THE INVESTIGATION ON EFFECT OF WIND TRADE TO PRECIPITATION IN KUANTAN, PAHANG

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ABSTRACT

The rainfall distribution is spatial and temporal variability. The development and intensity of rainfall is governed and influenced by monsoon systems, orographic convective systems and land-sea interactions. Monsoons are seasonal winds, and develop around thermally produced continental highs in winter and lows in summer. North-east monsoon wind, also known as trade-wind brings heavy rainfall to Kuantan District, part of east-coast Peninsular Malaysia that causes flooding. This study was to investigate the impact of trade-wind to precipitation during 2013 flood events at Kuantan District, Pahang. The specific objectives are as follows; to established satellite-based rainfall intensity database and wind direction using Geographical Information System and to analyse rainfall distributions intensity effect of wind direction. Tropical Rainfall Measuring Mission (TRMM) satellite-based rainfall intensity data and wind data from Meteorological Malaysia Department (MMD) were used to establish a database. Further, satellite-based rainfall intensity distribution and wind direction had been map. Therefore, relationship between rainfall intensity distribution and wind direction were analysed. The result shows, during research most direction of wind come from North North West (NNW), not as stated by previous research. This causing more rainfall distribution intensity in the South South East region of district. Consequently, flooding occurred at that area. In general, rainfall distribution intensity influenced by wind direction, meanwhile in local area topography affects wind direction.

ABSTRAK

Taburan hujan adalah kepelbagaian spatial dan duniawi. Pembangunan dan keamatan hujan adalah dikawal dan dipengaruhi oleh sistem monsun, sistem perolakan orografik dan interaksi tanah-laut. Monsun adalah angin bermusim, dan membangun sekitar haba yang dihasilkan pada paras benua tinggi pada musim sejuk dan rendah pada musim panas. Angin monsun timur laut, juga dikenali sebagai angin perdagangan membawa hujan lebat ke daerah Kuantan, bahagian Pantai Timur Semenanjung Malaysia yang menyebabkan banjir. Kajian ini adalah untuk menyiasat kesan angin perdagangan terhadap hujan semasa kejadian banjir 2013 di daerah Kuantan, Pahang. Objektif khusus adalah seperti berikut; untuk menubuhkan pengkalan data satelit-asas keamatan hujan dan angin menggunakan Sistem Maklumat Geografi dan menganalisis kesan angin terhadap keamatan taburan hujan. . Data keamatan hujan berasaskan satelit misi mengukur hujan tropika (TRMM) dan angin data dari Meteorologi Malaysia Jabatan (JMM) telah digunakan untuk menubuhkan pangkalan data. Di samping itu, satelit-asas taburan intensiti hujan dan angin hala-tuju telah dipeta. Oleh itu, hubungan antara taburan keamatan hujan dan arah angin telah dianalisa. Hasilnya menunjukkan semasa penyelidikan, kebanyakan arah angin datang dari Utara Utara Barat (NNW), tidak seperti yang dinyatakan oleh kajian-kajian lepas. Ini menyebabkan keamatan taburan hujan lebih banyak di Wilayah Selatan Selatan Timur. Oleh itu, banjir berlaku di kawasan tersebut. Secara umum, keamatan taburan hujan dipengaruhi oleh arah tiupan angin, manakala di kawasan tempatan, arah tiupan angin dipengaruhi oleh topografi.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Centre for Research on the Epidemiology of Disaster (CRED), secretariat for the United Nation International Strategy for Disaster Reduction (UNISDR) has outlines any flood that has the following characteristics ten or more people reported kill, 100 people reported affected, a call for international assistance and declaration of a state of emergency is natural disaster (http://www.emdat.be/). A heavy rainfall is the main reason flood event for any climate region. Peninsular Malaysia is not exceptional, monsoon bring rainfalls that causing flooding, especially during the North-east Monsoon (November- early January) (Table 1.1). Monsoon winds part of global trade winds, are giant sea and land breezes produced by seasonal changes in circulation. Since, Peninsular Malaysia located at a low-pressure area known as the Inter-tropical Convergence Zone (ITCZ), the trade winds act as the steering flow for tropical storms that form over the Pacific and make rainfall in that area.

