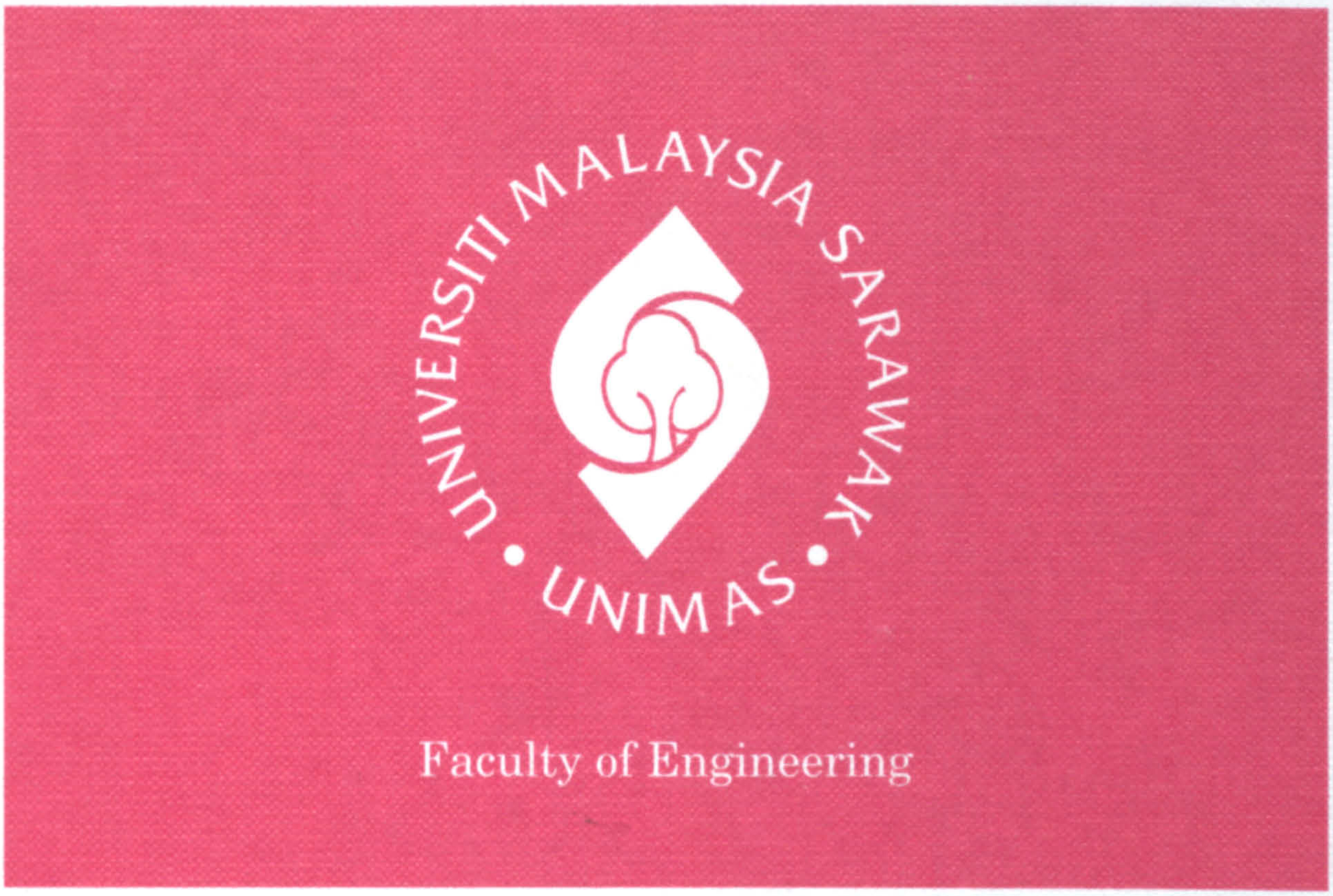

A STUDY OF STORM RAINFALL CHARACTERISTICS IN SAMARAHAN DISTRICT

Wahap B. Abu Bakar

Bachelor of Engineering with Honours
(Civil Engineering)
2005

BORANG PENYERAHAN TESIS

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SESI PENGAJIAN: 2004/2005

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This project report entitled "A Study of Storm Rainfall Characteristics in Samarahan District" was prepared by Mr. Wahap B. Abu Bakar as partial fulfillment of the requirement for the degree of Bachelor of Engineering with Honours (Civil Engineering) is hereby read and approved by:

