°C at the inland stations. It may be noted that air temperature of 38°C has very rarely been recorded in Malaysia. Although the days are frequently hot, the nights are reasonably cool everywhere.

However, for every 100 meters increase in altitude, the temperature drops by about 0.6 degrees Celsius. The only place where freezing point is experienced is at the peak of Sabah's Mount Kinabalu, the highest mountain in Southeast Asia.

(5) Relative Humidity

Malaysia has high humidity. The mean monthly relative humidity falls within 70 to 90%, varying from place to place and from month to month. For any specific area, the range of the mean monthly relative humidity varies from a minimum of 3% to a maximum of about 15%. It is observed that in Peninsular Malaysia, the minimum relative humidity is normally found in the months of January and February expect for the east coast states of Kelantan and Terengganu which have the minimum in March. The maximum is however generally found in the month of November.

(6) Sunshine and Solar Radiation

Being a maritime country close to the equator, Malaysia naturally has abundant sunshine and thus solar radiation. However, it is extremely rare to have a full day with completely clear sky even in periods of severe drought. The cloud cover cuts off a substantial amount of sunshine and thus solar radiation. There are, however, seasonal and spatial variations in the amount of sunshine received.

(7) Evaporation

Among all the factors affecting the rate of evaporation, cloudiness and temperature are two of the most important ones in this country. These two factors are however inter-related. A cloudy day will mean less sunshine and thus less solar radiation and in turn give rise to lower temperature.

An examination of the evaporation data shows that the cloudy or rainy months are the months with lower evaporation rate while the dry months are the months with higher rate. It is noted that Senai has an average evaporation rate of 2.6 mm/day in the month of November, the lowest for lowland stations. On the other side of the scale, Kota Kinabalu has the highest average evaporation rate of 6.0 mm/day in the month of April. For highland areas such as Cameron Highlands where the air temperature is substantially lower, the evaporation rate is proportionally lower too. While lowland area have an annual average evaporation rate of 4 to 5 mm per day, Cameron Highlands has a rate of only about 2.5 mm per day.

2.3.3 Topography

The backbone of Peninsular Malaysia is known as Banjaran Titiwangsa or the Main Range. The Main Range which is situated on the western flank of the peninsula is about 480 km in length from Malaysia-Thai border to the southern state with an average width of 65 to 80 km and rising to more than 2,100 m above sea level in places. This central spine effectively separates the eastern and western part of the Peninsula.

In Sabah, the most prominent highlands are the Crocker Range with average heights ranging from 457 to 914 meters. Also situated in the range are the three highest mountains in Malaysia: *Mount Kinabalu (4,101m), Gunung Trus Madi (2,597m) and Gunung* Tambuyukon (2,579m)

The heavy rainfall combined with the natural configuration of the land has given birth to many rivers that barely a century ago served as the main arteries for trade and travel. Almost all the states in Malaysia have adopted the names of the principal rivers flowing through their respective territories. In the Peninsula, the longest river is Sungai Pahang (475km) followed closely by Sungai Perak (400km).

2.3.4 Geology

Malaysia comprises a broad range of rock types, from the sands and silts of the coastal plains to the granite of the Main Range and limestone outcrops of the Langkawi Islands.

<Peninsula Malaysia>

Peninsular Malaysia, which forms part of the Sunda Shields, is the spine of the Peninsula. Its Triassic fold-mountain belt continues from eastern Myanmar through Thailand, Peninsular Malaysia, the Banka and Billiton Islands, and eastwards into Indonesian Borneo. The Triassic and older strata are essentially marine as opposed to the post Triassic rocks which are characteristically non-marine or continental in nature.

In Peninsular Malaysia, all the systems ranging from the Cambrian to the Quaternary, that is from 570 million years to about 10,000 years ago, are represented.

Throughout the Palaeozoic and Mesozoic eras, sedimentation was continuous; and due to the basin's instability, major breaks are apparent within and between the Palaeozoic, Mesozoic and Cenozoic group of rocks. Almost half of Peninsular Malaysia, notably in the Main Range, is occupied by granitoids. This granitic emplacement coincides with the culmination of the late Triassic orogenic event during which all the older strata were folded and deformed.

Regional metamorphism is widespread and most of the Palaeozoic and Mesozoic rocks show slight to moderate deformation but the grade has never been higher than the green schist facies which differentiate one rock from another in appearance and composition. The contact metamorphosed rocks generally form narrow aureoles around the igneous bodies. Major mineralization occurred during the granitic emplacement and commonly associated with faulting. Faulting is common in all rocks. At least three sets of faults have been recognized on a regional scale, the youngest of which occurred during the post-Early Createaceous period.

