HYDROLOGY STUDY AND TREND OF RAINFALL EVENT AT UMP GAMBANG

MUHAMMAD AMIRUDIN BIN SHIKH ALI

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Faculty of Civil Engineering and Earth Resources

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ABSTRACT

This research describes experimental studies on the collected data in order to identify the different between rainfall data collect by using rain gauge and weather station. The collected data also can be used for research and planning our daily activities. The location weather station and rain gauge existed in Kolej Kediaman 2, Universiti Malaysia Pahang (UMP) Gambang. The data from Department of Irrigation And Drainage (JPS KUANTAN) is used to design rainfall temporal pattern for five years from 2008 to 2014 at four best nearest place hydrological station with station UMP Gambang. The rainfall data collected from a weather station UMP Gambang were used to identify the trend of rainfall event at UMP Gambang and make comparison with data rainfall and wind data collected using weather station. The relationship between relative humidity, temperature and wind speed towards the rainfall pattern was analyzed. Based from the analysis, from October to February total of rainfall will increase with maximum rainfall while start on March until April the total of rainfall start decreased. It shows the changes from wet season to driest season.

ABSTRAK

Penyelidikan ini menerangkan kajian eksperimen pada data yang dikumpul untuk mengenal pasti perbezaan di antara data hujan yang di kumpul dengan menggunakan tolok hujan dan stesen cuaca. Data yang dikumpul juga boleh digunakan untuk penyelidikan dan merancang aktiviti-aktiviti harian kita. Lokasi station cuaca dan tolok hujan berada di Kolej Kediaman 2, Universiti Malaysia Pahang (UMP) Gambang. Data daripada Jabatan Pengairan Dan Saliran (JPS KUANTAN) digunakan untuk merekabentuk corak temporal hujan selama lima tahun bermula 2008-2014 di empat tempat terbaik stesen hidrologi yang berhampiran dengan stesen UMP Gambang. Data hujan yang dikumpul dari stesen cuaca UMP Gambang digunakan untuk mengenal pasti trend hujan di UMP Gambang dan membuat perbandingan dengan data hujan yang dicerap oleh stesen cuaca. Hubungan antara kelembapan, suhu dan kelajuan angin terhadap corak hujan juga dianalisis. Berdasarkan analisis, dari Oktober hingga Februari jumlah hujan akan meningkat dengan hujan maksimum manakala bermula pada Mac hingga April jumlah hujan mula berkurangan. Ini menunjukkan perubahan dari musim hujan kepada musim kering.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Weather and climate are among the foremost factors which determine how a society develops in geographical region. Weather usually describes the particular event or condition for the short period of time such as hours or days whereas climate refers to the behavior of the atmosphere to a place over many years. On the other hand, weather includes current atmospheric conditions such as the temperature, precipitation, humidity and the wind while climate describes the general weather conditions of a certain area over a long period of time.

Weather data are important in our daily life. The data collected such as rainfall and temperature can be used to serve as a precautionary measure to against natural calamity or disaster such as flood and drought. Besides that, it is important for others to plan the works. For example, in the construction industry, the weather data is important for a project manager to plan their schedule so that the project will complete on time. The weather data collected for a long period are use to predict the climate change in future trends. The weather data collected for the past decade can be used to analysis in order to identify the pattern of climate change.

Weather station is one of the devices to collect the weather data. The weather data such as precipitation, humidity, temperature, and wind speed can be collected by using this device. The usage of weather station is increasing popularity among the nation.

Weather station is a device that can update the weather data in a more quickly and frequent way. It can collect the data in minute or hourly based on the setting mode. The user can change the setting mode according to the purpose of the project respectively. Weather station has now been increasingly accepted as the technology that facilities faster and more up to date monitoring of the earth atmosphere system. In particular, it is becoming increasingly important in the study of hydrology pattern.

1.2 PROBLEM STATEMENT

Human activity is influenced by weather conditions, monitoring of weather conditions can help in controlling the activity. The weather change is not same at the Gambang area and the nearest place. It is important to monitor and study the pattern of weather at surrounding. The pattern and trend of weather at Gambang and closed area can be identify by making analysis study of hydrological data from hydrological station.

1.3 RESEARCH OBJECTIVES

The objectives of this study are as following:

i. To compare the different between rainfall data collect by using rain guage and weather station in Kolej Kediaman 2 in UMP Gambang.
ii. To determine the trend of rainfall event at UMP Gambang.