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(Supervisor)

1/4/2005

Date

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that is has not been previously or concurrently submitted for any other degree at UNIMAS or other institutions.

Signed

Name: Wahap B. Abu Bakar

Date: 29.03.2005

A STUDY OF STORM RAINFALL CHARACTERISTICS IN SAMARAHAN DISTRICT

WAHAP BIN ABU BAKAR

This project is submitted in partial fulfillment of
the requirements for the degree of Bachelor of Engineering with Honours
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Faculty of Engineering
UNIVERSITY MALAYSIA SARAWAK
2005

For my beloved God, mother, grandma, sister and family

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ABSTRACT

Rainwater - dynamic force following all storms water studies and design. A considerate of rainfall processes and the consequence of the rainfall design data is an essential precondition for preparing adequate drainage, storm water management, and flood control projects. It can appear from various forms, with almost no raining to a circumstance more than 700 mm per day. When rainfall occurs at extraordinarily capacity or rates on small urban watersheds, it will bring disaster like flooding and severely damage crops. It happens because the drainage facilities were well designed to draw off all the water generated by high rainfall rates. Given that Samarahan district is a under development district in state government plan, so it should have a study of rainfall characteristics in order to design a storm drainage system for preventing of flood. Therefore there are a lot of automatic functioning rainfall stations installed and historical profile of storm event can be review. Therefore the aim of this project is to have a review of rainfall data in Samarahan district, and then have a study of the storms that had been occurred. Finally, have a discussion of imply the storm characteristics in Design Storm or Flood. The Historical Storm that determine will be suggested as the alternative for the use of rainfall station that are manually functioning without using IDF curve. The rainfall stations are automatically functioning and year of observation will be 20 years. There is at least one station from coastal area and one station from hilly area chosen for study. The information that collected is required to study the duration and profile of the storms. The duration and profile of the 24 hours daily maximum rainfall was established and some conclusion can be derived. The design storm that was developed using historical data was compared to the IDF approach. As expected, there are differences in the results, and it is recommended for further study.

ABSTRAK

Air hujan ialah daya dinamik yang merupakan asas kepada semua kajian dan rekaan hujan ribut. Semua keputusan dan proses penilaian data adalah pertimbangan utama dalam segala pembinaan kemudahan pengaliran yang sesuai, pengurusan air hujan ribut, dan projek kawalan banjir. Ia boleh muncul dari segala jenis, dari langsung tidak berhujan sehinggalah mempunyai purata bacaan hujan sebanyak 700mm. Apabila isipadu hujan terhadap sesuatu kawasan melebihi jangkaan, ia akan mendatangkan malapetaka seperti banjir kilat yang akan membawa kehilangan harta benda. Ini disebabkan oleh kemudahan pengaliran yang tidak berkesan untuk mengalirkan air hujan yang berlebihan ke sungai atau tempat lain. Bahagian Samarahan adalah di bawah projek pembangunan Sarawak, jadi ia mesti mempunyai satu kajian yang teliti terhadap ciri-ciri hujan ribut untuk ciptaan satu sistem pengaliran yang berkesan. Oleh itu, bilangan stesen berfungsi secara automatik telah didirikan dan data-data dapat dijadikan rujukan. Tujuan penghasilan projek ini adalah untuk menjalankan kajian tentang ciri-ciri hujan di kawasan bahagian Samarahan. Seterusnya dari kajian yang diperolehi, perbincangan terhadap implikasi ciri-ciri hujan ribut ke dalam rekaan "Design Storm" dijalankan. Dari penghasilan "Design Storm", ia akan dijadikan rujukan kepada stesen yang hanya berfungsi secara manual dengan tidak merujuk kepada nilai-nilai "IDF". Stesen-stesen yang dikaji adalah berfungsi secara automatik dan pemerhatian yang dijalankan adalah sepanjang 20 tahun. Sekurang-kurangnya satu stesen dari kawasan pinggir laut dan satu stesen dari kawasan pedalaman atau pergunungan dipilih untuk kajian. Segala maklumat yang diperhati akan digunakan untuk kajian jangka masa hujan ribut yang berlaku dengan isipadunya. Jangka masa dan isipadu untuk masa hujan 24 jam telah dikaji dan kesimpulan dapat dihasilkan. Pembentukan "Design Storm" dengan merujuk kepada data-data yang dikumpul akan menjadi perbandingan kepada penggunaan cara-cara IDF. Seperti yang dijangkakan, terdapat perbezaan di antara keputusan yang diperoleh, dan ia akan dicadangkan sebagai kajian lanjutan.