The Tertiary rocks are distributed onshore as isolated lalcustrine basins underlying the Quarternary deposits and offshore areas mainly as thick continental areno-argillaceous sequences. The Quarternary deposits which consist mainly of unconsolidated to semi-consolidated gravel, sand, clay and silt occupy the coastal terrains and floors of some of the inland valleys. In the Kinta and Klang Valleys, the alluvium contains valuable concentrations of tin ore.

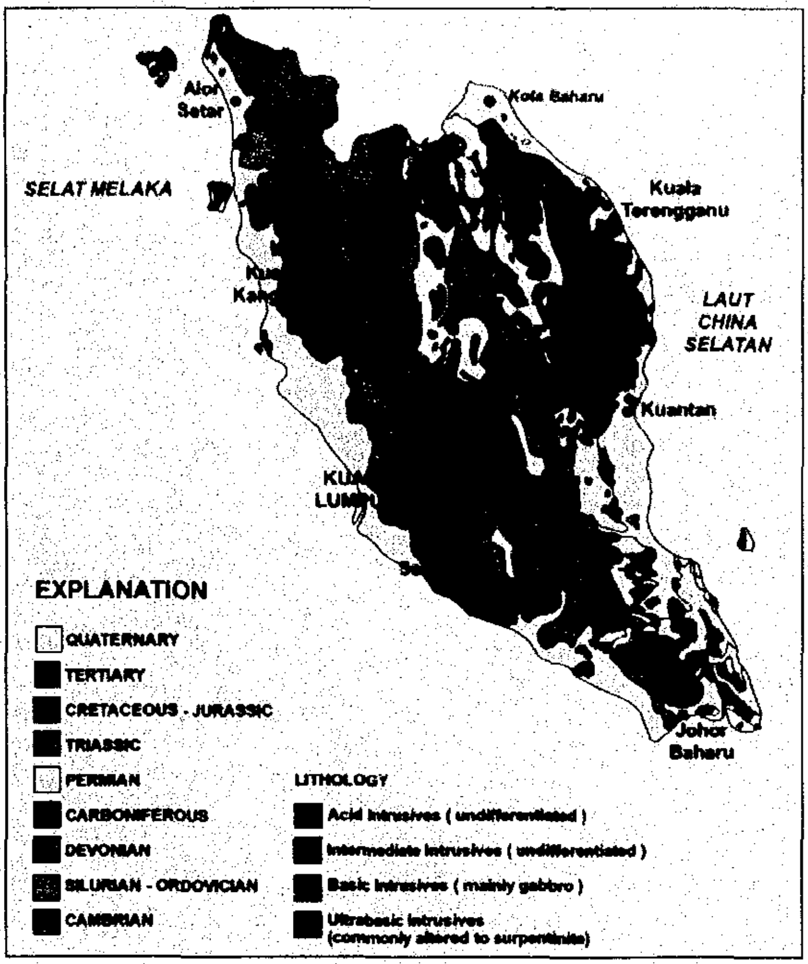


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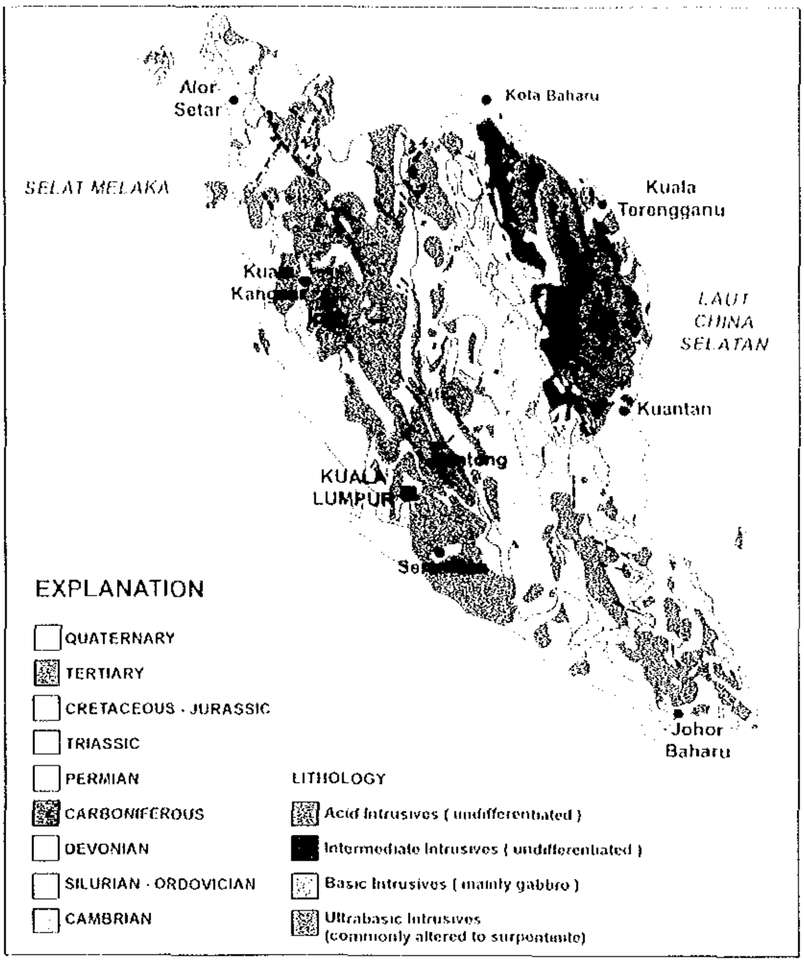
Figure 2.3.4 Geological Map of Peninsular Malaysia