Table 1.1: List of main flood events

Date	**Location**	**Victim**	**Remarks**
Jan 2001	Kuantan	9478 people	Utusan Malaysia, 25 Dec 2001

7-13 Dec 2004	Kuala Terengganu, Kemaman, Kuantan	11 death and more than 10,000 were evacuated	Utusan Malaysia, 13 Dec 2001
19 Dec 2006	Muar, Segamat, Kota Tinggi, Johor Bahru	127, 000 people	Utusan Malaysia, 20 Dec 2006
10 Jan 2007	Several part of Johor	10,000 people were evacuated	Utusan Malaysia, 11 Jan 2007
December 2007	East Coast of peninsula	3226 in Kelantan, 22,000 in Pahang.	MStar Online, 13 Dec 2007
December 2013	East Coast of peninsula	42,626 people	The Malaysian Insider, 6 Dec 2013

1.2 PROBLEM STATEMENT

A heavy rainfall is the main reason flood event for any climate region. The North-east monsoon brings heavy rains often causing flooding to the East Coast of Peninsular Malaysia. North-east monsoon is the trade-wind that blows from east to west, supposed able to bring rain farther inland. Yet, a lot of rain occurred in coastal areas, as such, recent major flood at Kuantan, Pahang in December 2013. The study attempts to answer research question; what is the main causes of this occurring.

1.3 OBJECTIVE OF STUDY

The main objective of this study was to investigate the impact of trade-wind to precipitation during flood events at Kuantan District, Pahang. The specific objectives of this study are listed as follows:-

a) To established satellite-based rainfall intensity database and wind direction using Geographical Information System technique

b) To analyse rainfall distributions intensity effect of wind direction.

1.4 SCOPE OF STUDY

The study was carried out at Kuantan District, Pahang, one of the east coast states of Peninsular Malaysia. The Tropical Rainfall Measurement Mission Multi-satellite Precipitation Analyze (TMPA) satellite-based rainfall was used as source of rainfall information during the flooding incident.

1.5 SIGNIFICANT OF STUDY

This study offer to water resource manager a valuable insight regarding the trade-wind that affect to rainfall distributions that led extreme drought and flooding events.

1.6 THESIS STRUCTURE

This research consists of five chapters. Chapter one comprises the introduction section. It states the study background, problem statement, objectives of study, scope of study and lastly significant of study. For chapter two, describe the key term in- purpose of these study and comprises the literature review that related and suitable for these study. Chapter three explains the research methodology that used for planning research type of data collected and the method of data analysis to be employed. For chapter four present the result that obtained from the study area and year of study and discussed the result from analysis. Finally, chapter five comprises the conclusion from the overall chapter and relates some recommendation for future work on research field.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In recent years, several extreme and drought events have been reported in Malaysia. For example, an extreme rainfall event from 9 to 11 December 2004 caused severe floods over the east coast of Peninsular Malaysia (Juneng et al. 2007). In addition, due to the cold surges of the northeast monsoon, abnormally heavy rainfall occurred in the southern part of Peninsular Malaysia for several days in late December 2006 and in the middle of January 2007, causing massive floods in the region (MMD, 2006, 2007). Referring to Tangang et al. (2008), the influences from the Borneo vortex, the Madden-Julian Oscillation, and the Indian Ocean Dipole also play an important role in contributing to the massive floods during those periods.

The literature review for this study is divided into three (3) main sections; 1) study area, 2) characteristic of rainfall, 3) global trade winds, and 3) characteristic of wind.

