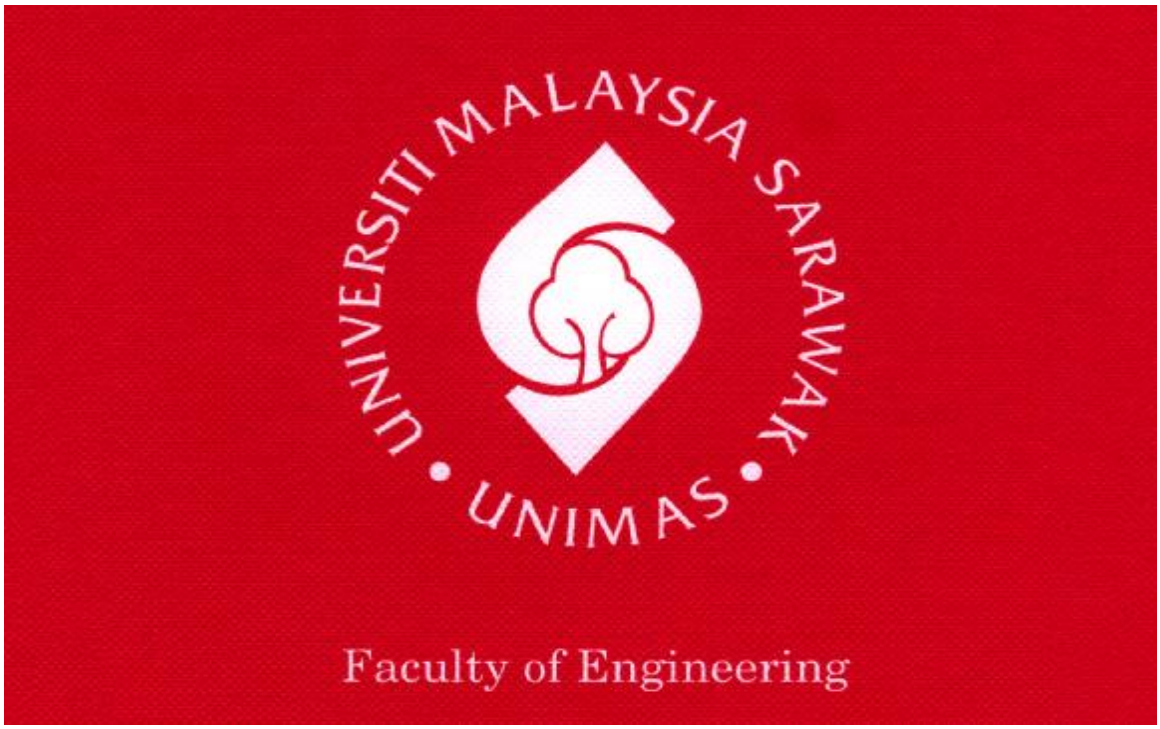

EXTREME RAINFALL PATTERNS FOR SG. SARAWAK AND SAMARAHAN RIVER BASINS

Wan Faizurah Binti Wan Ahmad

Bachelor of Engineering with Honours
(Civil Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN STATUS TESIS

Judul: **EXTREME RAINFALL PATTRENS FOR SG. SARAWAK AND SAMARAHAN RIVER BASINS**

SESI PENGAJIAN: 2008 – 2009

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Date

EXTREME RAINFALL PATTERNS FOR SG. SARAWAK AND SAMARAHAN RIVER BASINS

WAN FAIZURAH BINTI WAN AHMAD

This project is submitted in partial fulfillment of

the requirements for degree of Bachelor of Engineering with Honours

(Civil Engineering)

2009

Faculty of Engineering

UNIVERSITI MALAYSIA SARAWAK

2009

Dedicated to my beloved family members, lectures and friends

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratefulness to the Allah for giving me the strength and patient with works along the completion of this thesis.

Secondly, I want to express my special thanks to my supervisor, Prof. Salim Said for his assistance, considerable time, opinions and comments along the completion of this thesis.

I also wish to acknowledge to Dr. Onni Suhaiza binti Selaman for her assistances and opinions on constructing extreme rainfall region map using Geographic Information System (GIS) application.

My special thanks also dedicated to my beloved family members and friends for their opinions, comments and ever ending moral support.