Though recent studies on the geology on Malaysia by Geological Department of Malaysia (JMG) and Geological Department of Universities, some tectonic structures which could be related to the global structures have been found in Peninsula Malaysia as shown in Figure 2.3.5. Further studies have been done by JMG on East – West Highway which cross the major structure in northern part of Peninsula Malaysia. According to JMG, the structure might be found along the East – West Highway. However, they were not clear.



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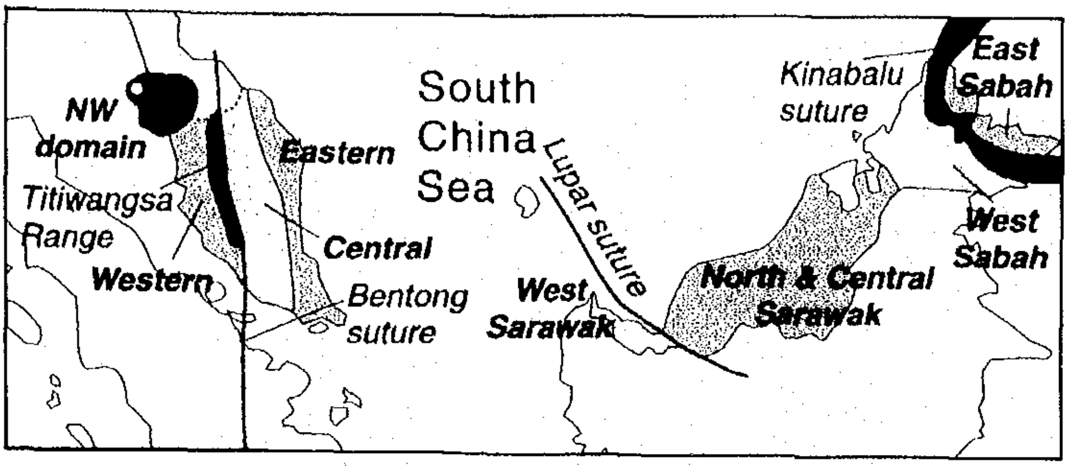
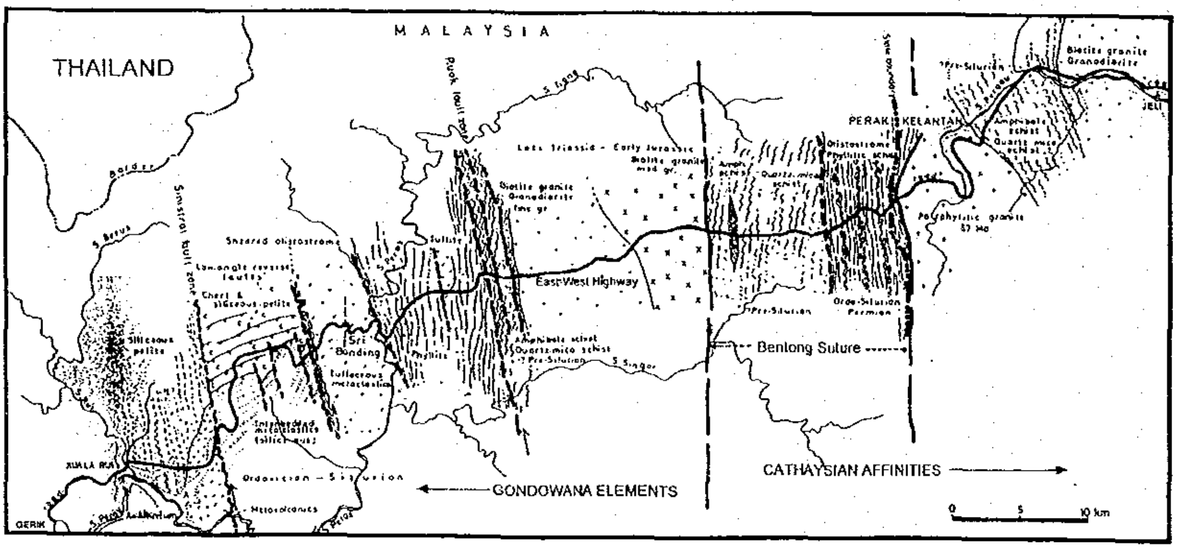