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NOTATION

IDF	-	Intensity-Duration-Frequency Curve
ARI	-	Average Reccurrence Interval
DID	-	Drainage and Irrigation Department
MMS	-	Malaysian Meteorological Service
Kpg	-	Kampung
mm	-	millimeter
mm/hr	-	millimeter per hour
PMP	-	Probable Maximum Percipitation
cm	-	centimeter
MIT	-	Minimum Inter-event Time
in	-	Inch
km	-	kilometer

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CHAPTER 1

INTRODUCTION

1.1 Objectives

It is very important to have a study for storm characteristics for the purpose to determine a Design Flood, especially for un-gauged river. In the un-gauged river, the flood frequency is derived from rainfall data. If there is no recorded data, then the annual maximum daily rainfall is used. In Samarahan district the rainfall data is collected from DID (Drainage and Irrigation Department) Sarawak. However, from the recorded data, no information is available about the average characteristics of the annual maximum rainfall, which is required for design flood estimates. Therefore, it is important to know the storm characteristics, such as area coverage, duration, and profile. The storm characteristics that become the objective of current study consist of:

a. To review the rainfall data collection in Samarahan District.
b. To study the storm characteristics (Duration, and Profile) from historical data.

c. To discuss the storm characteristics from historical data compare to the design storm.

The storm that will be studied will be limited to the annual maximum daily rainfall that recorded from 0800 to 0800 hour in Malaysia.

1.2 Background (General Overview) of Storm Rainfall

1.2.1 Rainfall Definition

Precipitation can take many forms, including rain, snow, sleet, hail, and mist. With respect to hydrologic design, only rain and snow are important.

Rainfall is the driving force behind all storm water studies and designs. An understanding of rainfall processes and the significance of the rainfall design data is a necessary pre-requisite for preparing satisfactory drainage, storm water management, and flood control projects.

1.2.2 Strom Characteristics and Design Storm

Rain storms come in many different forms. The amount of precipitation (number of inches or cm) can vary from nearly nothing to 700 mm or more in a day. The storm duration varies as well. A storm can deliver an inch of rain over an entire day. An intense thunder storm can deliver 30 mm in an hour. Runoff characteristics will change with the characteristics of the storm.

Storm events can be separated into two groups, actual storm and design storms. Rainfall analysis is based on actual storms. An actual storm event is a series of rainfall measurements made over time at rain gage.

Almost all hydrologic designs are based on what is called the design storm approach. A design storm is not an actual measured storm event; in fact, a real storm identical to the design storm has probably never occurred and it is unlikely that it will ever occur. A design storm is a rainfall hyetograph that has pre-selected characteristics.

However, most design storms have characteristics that are the average of the characteristics of storms that occurred in the past and therefore represent the average characteristics of storm events that are expected to occur in the future.