1.4 SCOPES OF STUDY

i. The study will conduct at Kolej Kediaman 2 at UMP Gambang.
ii. This study will focus to collect the data such as wind speed, temperature and rainfall data.
iii. Analyze the hydrological data from JPS hydrological station with hydrological data collected used weather station at UMP Gambang.
iv. Develop temporal pattern for selected hydrology station.

1.5 SIGNIFICANT OF STUDY

This study can help many future construction company and future researchers for planning their schedule to complete their project on the time and avoid delay in construction process. All the result result collected in this study will be compile and a weather database for UMP can be recorded. The study also can identify the rainfall pattern of Gambang area.

CHAPTER 2

LITERATURE REVIEW

2.1 MALAYSIA CLIMATE

Malaysia is located at South East part of Asia where Peninsular Malaysia and East Malaysia is separated by the South China Sea. There are thirteen states and three federal territories in the country. Malaysia is observed to have a tropical climate, means the average temperature of the country are usually range from 21 °C to 32 °C and the humidity is range in between 70% to 90% (Tangang et al, 2012). The climate is affected by the northeast and southwest monsoons, tropical winds that alternative during the course of the year. The northeast monsoon blows from November to March and the southwest monsoon from May to September.

Climate change is expected to cause adverse health consequences. A direct impact could be dead due to heat stress or respiratory disease due to air pollution, while indirect effects could include increased food and water borne diseases, resulting from changes in rainfall pattern. There could be an increase in vector borne diseases such as, malaria and dengue fever as change in temperature will increase the available of suitable breeding habitats for the vector. In addition climate change will have adverse impacts on electricity production and consumption, and the oil and gas industries. Operational and maintenance costs of electricity producers will be substantially increased to provide the necessary protection for power plants located along the coasts due to increased coastal erosion. A rise in the air and water temperature will reduce plant efficiency and power output leading to higher production costs. There will also be an increase in the consumption of electricity if there is a rise in the air temperature, as it would result in an increased use of air conditioning (Gleick. P.H, 1989).

2.2 RAINFALL

In Malaysia, the rainfall is depends on two monsoon seasons which is southwest monsoon and northeast monsoon. Southwest monsoon seasons where originated from deserts of Australia usually started from May to August whereas the northeast monsoon seasons which originated from China and north Pacific commence between November and February. Besides, there are two transition period of inter-monsoon period which usually start from March to April and from September to October which brings heavy rainfall. The direction of the wind in this inter-monsoon season is variable and usually more than 10 knots (Ho & Yusof, 2012). Due to the seasonal rainfall in Malaysia, the probability for occurrence of rainfall amount is varying during the whole year (Suhaila & Jemain, 2009).

The seasonal variation of rainfall in Peninsular Malaysia is can divided into three main types. The first is over the east coast districts, November, December and January are the months with maximum rainfall, while June and July are the driest month in most districts. The second is over the rest of the Peninsular 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 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. The third is the rainfall pattern over the southwest coastal area is much affected by early morning from May to August with the result that the double maximum and minimum pattern is no longer discernible. October and November are month with maximum rainfall and February the month with minimum rainfall. The March-April-May maximum and June-July minimum are absent or indistinct.

The rainfall is an important consideration in design runoff conveyance and erosion control system. The rain gauge can be measure the amount of rainfall since it has a quite high level of accuracy in measuring the amount of rainfall (Pettazi & Salson, 2012).

2.3 HUMIDITY

The relative humidity is a measure of the amount of water vapor in the air compared to the maximum amount of water vapor air could hold at that temperature, and is given as a percentage value. Relative humidity depends on the temperature of the air, as warm air can hold more moisture than cold air. A relative humidity of 100 % indicates that the air is holding all the water it can at the current temperature and any additional moisture at that point will result in condensation. A relative humidity of 50% means the air is holding half the amount of moisture that it could. As the temperature decreases, the amount of moisture in the air does not change, but the relative humidity goes up (Davis Instruments Corp, 2004).

There are many technologies for humidity measurement instruments. Capacitive or dielectric instruments have a material that absorbs moisture, which change its dielectric properties and enhances its capacitance. Chilled mirror technology uses a mirror that is chilled to the point that moisture starts to condense on it. This temperature is the dew point. With electrolytic technology, moisture is proportional to the current needed to electrolyze it from a desiccant. For resistivity or impedance style sensors, a material absorbs moisture, which changes its changes its resistivity or impedance. In strain gage instruments, a material absorbs water, expands and is measured with a strain gage (Davis Instruments Corp, 2004).