SOURCE : THE ENCYCLOPEDIA OF MALAYSIA, VOLUME 1 THE ENVIRONMENT

Figure 2.3.5 Major Geological Structures, Domains in Malaysia



SOURCE : GEOLOGICAL DEPARTMENT OF MALAYSIA, IPOH after TAJUL ANUAR (1989)

Figure 2.3.6 Geological Map along East – West Highway, Gerik - Jeli

<East Malaysia>

Sabah, situated at the northern tip of Borneo, is geologically complex. The oldest rocks are the Early Triassic metamorphic rocks of the Crystalline Basement, found mainly in eastern Sabah. Large bodies of granite, granodiorite, tonalite, ultramafic and mafic rocks intruded into the metamorphic rocks. The ultramafic bodies are distinctly elongated and commonly aligned east-west along the general metamorphic foliation trend.

During the Early Cretaceous period, limestone was deposited in several localities on an emerging basement in eastern Sabah. By Late Cretaceous, thick clastic and calcareous sediments, chert, limestone and volcanic rocks were deposited over a large part of northern Sabah. Deposition continued until the Eocene epoch.

By early tertiary, an elongated northeast trending marine trough already existed, extending from the Kalimantan border into western and northern Sabah. Deposition of thick sequences of sandstone and mudstone occurred uninterrupted into the Upper Miocene epoch until it was terminated by folding and uplift, accompanied by the intrusion of the Kinabalu Batholith.

During this major Late Miocene tectonic event, slump deposits and pyroclastics accumulated in several deep basins in eastern Sabah, followed by the deposition of sandstone and mudstone with minor amounts of limestone and coal in a chain of circular to sub-circular shallow basins. Rapid uplift in the Late Miocene epoch resulted in the formation of conglomerate at Lahad Datu and cessation of deposition in the area, except in the easternmost part – the Dent Peninsula – where Pliocene sediments were deposited in coastal swamps and shallow-marine waters.

From the Late Miocene to Quarternary epochs, extensive volcanism and associated shallow intrusions along the Semporna Peninsula and a batholith-size granitic intrusion at Mount Kinabalu occurred. The post-tectonic volcanic rocks that erupted in the Semporna Peninsula are typical of the calc-alkaline Pacific island arc type, being rich in soda-lime feldspar and generally low in potash. The early eruptions are mainly andesite, dacite and basalt. Several volcanic cones are still recognisable, and hot springs – remnants of volcanism – occur at several places in the Semporna Peninsula.

Quaternary deposits, consisting of coarse gravel, sand, silt, clay, peat and coral accumulated along the coast and are now found in raised terraces and in inland plains in Tenom, Klias, Padas valley, and the Sook-Keningau plains.

Most metallic mineral deposits and occurrences in Sabah occur along a central belt stretching from the northern islands of Banggi and Malawali, through Taritipan, Mount Kinabalu and the Labuk valley to the upper Segama valley – Darvel Bay area and Semporna Peninsula.

In Sarawak, the oldest formations date back 300 million years. These ancient rocks form part of the West Borneo Basement which is the exposed part of Sundaland in Southwest Borneo, and is thus related to continental South-East Asia. The Basement is built up of

Palaeozoic and Mesozoic rocks. Most of Sarawak is underlain by younger Tertiary sedimentary rocks especially the region northeast of the Lupar river.