1.2.3 Storm Event

Return periods (or frequencies) can be assigned to rainfall events on the basis of several different parameters, but most commonly on the basis of total volume, average intensity, peak intensity, duration, or inter-event time. To work with any of these parameters, the rainfall time series must first be separated into a series of discrete, independent events. When this is done, they may be ranked by volume or any desired parameter and a conventional frequency analysis performed.

For ease of computation, a statistical measure is usually employed to separate independent storm events. A minimum inter-event time (MIT) is defined such that rainfall pulses separated by a time less than this value are considered part of the same event.

1.2.4 Effects of Storm Rainfall

Problems result when rainfall occurs at extreme volumes or rates. High rates of rain fall on small urban watersheds cause flooding of streets and parking lots because the drainage facilities were not designed to drain all the water generated by high rain fall rates. High rain fall rates can also severely damage crops.

It should be evident that problems can occur from extremes in rain fall, with the extremes in the rate, the duration, or the time interval between storms. Find an extreme storm will increase the surface runoff into the river that can bring a flood disaster.

1.3 Studies about Samarahan District

1.3.1 Climate and Physical Condition

Malaysia is influenced by the equatorial environment and is well outside volcanic, tornado, and severe drought belts. Malaysia is generally formed by highland, floodplain, and coastal zones In Sarawak and Sabah, most towns such as Kuching(include Samarahan District), Sibu, Miri, and Kota Kinabalu are situated on coastal alluvium. The majority of Sarawak and Sabah are formed mainly by limestone. Malaysia is warm and humid throughout the year, as characterised by the equatorial climate, and has an average annual rainfall of more than 2500 mm. The West Coast of the Peninsula is subject to localised and convective storms generated by the inter monsoon seasons/Sumatera wind system in the months of April/May and October/November. Storms mainly occur in the late afternoon and early evening. The South-West Monsoon (normally from May to September) produces less rain in the West Coast of the Peninsula whilst the North-East Monsoon, from November to March, carries longer and heavier rains to the East Coast of the Peninsula, North Sabah, and inland Sarawak. Samarahan district located in the State of Sarawak, so it has similar climate and physical condition that had mentioned above.

1.3.2 River Basin in Sarawak State and Samarahan District

For development purpose, the State of Sarawak had been divided into 21 major river basins. That is Kayan, Sungai Sarawak, Samarahan, Sadong, Lupar, Krian, Saribas, Oya, Mukah, Balingian, Tatau, Rajang, Kemena, Similajau, Suai, Niah, Baram, Limbang, Trusan, and Lawas. Meanwhile, Samarahan District had been divided into two basins, that is, Sadong Basin and Samarahan Basin. Their location is shown in (Figure 1)