Last but not least, my thanks also dedicated to those who are involved either directly and indirectly along the completion of this project.

ABSTRAK

Analisis corak dan frekuensi hujan telah dijalankan berdasarkan data hujan yang telah diekstrak dari 23 buah stesen hujan dalam besen Sg. Sarawak dan 7 buah besen hujan dalam besen Samarahan. Dalam kajian ini, data hujan maksima harian dan hujan min bulanan telah digunakan untuk analisis corak hujan manakala data hujan maksima harian digunakan untuk prosedur analisis frekuensi hujan. Objektif utama kajian ini adalah untuk membina peta kawasan hujan maksima besen Sg. Sarawak dan besen Samarahan berdasarkan analisis frekuensi lengkungan variat graf yang lebih baik di padankan untuk taburan Ektrim I (EVI), sama ada formula kedudukan memplot Gringorten atau formula kedudukan memplot Weibull menggunakan aplikasi Sistem Maklumat Goegrafi (GIS). Selain itu, objektif kajian juga untuk mengenalpasti faktor-faktor yang mempengaruhi taburan hujan dalam besen Sg. Sarawak dan besen Samarahan. Dari keputusan analisis, taburan hujan di kawasan pantai kedua-dua besen dipengaruhi oleh kewujudan angin semasa monsun utara-timur di mana taburan hujan dengan rejim satu maksima dan minima boleh diperhatikan. Sementara itu kawasan pedalaman adalah kurang dipengaruhi olehnya dimana hujan disebarkan lebih kurang sama rata sepanjang tahun. Keputusan yang diperolehi dari analisis frekuensi hujan menunjukkan bahawa formula Gringorten memberi nisbah yang lebih kecil daripada formula weibull yang mana persesuaian dengan kajian sebelum ini dan ulasan dalam kajian. Daripada keputusan ini, graf frekuensi dalam lengkungan pengurangan variat untuk kedua-dua besen mengunakan formula Gringorten diplot dan seterusnya peta kawasan hujan maksima dibina mengunakan aplikasi Sistem Maklumat Geografi hasil daripada graf tersebut.

ABSTRACT

Rainfall patterns and frequency analysis are carried out based on rainfall data extracted from 23 rainfall stations in Sg. Sarawak and 7 rainfall stations in Samarahan basin. In this study, Daily Maximum Rainfall (DMR) and Monthly Mean Rainfall (MMR) data has been used for rainfall pattern analysis whereas rainfall frequency analysis procedure is applied only for DMR data. The objectives of this study are to constructing the extreme rainfall region map based on frequency analysis reduced variate curves which is the better plotting formula fit to Extreme Value Type I (EVI) distribution either plotting position formulae Gringorten and Weibull formula using Geographic Information System (GIS) application. Besides, these study also to determine the factors influencing the rainfall distribution in Sg. Sarawak basin and Samarahan basin. From the results and analysis, the rainfall distribution in coastal areas of Sg Sarawak basin is influencing by prevailing wind during northeast monsoon season where a regime of one maximum and minimum rainfall distribution can be observed. Meanwhile, those inland is less likely influenced where the rainfall is distributed quite evenly throughout the year. The results obtained from rainfall frequency analysis showed that the Gringorten formula gives least ratio than Weibull formula which is in accordance to previous study and literature review. From this result, frequency analyses in reduced variate graph are plotted for both basins and then the extreme rainfall region map are constructed using Geographic Information System (GIS) based on the graph.

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GLOSSARY OF SYMBOLS

T	Return Period
P	Exceeedance probability
y_T	Gumbel reduced variate
m	The rank of a value
n	The total number of values
b	Parameters for plotting Position's Formula
K_T	Frequency Factor
σ	Population standard deviation
μ	Population mean
γ	Dimensionless coefficient of skewness
x_i	The sample at *i*th order
x_T	Variate-x
s	Standard deviation of a set data

CHAPTER 1

INTRODUCTION

Malaysia is blessed with good tropical weather. In general, Malaysia experiences wet and humid tropical climate throughout the year that is characterized by high annual rainfall, humidity and temperature. The average annual rainfall is about 2,420 mm/yr in the peninsular, 2,630 mm/yr in Sabah and 3850 mm/yr in Sarawak. However, the annual rainfall is more than 4,000 mm/yr in mountainous areas of Sarawak and more than 3,000 mm/yr in the northern half of Peninsular Malaysia and the coastal areas of Sabah and Sarawak.