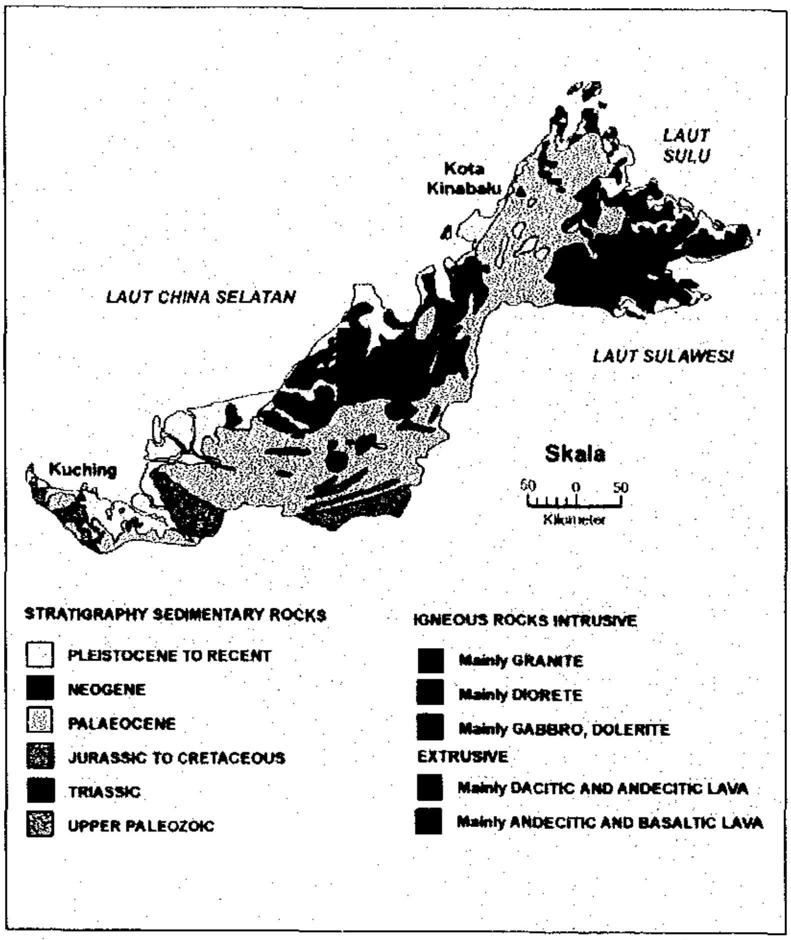


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Figure 2.3.7 Geological Map of Sarawak and Sabah, Malaysia

Among the more prominent geomorphological landforms are the many caves developed in limestone formations including the famed Niah Caves and Mulu Caves; and the high waterfalls developed over Tertiary sedimentary rocks of the Usun Apau Plateau and Hose Mountains in the interior of the state.

The Mulu Caves, developed in the Melinau Limestone during the Tertiary period, stand out as one of the most spectacular cave systems of the world.

2.3.5 Environment

(1) Environmental Impact Assessment

Guidelines for the Environmental Impact Assessment

The Public Works Department, Malaysia (Roads Branch) has "Guidelines for the Environment Impact Assessment of Highway/Road Projects" on its own terms.

"The EIA procedure adopted in Malaysia consists of three major steps. The steps in the EIA procedure are as follows:

a. Preliminary assessment of all prescribed activities,
b. Detailed assessment of those prescribed activities for which significant residual environmental impacts have been predicted in the preliminary assessment,
c. Review of assessment reports.

Details of those steps are as follows;

<Preliminary Assessment>

The objectives of Preliminary Assessment for prescribed activities are:

a. To examine and select the best from the project options available.
b. To identify and incorporate into the project plan appropriate abatement and mitigating measures.
c. To identify significant residual environmental impacts.

A Preliminary Assessment should normally be initiated during the early stages of project planning. Standard Procedural Steps are provided and the assessment might be conducted "in house", or by a consultant. Some form of public participation is mandatory. Environmental data collection may be necessary and close liaison between the assessor and relevant environment related agencies is encouraged. The results of Preliminary Assessment are reported formally for examination and approval by the project approving authority and the Director General of Environmental Quality. Preliminary Assessment requires resources that are a small proportion of the man-hours, money, skills and equipment committed to a pre-feasibility study and the assessment should be completed within the time frame of that study.

<Detailed Assessment>

The objectives of Detailed Assessment for prescribed activities with potentially significant residual environmental impact are:

a. To describe the significant residual environmental impacts predicted from the *final project plan;*
b. To specify mitigating and abatement measures in the final project plan; and

c. To identify the environmental costs and benefits of the project to the community.

Detailed Assessment should continue during project planning until the project plan is finalised. Standard procedural steps are provided and specific terms of reference based on the results of Preliminary Assessment are issued for each project. The Assessment *might be conducted "in house" or by a consultant.* The assessment method is selected according to the nature of the project; some form of public participation is required. Environmental data collection is almost certainly necessary. The results of detailed assessment is reported formally.

<The EIA Review Process>

The objectives of Review for Prescribed Activities subjected to Detailed Assessment are:

a. To critically review the Detailed Assessment reports;

b. To evaluate development and environmental costs and benefits of the final project plan; and

c. To formulate recommendations and guidelines to the project approving authority relevant to the implementation of the project.

Review of EIA Reports is carried out internally by the DOE for preliminary assessment reports and by an ad hoc Review Panel for detailed assessment reports. Recommendations arising out of the review are transmitted to the relevant project approving authorities for consideration in making a decision on the project. The normal period allocated for a review of a preliminary assessment report is two months while that for a detailed assessment report varies depending on the type of project under review. The DOE maintains a list of experts who may be called upon to sit as members of any Review Panel established. The selection of the experts depends on the areas of environmental impacts to be reviewed."