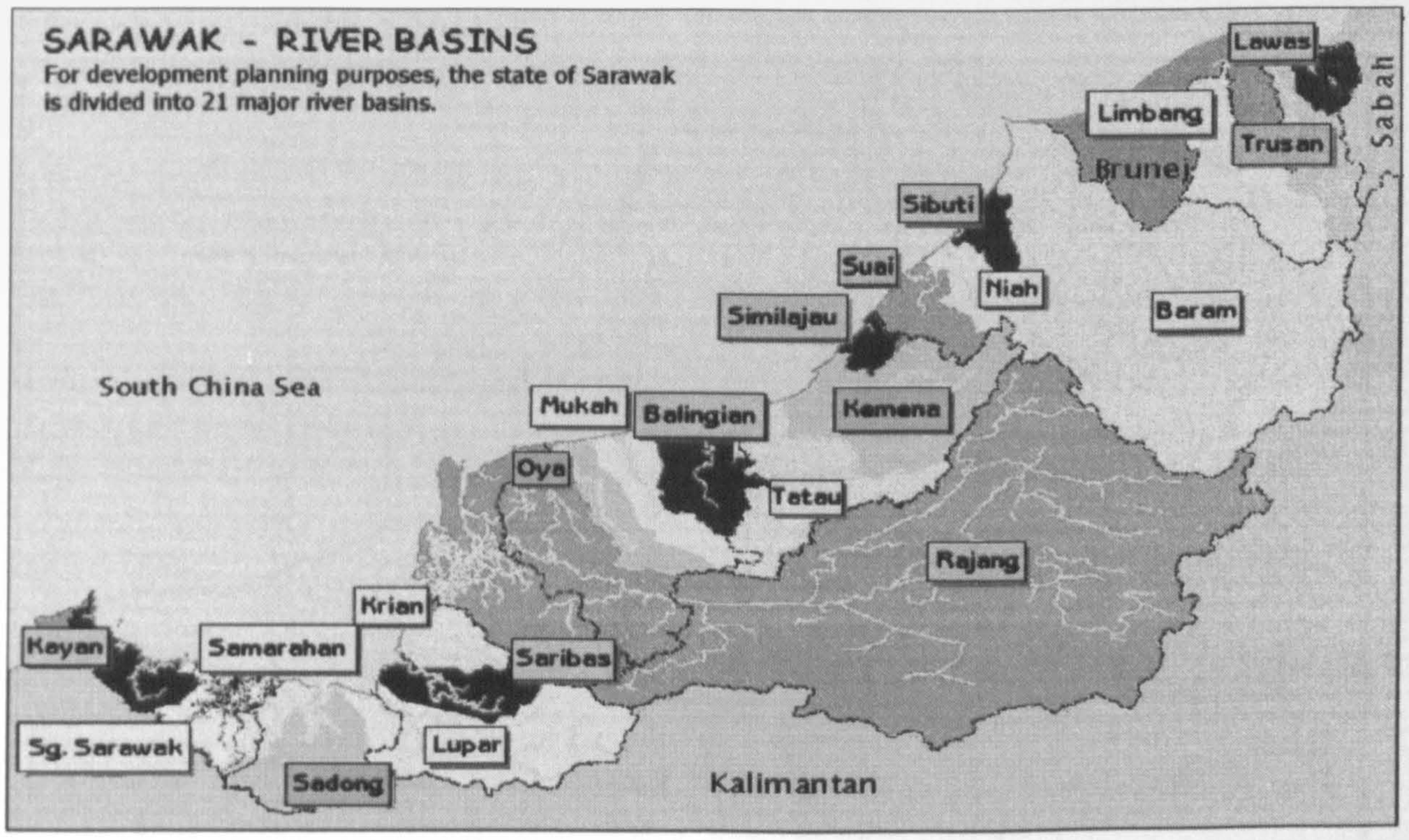

Figure 1 River Basins in the State of Sarawak

1.3.3 Rainfall Stations at Samarahan Basin

Samarahan basin has a total area of catchments of 1090 km^2. There is a main river located at Samarahan basin. Name of the river is Batang Samarahan River. Total length of Batang Samarahan is 115 km. There are 10 river stations that collecting rainfall data in Samarahan basin. The stations are Semilang, Semera, Asajaya, Ketup, Kota Samarahan, Paya Paloh, Semonggok, Samarahan Estate, Kpg Gayu, and Nyabet. Their location is shown in (Figure 2)