The distribution of rainfall in Malaysia is very much effected by two types of monsoon, the Northeast monsoon and Southwest monsoon. During Northeast monsoon, (Nov-Mac), the north eastern cost of Malaysia received heavy rainfalls meanwhile Southwest monsoon (May-Sept) bring heavy rainfalls to the west cost region of Malaysia.

Rainfall is a type of precipitation, a product of the condensation of atmospheric water vapor that is released on the Earth's surface. It forms when separate drops of water fall to the Earth from clouds.

From Department of Irrigation and Drainage Kuching, Sarawak data, abnormally extreme rainfall distributions occurred where many parts of Sarawak experienced the most severe floods in recorded history during January and February 1963. During this period, the state experienced rainfall in amounts far greater than the normally high total for this time, and this was the major cause of the flooding. The long duration of rainfall and their high intensity contributed significantly to the seriousness of the flood situation**.** It is contribute towards lost of life, damage in infrastructures, bridges, roads, agriculture and private commercial and residential properties. Several places in Sarawak that had flooding during January and February 1963 are shown in Figure 1.1 until 1.5.

Therefore, analysis on the extreme rainfall pattern is important to be carried out to mitigate flood history in 1963 from reoccur. For this analysis, the Gumbel distribution also known as Extreme Value Type I will be used to analyze the extreme rainfall frequency and from that data, the extreme rainfall region map can be producing.

Figure 1.1: The flooding picture of Bau town

(Source: http://www.did.sarawak.gov.my)

Figure 1.2: The flooding picture of Bau Town

(Source: http://www.did.sarawak.gov.my)

Figure 1.3: Batu Kawa Police Station, Kuching

(Source: http://www.did.sarawak.gov.my)

Figure 1.4: Siniawan Bazaar along Sarawak River

(Source: http://www.did.sarawak.gov.my)

Figure 1.5: Marudi Bazaar, Baram

(Source: http://www.did.sarawak.gov.my)

1.1 Area of Study

Sarawak is one of two Malaysian states on the island of Borneo. Known as *Bumi Kenyalang* ('Land of the Hornbills'), it is situated on the north-west of the island. It is the largest state in Malaysia. For development planning purposes, the state of Sarawak had been separated into 21 major river basins. They are Lawas, Limbang, Trusan, Sibuti, Niah, Baram, Smilajau, Kemena, Mukah, Balingian, Tatau, Rajang, Oya, Saribas, Krian, Saribas, Lupar, Samarahan, Sadong, Sg. Sarawak, and Kayan. Sg. Sarawak basin and Samarahan basin were choosen as an area for this study.

Sg. Sarawak basin has an enclosed an area of 2375 square kilometres. In Sg. Sarawak basin alone, there are altogether 23 rainfall station and has 7 river gauge station. Meanwhile Samarahan basin has covered an area of 1090 square kilometres. There is a main river located at Samarahan basin which is Batang Samarahan River. It has been provided with 11 rainfall stations and 4 river gauge stations but the stations that will study are Semilang, Kpg, Semera, Asajaya, Ketup, Kota Samarahan, Paya Paloh and Semonggok Station. Samarahan basin and Sg. Sarawak basin are shown in Figure 1.6 and Figure 1.7.