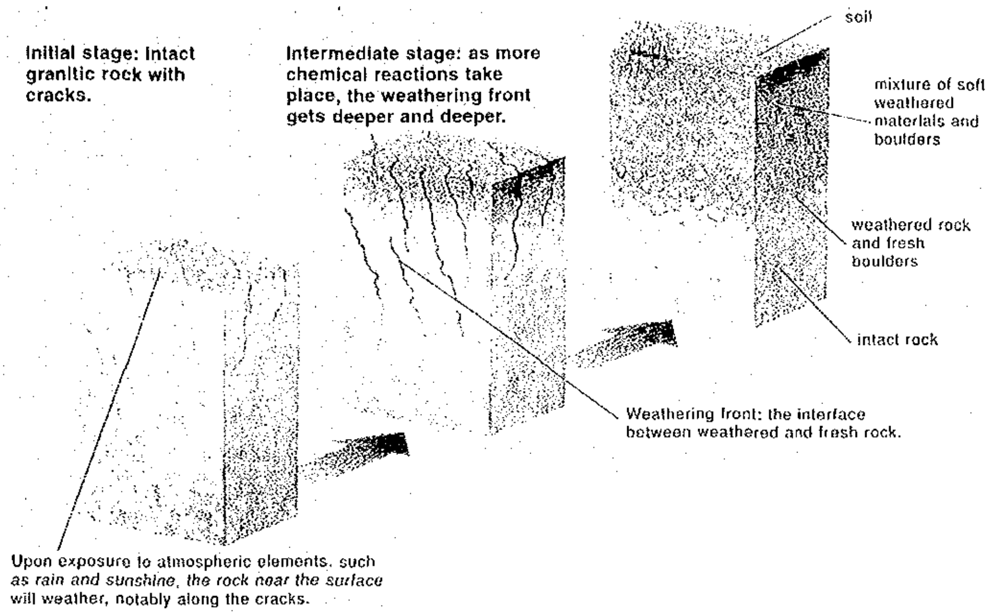
Source: Home page of Department of Environment Malaysia http://www.jas.sains.my/doe/egeia.htm

(2) Tropical Weathering

Malaysia's landscape provides an environment conductive to prolonged chemical weathering because of its high moisture content, extremes in temperature and the absence of a significant glacial history. Rocks in the tropic normally show extensive transformation by the weathering process. Rocks are weathered into thick soils which are rich in oxides and hydroxides of iron and aluminium.

During weathering some constituent elements are released to the environment. These elements enter drinking water, ponds and soils, and determine the quality of water received by humans and aquatic life and the availability and toxicity of natural nutrients for plant growth. More severe examples of weathering lead to extensive earth or rock displacements, such as rock falls, landslides and mudflows.

Weathering involves chemical, physical and, in some cases, biological processes, but chemical weathering is most dominant in the tropics. Generally, the chemical weathering of rocks involves many stages. The initial stage is in situ decomposition of rock into earth materials. At this stage, identification of the weathered rock is still possible. Significant clay formation occurs at the intermediate stage where the decomposition of primary minerals or rock constituents takes place very rapidly. The final stage is the accumulation of reddish materials, predominantly oxides and hydroxides of iron and aluminium. Laterite (iron-rich) and gibbsite (aluminium-rich) are the common products at the final stage of tropical weathering. Normally the soil becomes low pH value at the final stage.



THE ENCYCLOPEDIA OF MALAYSIA, VOLUME 1 THE ENVIRONMENT

Figure 2.3.8 Stage in The Weathering of Granitic Rock

(3) Soil

Soils are made up of mineral grains derived from the weathered particles of the parent rock, organic material, air and water. The relative proportions of the mineral grains of sand, silt and clay dictate important properties of the soil – such as texture and color. A limestone–derived soil, for instance, has a highly clayey texture, whereas granite gives rise to sandy clay soils. The reddish brown soil colors that predominate are caused by iron oxides. Intense weathering has also resulted in iron-rich accumulations as found extensively in Melaka, Selangor, Pahang and Kedah. These hard concretions may prove problematic to plant life, denying them water and root-anchoring locations. Flat and enclosed basins suffer from impeded drainage and thus a lower rate of weathering than sloped land.

Soil types and corresponding vegetation in Malaysia are described as follows;

(a) Marine clay

Waterlogging is common and the heavy clay texture may accumulate sulphur compounds and thus has a high salt content. Only mangrove trees that have evolved special 'breathing' roots are able to grow in the anaerobic swampy conditions.

(b) Peat

These contain fibrous organic components derived from decomposing woody matter and can be several meters in depth. Generally chemically poor (acidic) and badly drained, they support peatswamp trees and palms which have adapted to the harsh conditions.

(c) Alluvial

Formed from sediments transported by rivers from higher ground, these vary in texture, ranging from adequately drained sandy loams on raised areas to organic clay on flood plains, such as those which are sourced by the Pahang and Kelantan rivers. Sediments range from coarse to fine and the soils are correspondingly mixed. More clayey types support swamp vegetation and the coarser, drier soils are home to riparian, or river-based, forests.