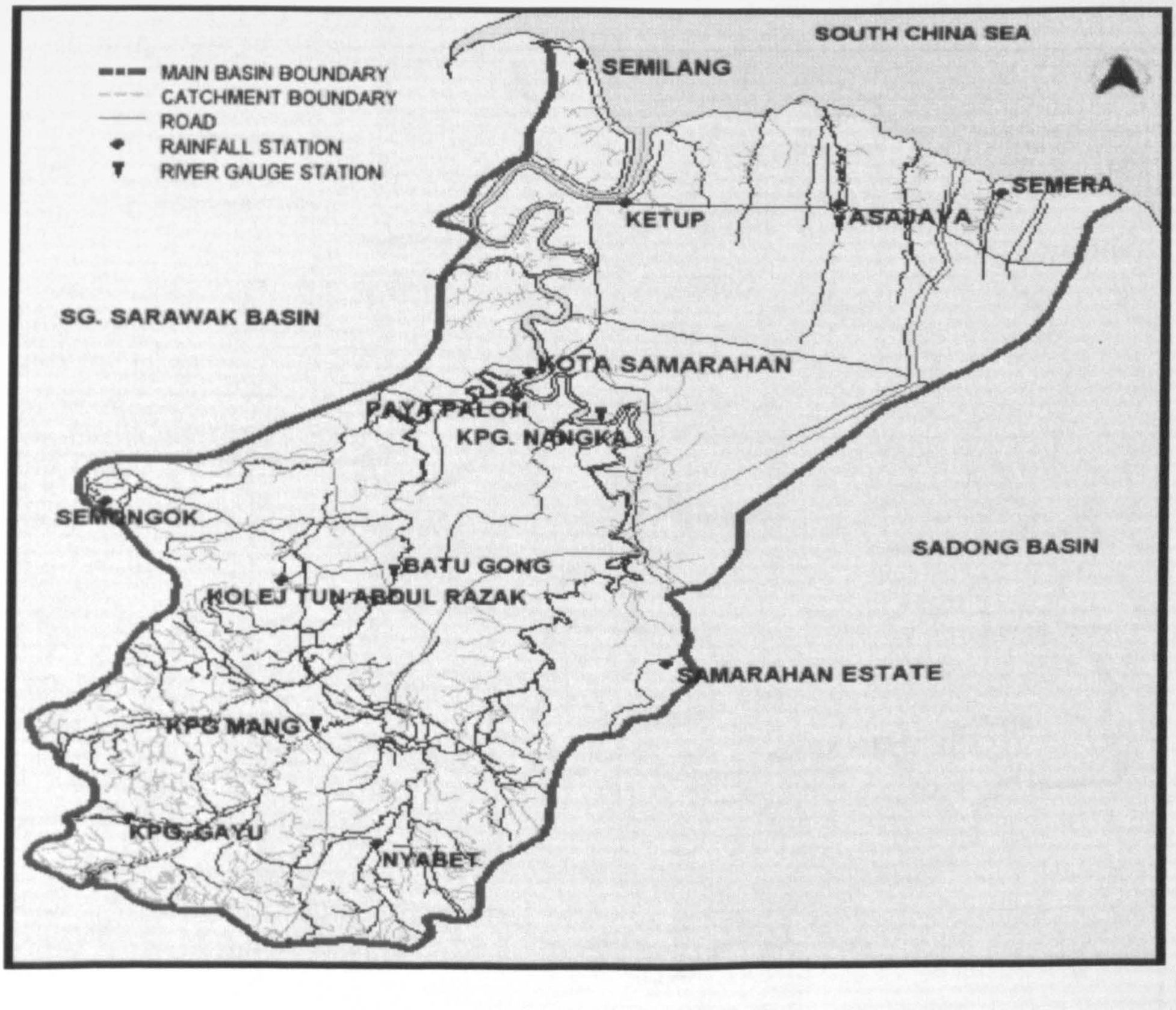

Figure 2 Rainfall Station of Samarahan Basin

1.3.4 Rainfall Station at Sadong Basin

Sadong basin has total area of catchments of 3550 km^2. There is a main river located in Sadong basin. The name of the river is Batang Sadong River. The total length for Batang Sadong is 150 km. There are total 19 rainfall stations collecting rainfall data at Sadong basin. The stations are Sadong Jaya, Simunjan, Lubok Ipoi, Gedong, Sangkalan Pasir, Pinang, Balai Ringin, Parat, Serian, Semuja Nonok, Kpg Merang, Busit, Sg Bedup, Teb, Matuh, Krusen, Tebakang, Tebedu, and Bunan Gega. Their location is shown in (Figure 7)