2.2 THE MAIN FEATURES OF THE PHYSICAL AND CLIMATIC STUDY AREA

Peninsular is part of the country. Some are the States of Sabah and Sarawak or known as East Malaysia. Peninsular Malaysia is located at Latitude 1-7° N and Longitude 100-104.5 °E. The area is 131, 798.35 km^2, divided into 11 States and two federal territories. Pahang which has an area of 35965 km^2 is the largest State in Peninsular Malaysia whilst Perlis a 795 square kilometers is the smallest State (Figure 4.1). There are several mountain ranges that parallel from North to South. The main mountain range (Banjaran Titiwangsa) was dividing the two peninsular to the West Coast (facing the Straits of Malacca and the Indian Ocean) and East Coast (facing the South China Sea), making it as a maritime country with a long coastline and sloping ground. The land area covered with tropical rainforest. Since the 1960s, the forest area has opened up for expansion of plantation area and placement to increase the economic activity of the population. This has changed the landscape of the river basin with the diversity of Land Use and Land Cover (LULC). Information on the climate of Peninsular Malaysia can be found on the Web the Malaysian Meteorological Department (www.met.gov.my). The following is a summary of that information.

The entire study area is located in the zone from Equatorial doldrums. The climate is equator but for some places in Malaysia, especially in the northern part of Peninsular Malaysia experienced a tropical monsoon climate. The climate is subject to the influence of the sea and the wind blowing system changes from the Indian Ocean and the South China Sea. Typically the climate here is divided into southwest monsoon season (May-September), the North-Eastern monsoon season (November-March) and between the monsoon in April and October. . The wind pattern of seasonal local topography determines the joint nature of the rainfall patterns in the study area. Peninsular Malaysia has an average annual rainfall (MAP) 2490mm (NWRS, 2011).

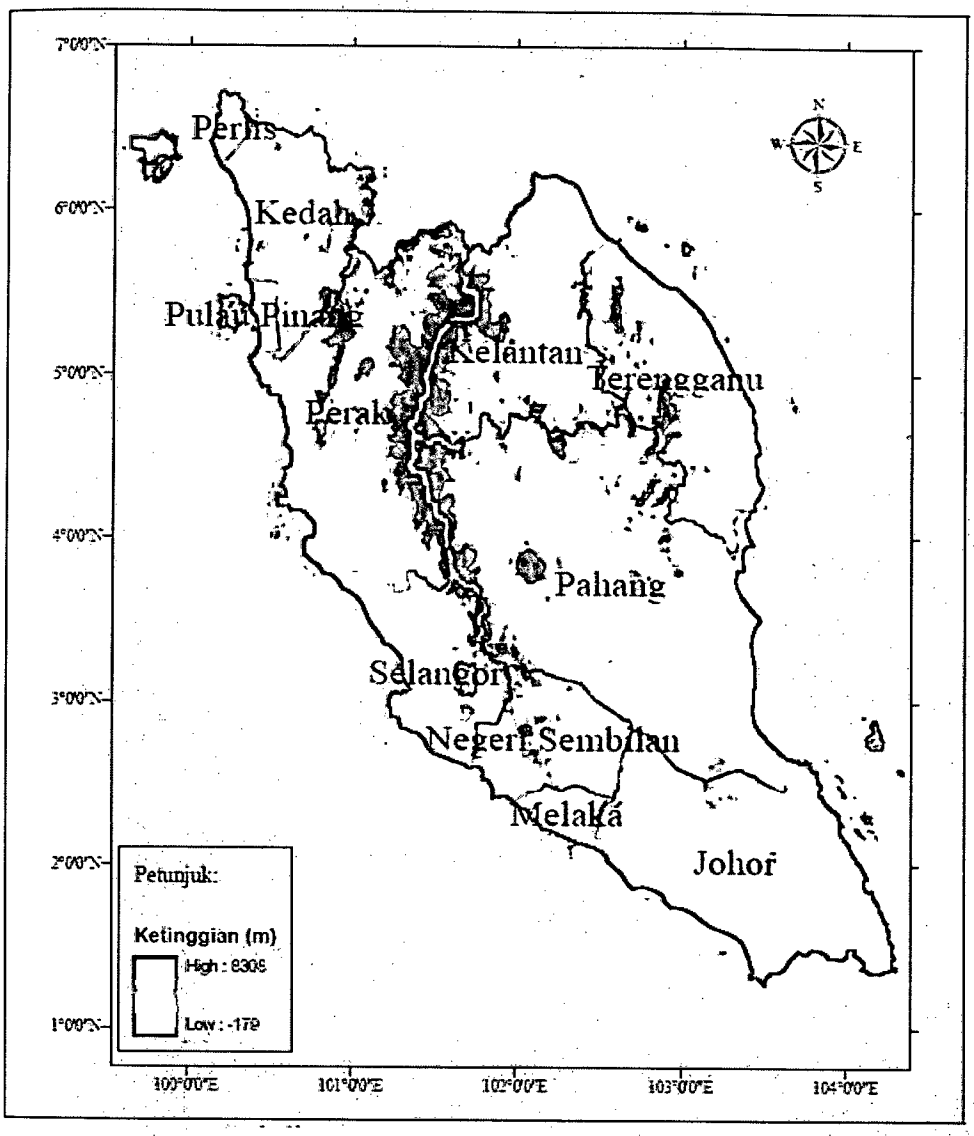
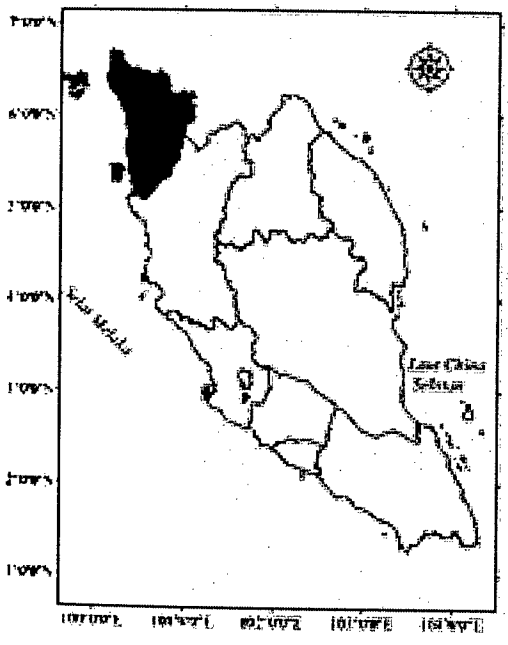