(d) Lowland hill

Reddish yellow, yellow or brown soils developed over highly weathered parent rock. In some reddish soils, an iron-rich concretionary layer may occur not far below the surface. On muddy shales, mottled greyish white colour may develop. The most fertile hill soils, as found in Sarawak's interior, include a thin layer of top soil with abundant volcanic rock fragments just beneath. They support healthy dipterocarp forests.

(e) Limestone

These are typically shallow, can be peaty and are found on steep limestone hills characterised by jutting pinnacles such as those of Gunung Mulu. Vegetation is sparse and stunted. On less steep limestone hills, reddish soils are found.

(f) Upland hill

If undisturbed, soils may develop strong reddish colors showing no distinct change in character with depth. However, many upland regions are highly eroded and can only support a thin layer of soil.

(g) Montane peat

Comprised mainly of decomposed mosses, these are never as thick as lowland peat. They lie on a shallow to moderately deep soil and support montane forest vegetation.

(4) Soil Erosion & Slope Disaster

Almost all the high-erosion risk areas are hilly terrains where the gradient of the slope is greater than 20 degrees. A long, continuous and steep slope, for example, allows runoff to build up momentum and erode the top soil. Vegetation cover, on the other hand, shields soil surface from the impact of falling rain. It slows the velocity of runoff, holds soil particles in place and maintains the soil's capacity to absorb water. Serious cases of soil erosion across Malaysia have occurred where extensive areas of forests and vegetation have been cleared for development.

Peninsular Malaysia has five soil erosion categories ranging from Low- to Very High-Risk areas. Highland sloes are all over 20 degrees in gradient, which is considered very steep. They include the Titiwangsa Range. In Very High-Risk areas, an average of 150 tonnes per hectare of soil is lost per year.

Development projects bring about substantial soil loss. In Sabah, for instance, as much as 55,000 tonnes per square kilometer a year are lost through land clearing, logging track activities and road and infrastructure development. Construction sites on granite rock type are equally responsible for massive annual depletion of up to 40,000 – 50,000 tonnes per square kilometer. The planting of commercial crops, such as oil palm in Pahang, to replace natural forest also contributes substantially to loss of soil. Shifting cultivation and traditional agricultural land uses, however, are responsible for only limited destruction which can be considered natural soil erosion. The following are the erosion rates by land use and rock type.

Table 2.3.1 Erosion Rates by Land Use and Rock Type

Land Use Type	Rate of Erosion (tons/hectare/yr)
Undisturbed Lowland rainforest	0.19 – 3.12
Selective logging, lowland forest	0.2 – 16.5
Selective logging, steepland forest	11.2 – 28.5
Shifting cultivation	0.18 – 0.34
Logging roads	10 – 550
Temperate vegetables, highlands	2 – 10.5
Traditional pepper cultivation	80 – 85
Conversion of forest to oil palm	2.2 – 2.5
Construction site	400 – 500
Streams affected by construction activity	12 - 100

Source: The Environment after Department of Environment Malaysia (1996)

As a consequence of erosion, river siltation during heavy rain is very high. Because of extremely deep weathering, steep slopes are easily eroded by streams and rivers. This in turn increases the rate of mass movement, such as soil creep, slope failure and landslides. The high erosion capability, coupled with a high rate of mass movement, makes hillsides geomorphologically sensitive regions.

For physical development, suitability, safety and value for money are the most important factors. In hillsides, 'suitable' areas are limited, hence the necessity to build on steep slopes and other difficult terrain. In such situations site investigations need to be carried out with extreme care in order to avoid man-induced hazards which can lead to loss of life. Not only will development on hillsides create difficulty in ensuring public safety, it will also pose problems to adjacent low-lying areas.

Rapid growth has taken place in Malaysia's hillside areas, sometimes with detrimental results. These include the destruction of the landscape, modification of the climate and the degradation of the quality of the soils and rivers. Deforestation and loss of vegetation cover have resulted in rising temperatures, which not only reduce the attractiveness of hill locations as cool gateways, but also may interfere with the prevailing agriculture of the area. Land clearing, to make way for new roads and buildings, significantly increases the rate of soil erosion and the mass movement of earth – soil creep – from one area to another. Costs involved in the mitigation of such problems, which include putting in place retaining walls and other control measures, and to continue maintaining such structures, are considerable. Development on hillsides increases the prospect of slope failure, or landslides, the problem becoming particularly critical in wet seasons. Slope disasters are likely to occur because of the combination of deep weathering and steep slopes. They cause severe property damage and can also lead to loss of life such as the following;

30 June 1995:

Mud, boulders and debris flowing violently on the narrow gully of the Genting Sempah are swept away a dozen vehicles on the slope road to the Genting Highlands, killing 21 people and injuring 22 others on the afternoon of 30 June 1995.