2.4 WEATHER STATION

Weather study is a part of remote science. It will be able to study the weather condition of faraway places without ever having to go there. A weather station is a facility with instruments and equipment to make weather observations by monitoring atmospheric condition to study the weather. It will help people to measure wind, air pressure, rainfall, humidity and temperature. Before use the instruments, explanation and demonstration will be to visualize how each instrument is used to measure weather. From there, everyone will know and use it by ourselves in the future. From the instruments use, all the data will gather and will be comparing with the weather data of the station which is at Kuantan. All the weather data collected from the previous one week period will use and analyze it using graph, chart, and averages to look for pattern and trends. Computational skills will be use to interpret data. From the graph or chart, weather can be describe and relate how weather affects the daily lives.

2.5 IMPACT OF CLIMATE CHANGE

The weather change includes the change of weather parameter such as change of temperature, change of wind speed and change of relative humidity. The change of the weather parameters may affect the amount of rainfall during the specific time. The climate change is issues that arise during 21st century with comprise a lots of environment problems (IPCC,2007). The impact of climate change affects several sectors in Malaysia mainly agriculture, forestry, public health, energy sector and water and also coastal resources. Agriculture is one of the sectors greatly affected by extreme climate change. Physical damage, lost of crop harvest, drop in productivity, vigor and other related to crop potentials are examples of direct and indirect effect of the extreme climate change. There are numerous impact for the climate change due to natural course and anthropogenic activities. The amount and the times for extreme event to happen are increase in future (Sunyer et al, 2012). In addition, the increase in temperature and rainfall will affect the water resources (Wang et al., 2013). Since the availability of water resources are mostly depends on climatic condition, it is important to reduce the adverse effect from climate variable towards the water resources. The agricultural activities and forestry are depend on the water resources. Due to the effect of climate change, the availability for water resources will be scarcity and effect the ecosystem for industrial and also aquatic life. As the consequence of climate change, the water quality

for surface and groundwater will be affected. The water supply for drinking purpose may be contaminates and increases the risk of having diseases.

Besides, there are negative effects on the agriculture production. Due to heavy precipitation which increases the moisture, the production of crops will decrease because of excessive soil moisture content. In contrast, the area which suffers from drought will increase too (Bates et al 2008).

2.6 WIND SPEED

Wind speed is measured in meter per second or knots. Calm is reported when the wind is less than 0.5 meter per second or less than one knot. Instruments used for measuring the surface wind speed are called anemometers, the most common of which is the cup mounted symmetrically at right angle to vertical shaft. The difference in wind pressure from one side of the cup to the other causes the cups to spin about the shaft. The rate at which they rotate is directly proportional to the speed of wind. The highest mean daily wind speed recorded is 3.8 m/s and highest maximum wind speed recorded is 41.7 m/s (Malaysian Meteorological Department 2014).

Wind direction is the direction from which the wind is blowing. It is expressed in degrees measured clockwise from geographical north. Wind vanes do not respond to changes in wind direction when the wind speed is less than one meter per second or two knots.

2.7 TEMPORAL PATTERN RAINFALL

The temporal distribution of rainfall within the design storm is important factor that effects the runoff volume, and magnitude and timing of the peak discharge. Design rainfall temporal pattern are used to represent the typical storm burst. Standardization of temporal pattern allows standard design procedures to be adopted in flow calculation. It is important to emphasize that these temporal patterns are intended for use in design storm. Temporal pattern should be choose so that the resulting runoff hydrographs are consistent with observed hydrographs. Therefore the form of the temporal pattern and the method of runoff computation are closely interlinked. A range of method to distribute rainfall is Average Temporal Pattern develop from local point-rainfall data measured in short time interval, simple idealized rainfall distribution fitted to local storm data by the method of moments and temporal pattern from local IDF relationships.

CHAPTER 3

STUDY AREA

3.1 INTRODUCTION

Pahang is the largest state in Peninsular Malaysia and Kuantan is its capital city, located along the East Coast with land area of 35960 square kilometer. It is about two thirds of land area in Pahang is covered in dense tropical rainforest, making it a repository for Malaysia natural treasures. Almost all of the highland retreats, some beautiful island and beaches are found in the Pahang. Pahang tropical monsoon climate brings with it a uniform temperature range 21 °C to 32 °C whereas the relative humidity varies from 62% (mild humidity) to 92% (very humidity). On the average, the driest month for is on February whereas on December is the wettest month. Average precipitation per year 2014 is between 274.3mm to 674.7mm.(Website MMD 2013, Average rainfall for 2013).