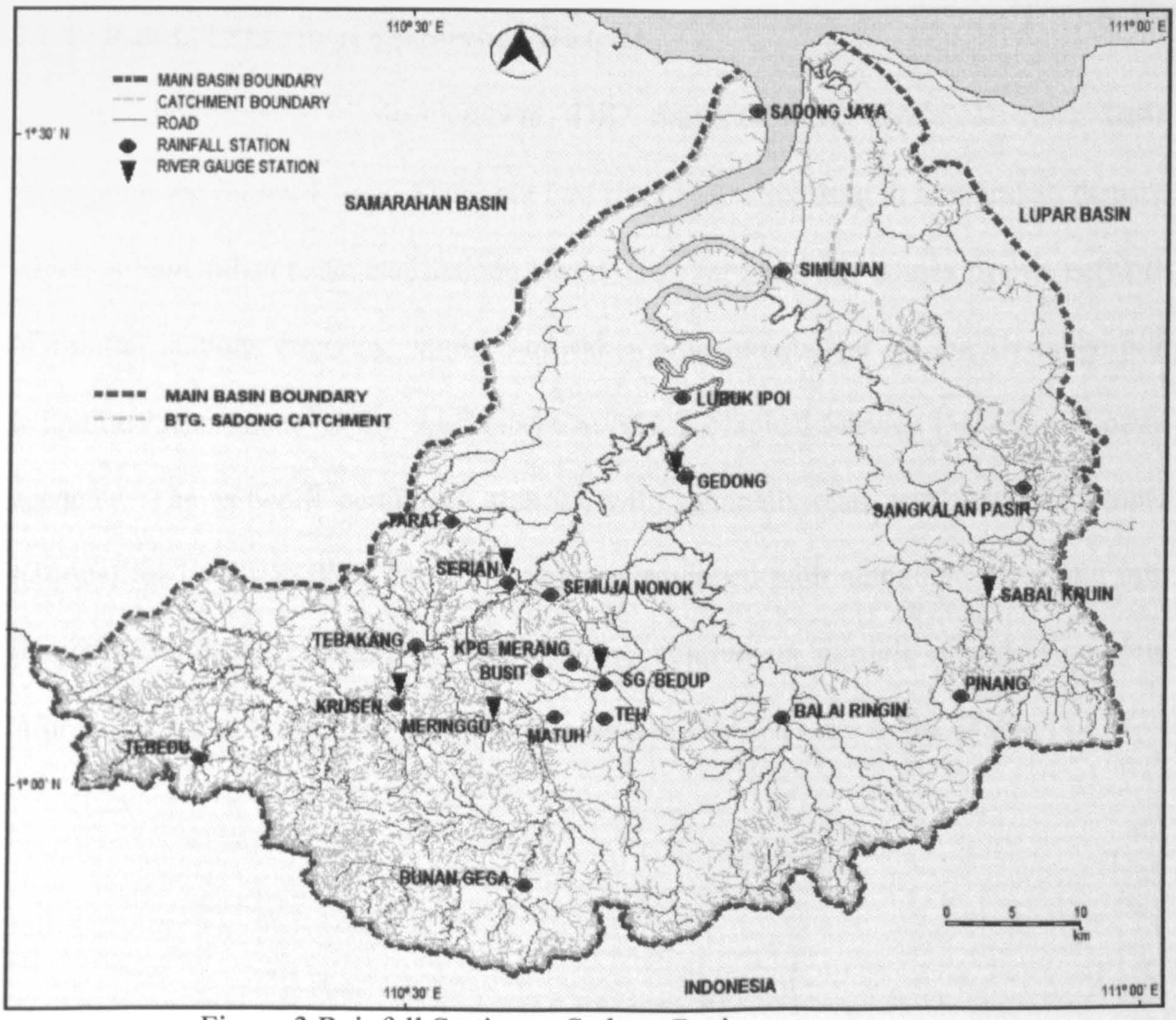

Figure 3 Rainfall Station at Sadong Basin