Figure 2.1: Study Area

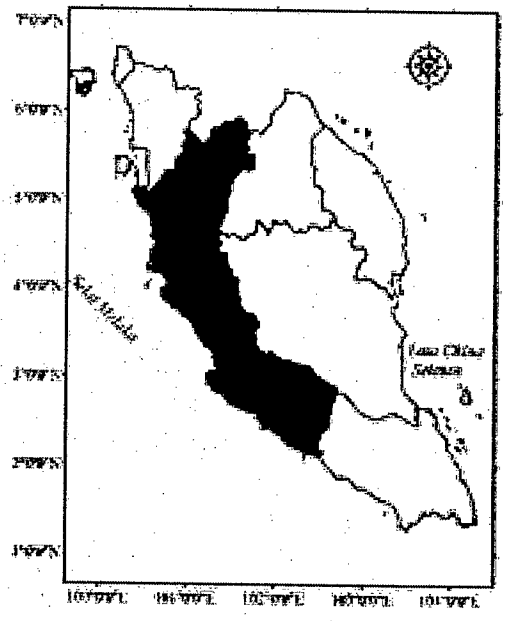
However, for the States on the East Coast, has a maximum rainfall in November to January, minimal rainfall in June and July. Rain pattern in the West coast of Peninsular Malaysia shows two maximum rain periods separated by two periods of minimum rainfall. The main maximum usually occurs in October and November, while the second occurred in maximum April to May. In the Northwest, the main minimum occurred in January to February, while the second minimum occurred in June to July. In other places, the main minimum occurred in June to July, while the second minimum occurred in February. Rain pattern in the West coast of Peninsular Malaysia more patterned by the

creation of ' Sumatra ' morning in May to August and the maximum as well as minimum double pattern does not exist. October and November are the months with the maximum rainfall, while February is the month that has minimal rainfall. Maximum in March to May and minimum in June to July does not exist or lack of clarity.