11 December 1993:

Block 1 of the Highland Towers at Hillview Garden, Ulu Klang, Selangor, toppled, burying 49 people in its rubble on Saturday, 11 December 1993, at 1:30 in the afternoon. Believed to have been trigger by as period of intense and prolonged rainfall in the area, the collapse of the 12-story building was caused by the landslide of the hill behind the condominium, involving some 50,000 cubic meters of earth. This disaster was the first to attract public attention, helping to open the eyes of many Malaysians to the importance of proper geological and geotechnical investigation and slope stabilization measures for hillside development.

26 January 2001:

This was one minor slope disaster in Malaysia at Taman Perumahan Rawang Perdana on 27 January 2001, at 11:00 in the morning. Two detached house were damaged by the disaster, however nobody was injured since the residents were away at their home towns for the Chinese New Year Celebration. JICA Study Team visited and found it was the typical wedge slip of granitic rock as shown in the photo below.

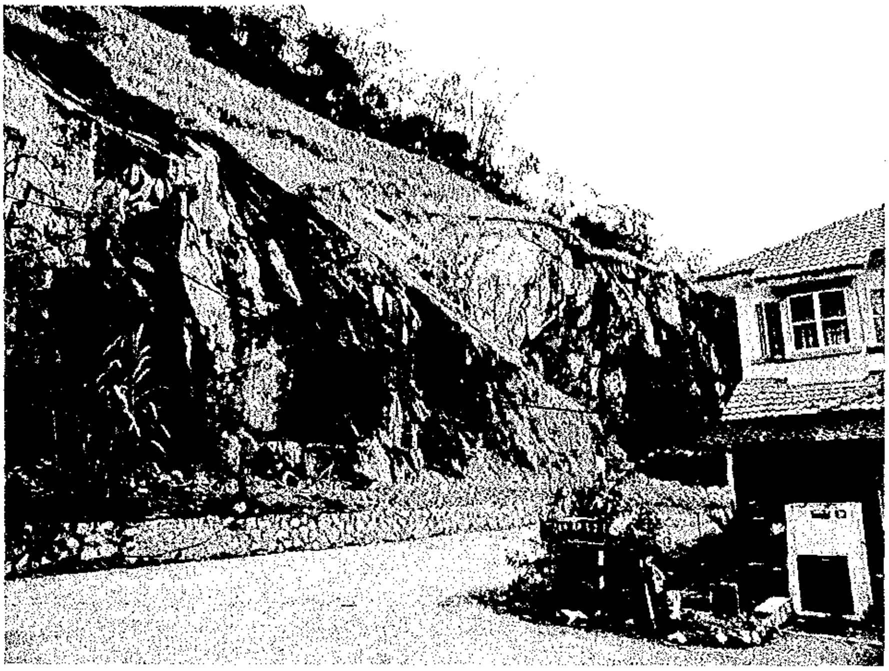


Figure 2.3.9 Wedge Slip at Taman Perumahan Rawang Perdana

(5) Flora

About four-fifths of Malaysia is covered by tropical rain forest. Malaysia's rain forest has a very complex structure and is rich with its variety of plant life forms and species. The most physically dominant life form in the rain forest are trees such as Kapur and Tualang attain a height of about 84 m, while there are also a variety of plant groups including herbs, shrubs, climbers etc.

Rice cultivation is practized throughout the Peninsula but the main and traditional centers are the states of Perlis, Kedah and mainland Pualu Pinang. Most of the larger rubber and oil palm estates are located on the West Coast of the Peninsula.

In Peninsular Malaysia, the flowering plant flora exceeds 8,500 species, while in Sabah and Sarawak there are more than 12,000 species. One of the most celebrated is the Rafflesia, the world's largest flower measuring up to one meter across.

(6) Fauna

Malaysia's equatorial climate is conducive for the proliferation of a variety of animal species, many of them endemic to this country. It is documented that there are more than one thousand species of butterflies, 600 species of birds, 280 species of mammals, 140 species of snakes, 165 species of frogs and toads, 80 species of lizards and a myriad of insect species. These animals are found in many different environments including mangrove swamps, rivers and mountainsides, primary and secondary forests as well as former mining land.

(7) Other Environment Disruption

Malaysia, in which 50% of land is covered with rain forest, is rich in tropical plants and animals. However, the destruction of forests by deforestation with the progress of industry has become worse rapidly. The vast destruction of forests in highland areas caused various environmental problems such as erosion, siltation, lost of cultivation soil, decrease of wild animals, floods and erosion at watershed. Some species of fishes are endangered because of overfishing both on and off the coast.

Urbanization and industrialization cause the problems related to the control of Solid Waste by which the most of the coastal area and rivers in the country are affected.