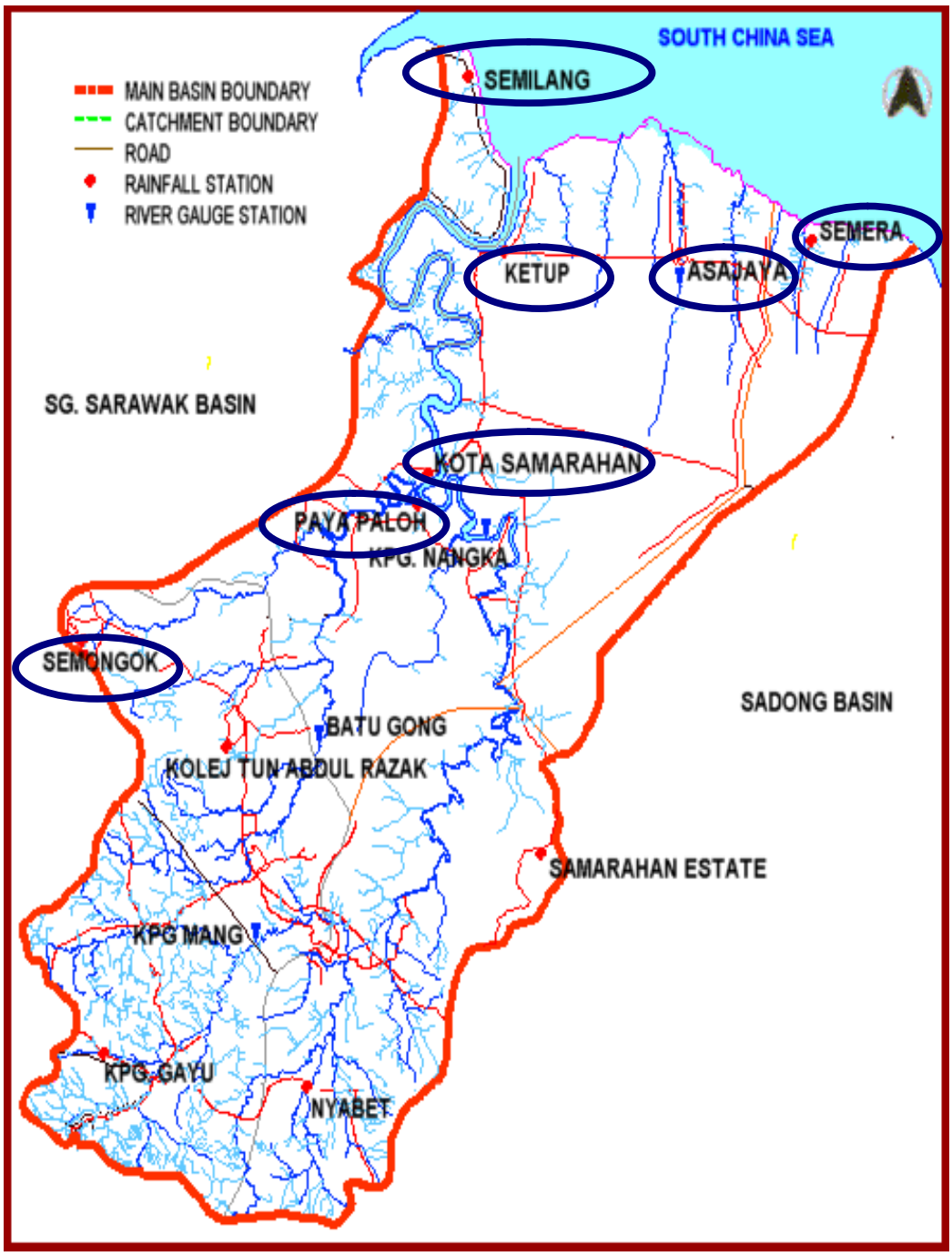

Figure 1.6: The Map of Samarahan Basin

(Source: http://www.did.sarawak.gov.my)