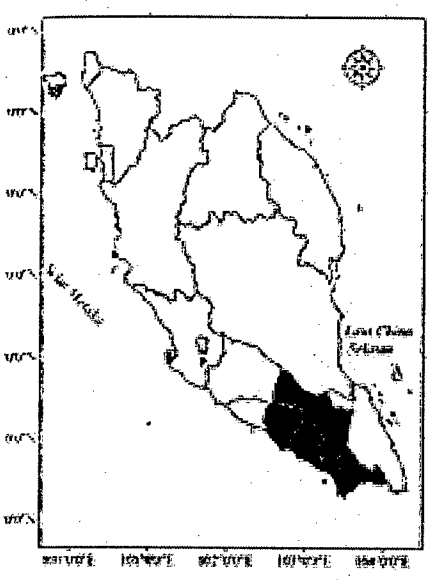
Dale (1959) has divided the study area into five (5) regions of rainfall, with the characteristics of different monthly rainfall, which is Northwest of Malaya (NWM), West of Malaya (WM), Port Dickson and Muar Coast (PDMC), South-west of Malaya (SWM) and East of Malaya (EM). However, for the purposes of this study, the rain gauge station MMD is divided into four (4) regions, namely; The North-West of Peninsular Malaysia (UBM) overlapped with NWM, Western Peninsular Malaysia (BM) overlapped with WM and PDMC, South-West of Peninsular Malaysia (SBM) overlapped with SWM, and Eastern Peninsular Malaysia (TM) overlapped with EM (Figure 3.2).



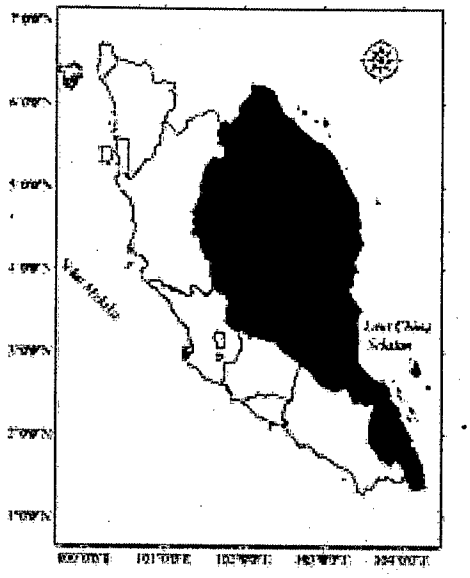
a) North-West of Peninsular Malaysia (UBM)



b) West of Peninsular Malaysia (BM)



c) South-West of Peninsular Malaysia (SBM)



d) Eastern Peninsular Malaysia (TM)

Figure 2.2: Regional study area

The wind in Peninsular Malaysia is generally weak. The wind blow also vary, based on the monsoon and the monsoon. During the southwest monsoon, the prevailing wind were from the Southwest with poor speed, in 15 knots. While, during the northeastern monsoon season, prevailing wind is from the East or Northeast with speeds between 10 and 20 knots. The East Coast States of Peninsular Malaysia is more affected by the wind that can reach 30 knots current, its speed or more surge strong cold air from Siberia (winter wind surge).

During the monsoon, the wind generally weak and variable speed towards it. The study area is located close to the Equatorial Line, experienced an almost uniform temperature throughout the year. Annual temperature difference is less than 2 ° C except for the East Coast area the study area that are often influenced by wind surge from Siberia during the winter northeast monsoon which occurs in the northern hemisphere winter. The daily temperature range is great, for both the near beach is between 5 ° C to 10 ° C, while for rural stations is between 8 ° C and 12 ° c. However, the study area has

not been suffering from daily temperature high as there is in the tropical continent. Although the day is usually hot, evenings cold everywhere except during the southwest monsoon, which at night can be quite overwhelming.

Peninsular Malaysia has a high humidity. The average relative humidity was between abstention 10% to 90%, and vary with the place and month. Minimum relative humidity usually found in January and February, except for the East Coast States of Kelantan and Terengganu, where comparative humidity it is in March. Comparative humidity maximum is typically in November. As in the case of temperature, relative humidity daily changes is greater than the annual change. Average daily minimum can reach as low as 42% during the dry months and reaching as high as 70% during the slow months. However, the average maximum daily did not much change from one place to another place, which is more than 94% and may reach as high as 100%. In the Northwest, namely Kedah and Perlis had the largest relative humidity changes daily.

As a country that is surrounded by the sea and is located near the equator, Peninsular Malaysia naturally receive plenty of sunlight from the sun. However, it is rarely found in the rest of the day are not covered except for direct drought period cloud. Cloud cover can reduce the content of sunlight and the sun. On average, it received a total of 6 hours of sunlight a day. However, there are differences in the amount of sunlight received according to season and place. On average, Alor Star and Kota Bharu receive 7 hours of sunlight a day. In addition, Alor Star received the maximum value of 8.7 hours a day on average in the same month. The Sun is related closely to the period of sunlight. Changes in seasonal and located is approximately equal to the sunlight.

Evaporation areas of Peninsular Malaysia, much influenced by the season (i.e., rain and dry) and cloud cover as well as the height of the terrain. Evaporation rate months cloudy or rain is low, while the month of cleaning is the month that has a high rate of evaporation. For highland areas like Cameron Highlands, temperature and a low rate of the evaporation is approximately 2.5 mm per day, while the low-land areas has annual average evaporation of 4 mm to 5 mm a day.

2.2.1 Disaster Happened Caused By Rainfall and Wind

In Malaysia, there are many cases that caused by rainfall and wind. For an instance, heavy rainfall and strong wind in certain states in Malaysia causes flood and flash flood. On December 2013, a major flood had occurred in Kuantan, Pahang caused a range of negative impacts on residents in the area. The flooding in Pahang has almost paralyzed the town center and surrounding areas when there is no electricity and water supply in most parts and a total of 14, 044 people had been evacuated which shows the highest number of evacuation in East Coast of Peninsular Malaysia. The Malaysian Meteorological Department also had issued an orange level, warning of continuous heavy rainfall in several areas of Pahang.

From a news report, on 2nd December, a few routes around the area closed to light vehicles following the flood arising from heavy rain since early morning. According to social sites Facebook Police, some 28 kilometers of Road involved is Sungai Lembing, Batu 3 Jalan Kuantan-Gambang and the junction before the Wisma Belia under flyovers Kuantan Bypass, in addition, the path in Jalan Bukit Ubi before Fire Kuantan, Jalan Tok Sira building Chemistry Department and a shortcut Setongkol Hill points to the supermarket Giant also flooded. In this regard, the Police advise people to be careful and be prepared for any possibility and according to the instructions of the authority to move if required to do so, ' he said. (Utusan Online, 2nd December 2013). Below are some other reports on this disaster.

sday, 5 December 2013

Disember 2013 : Banjir Terburuk Dalam Sejarah Kuantan

Bermula Sabtu 30 November hujan dah mula turun sekejap-sekejap..Ahad 1 Disember bersambung lebih kerap..

Isnin 2 Disember dah mula ada yang melimpah..Sungai Lembing kawasan pertama menunjukkan amaran apabila air melepasi paras bahaya. Lewat petang beberapa kawasan sudah mulai dinaiki air..Malam yang sama juga fenomena air pasang berlaku.

Selasa 3 Disember keadaan semakin teruk. Hujan juga semakin berderu turun seperti tiada tanda akan berhenti. Laluan sudah mula banyak tidak dapat dilalui. Jalan By-pass Kuantan Kemaman banjir di Persimpangan Wisma Belia..Susur turun ke Polisas juga banjir. Jalan Kuantan-Gambang air naik disekitar Tanah Putih, Sungai Isap dan Permatang Badak. Jalan Kuantan-Pekan banjir di pangkalnya di hadapan KIPSAS, kawasan Inderapura dan Indera Sempurna.

Rabu 4 Disember banjir yang melanda Kuantan bertambah buruk apabila kawasan yang tak disangka-sangka pun turut tenggelam. Kawasan Permatang Badak tenggelam sehinggakan jalan raya turut ditenggelami air. TNB juga terpaksa 'shutdown transformer' di PMU Utara kat Indera Mahkota. Bekalaan elektrik pulih semula sekitar jam 12 tengahari.