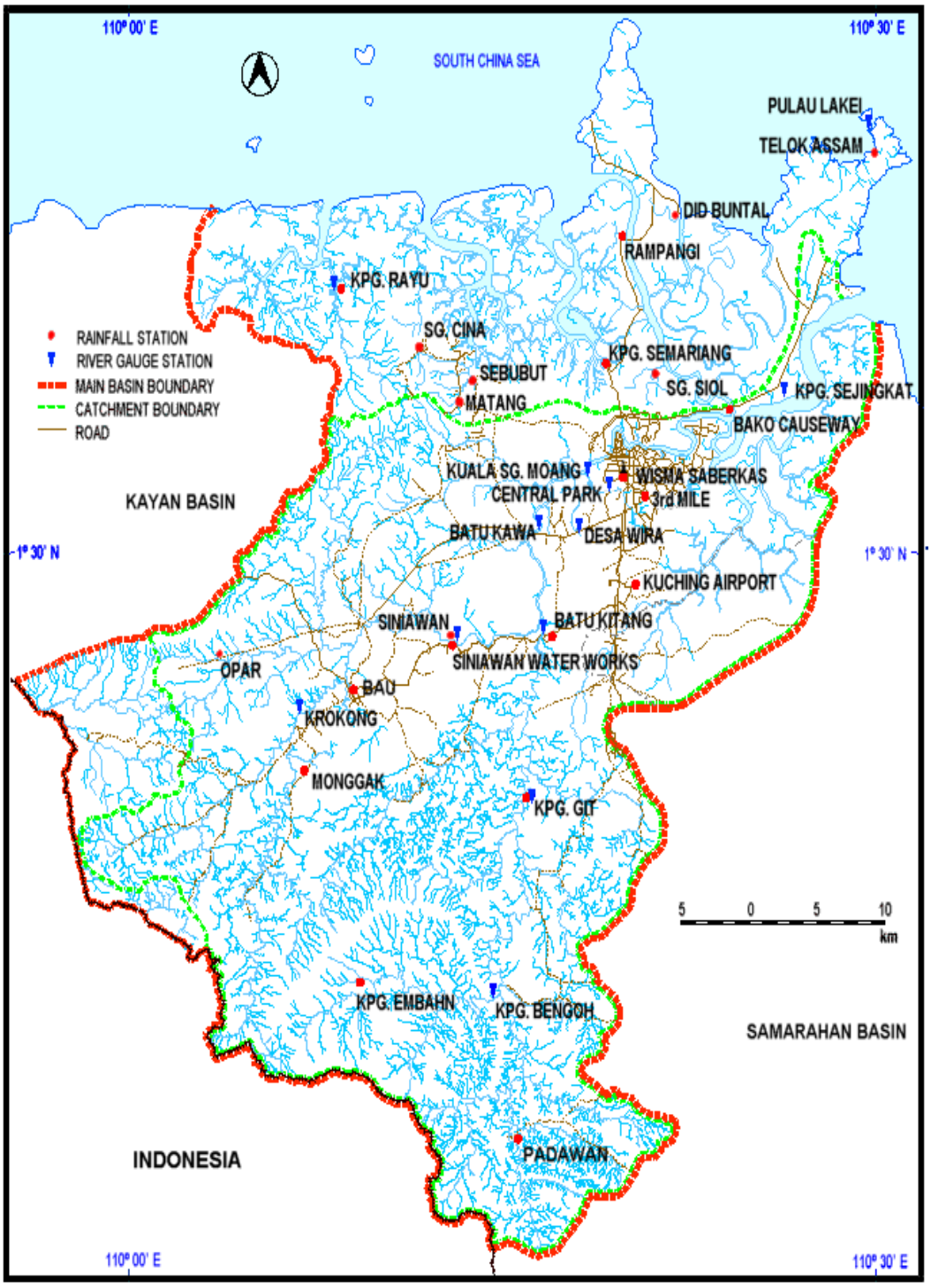

Figure 1.7: The Map of Sg. Sarawak Basin

(Source: http://www.did.sarawak.gov.my)

1.2 Objectives or Purposes of Study

The main intention of this study is to construct the extreme rainfall region map for Sg. Sarawak basin and Samarahan basin based on frequency analysis reduced variate curves which is the better plotting formula fit to Extreme Value Type I (EVI) distribution either plotting position formulae Gringorten and Weibull formula using Geographic Information System (GIS) application. Besides, it is also to identify the effects of rainfall distribution in Sg. Sarawak basin and Samarahan basin based on Monthly Mean Rainfall (MMR) data provided for the year with the highest DMR value in rainfall station.

1.3 Limitation of the Study

The selected of data for analysis in this study is based on the criteria engaged in Gumbel distribution. As a result, the data being utilized for this study is only limited into Sg. Sarawak basin and Samarahan basin. For the rainfall pattern based on Daily Mean Rainfall (DMR), the data is analyzed for the period of 10 to 20 years from 1986 until 2006 for Sg Sarawak Basin and 11 years from 1997 to 2007 for Samarahan basin. Rainfall frequency analysis method will be used the DMR data only and will be carry out based on a single historical sequence of hydrologic variables by graphical method where the scope is bounded to the application of Gumbel Distribution and plotting position formula for reduce variate curve based on Gringorten and Weibull formula.