Menjelang malam (sekarang) dilaporkan bahawa kawasan bandar semakin pulih...Menurut orang yang dah lama dok kat Kuantan ni..katanya kali ini lebih buruk dari kejadian banjir tahun 2002...

Figure 2.3: Report on Flood in Kuantan, Pahang on December 2013.

Source: http://dkdayat.blogspot.com/2013/12/disember-2013-banjir-terburuk-dalam.html

Figure 2.4: View from Sungai Isap village on 4th December 2013

Figure 2.5: Kuantan – Pekan roadway

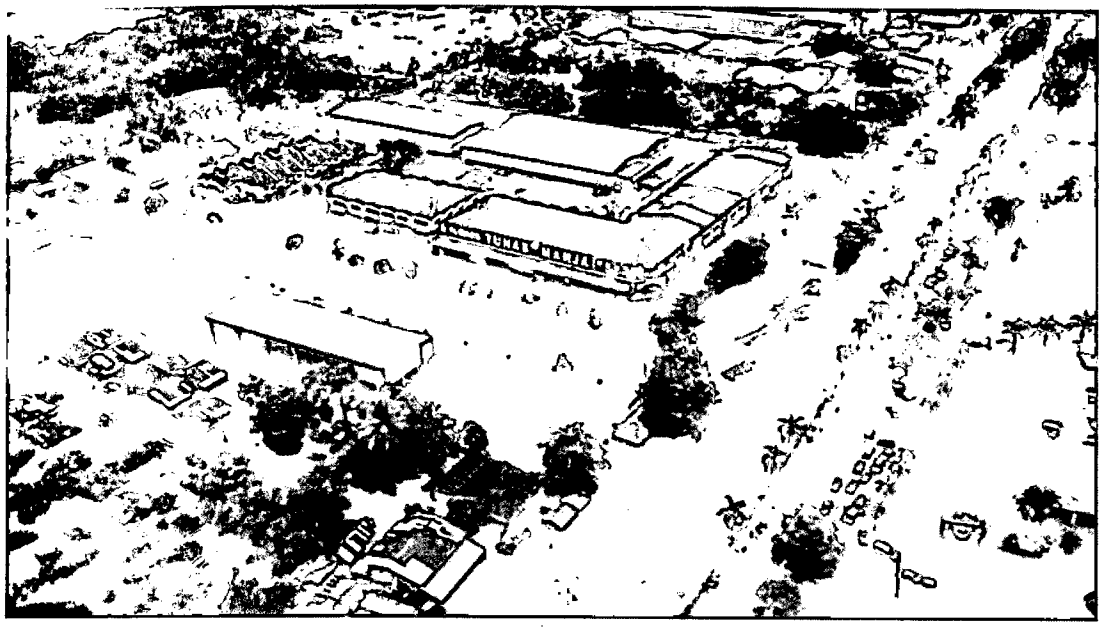


Figure 2.6: Tunas Manja supermarket at Batu 3.5

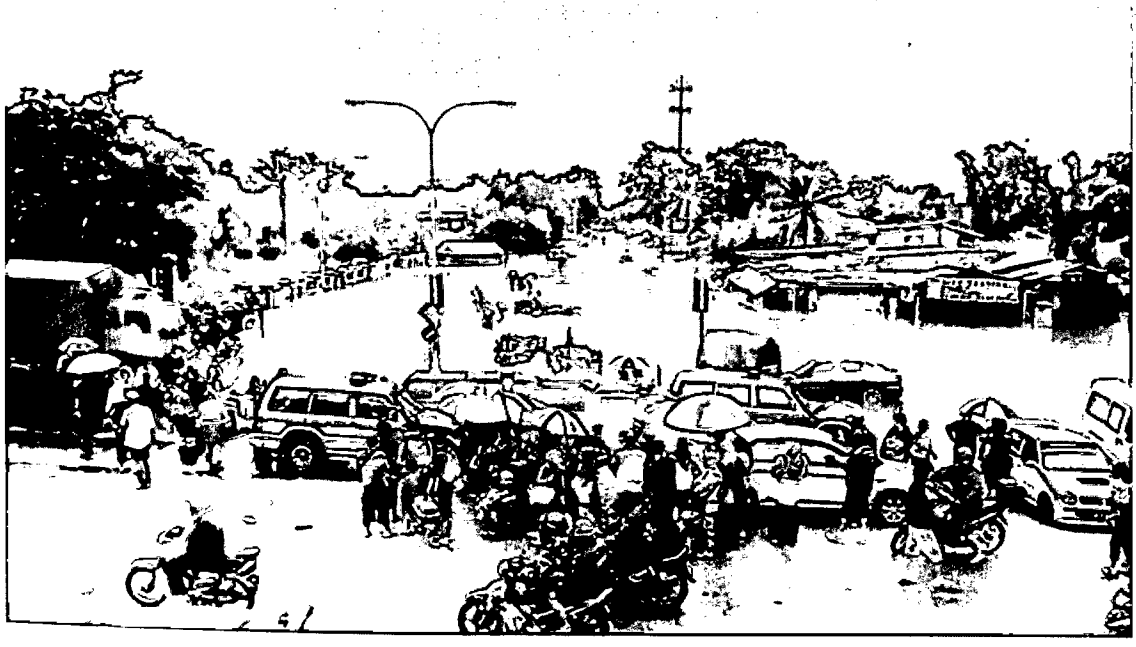


Figure 2.7: PermatangBadak – Kuantan – Gambang interchange

2.2.2 Seasonal Rainfall Variation in Peninsular Malaysia

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

1. Over the east coast states, November, December and January are the months with maximum rainfall, while June and July are the driest months in most districts.

2. Over the rest of the Peninsula with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October - November while the secondary maximum generally occurs in April - May. Over the northwestern region, the primary minimum occurs in January - February with the secondary minimum in June - July while elsewhere the primary minimum occurs in June - July with the secondary minimum in February

3. The rainfall pattern over the southwest coastal area is much affected by early morning "Sumatras" from May to August with the result that the double maxima and minima pattern is no longer distinguishable. October and November are the months with maximum rainfalls and February the month with the minimum rainfall. The March - April - May maximum and the June -July minimum rainfalls are absent or indistinct.

2.2.3 Flood in Malaysia

Flooding is a natural disaster which occurred due to factors such as climate or climatologically conditions, temperature, sprinkling rain, evaporation, wind and natural state of Earth (Balck, 1983). In Malaysia, any flash flooding would flood occurred in the tradition, especially on the East coast of the Peninsula during the monsoon season. Increased frequency of flooding in the Country is either natural or due to monsoon as a result of the increase of urban squatter areas in the (Chan 1996; Jamaluddin Sham of 1987; Peter Rose, 2001). Flooding usually caused either by continuous rain result in greater quantities than usual or the river water that overflows into the river bank or from both (Balkema et al. 1993; Schulz et al. 1972). The increasingly superficial river in the downstream result in recurrent floods to occur (Bradley Potter 1992; Whiting 1998). The situation of the municipality that was guided by the clay is impermeable to water, quickly saturated and less absorb water, if there is heavy rain will cause water to spill over to the banks of the river fast (Smith Ward, 1998). The erosion that affects the thickness of the sediment in rivers also contributes to flooding (Ward Trimble 2004). Muhd. BarzaniGasim et al. (2007) identifies flood which occurred in Dungun, Terengganu was caused by four factors; the high rainfall, the river flows slowly, sea surge toward the mainland, and the wind direction and way to the mainland. The above phenomenon is the effect of the tidal difference quite large in the East Coast.

2.3 CHARACTERISTIC OF RAINFALL

2.3.1 The Intensity of Rainfall

The intensity of rainfall is a measure of the amount of rain that falls over time. The intensity of rain is measured in the height of the water layer covering the ground in a period of time. It means that if the rain stays where it falls, it would form a layer of a certain height. We say things like: 30 millimeter of rain fell today or it rained 20 millimeter in two hours. Sometimes people speak of the volume of water that falls on a square meter in a period of time: ten liter per square meter per day for instance.