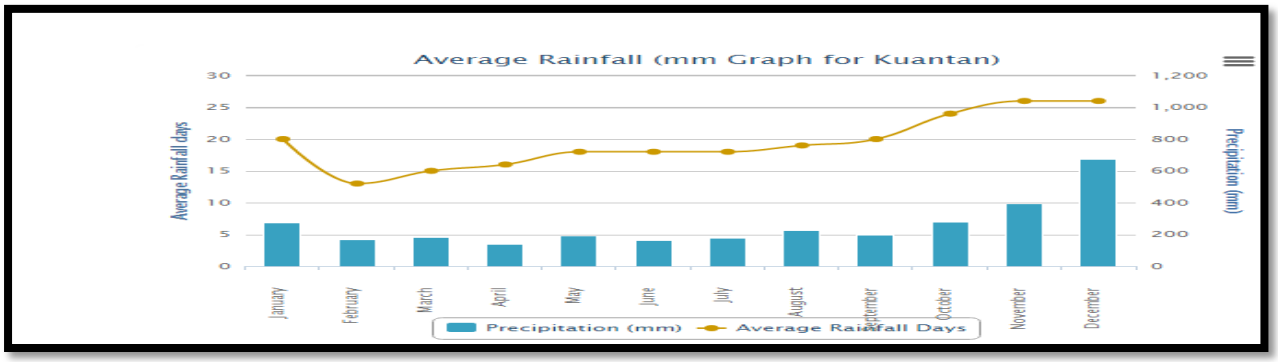

Figure 3.1: The graph show the highest precipitation for 2013 at December 674.7mm and the highest Average Rainfall for 2013 at December 26mm

Figure 3.2 : Map Of Peninsular Malaysia

Figure 3.2 shows the Pahang state in the map of Peninsular Malaysia. There is eleven districts in Pahang which is Lipis, Jerantut, Raub, Bentong, Bera, Rompin, Pekan, Maran, Temerloh, Cameron Highland, and Kuantan. Kuantan is a small but lively city off the East Coast of Malaysia, which also the capital of the state of Pahang. Over the years, rapid modernisation and development has turned Kuantan into a fast growing city from what was originally a quaint, quiet town.

Gambang is the study area which is in "mukim" Kuala Kuantan. There is 6 "mukim" in Kuantan district which is Sungai Karang, Penor, Hulu Kuantan, Hulu Lepar, Beserah, and Kuala Kuantan. For more detail, the study area is Gambang and people knows it because it nearly the exit of the East Cost Expressway. East Coast Expressway is main expressway in Malaysia. It is an extension of Karak Expressway, which start from Karak to Kuala Lumpur. It provides a link from the West Coast of Peninsular Malaysia to the East Coast of Peninsular Malaysia.

3.2 LOCATION OF METEOLOGICAL STATION AT PAHANG

In Pahang, There are five weather station owners by Drainage and irrigation Department (JPS) Kuantan which is in Batu Embun, Muadzam Shah, Temerloh, Cameron Highlands and Kuantan. The meteorological stations collect the data such as humidity, rainfall, temperature and wind speed which is needed in this study. Among these five station, for the study area in Gambang, the comparison will make the two stations which is nearest station. The latitude and longitude of station is listed below. The distance between Kuantan station and weather station in UMP Gambang is around 18.5km.

Figure 3.1: Hydrological Station at Pahang

Station name	Latitude	Longitude
Batu Embun	3°58′ N	102°21′ E
Cameron Highlands	4°28′ N	102°21′ E
Kuantan	3°46′ N	102°21′ E
Muadzam Shah	3°03′ N	102°21′ E
Temerloh	3°28′ N	102°21′ E

Figure 3.2: List of Hydrological Station at Kuantan

No station	**Station Name**	**Latitude**	**Longitude**
3731018	JKR Gambang	03 42 20	103 07 00
3732020	Paya Besar Kuantan	03 46 20	103 16 50
3732021	Kg Sg Soi	03 43 50	103 18 00
3833002	Pejabat JPS Pahang	03 48 30	103 19 45
3930012	Sg Lembing P.C.C.L Mill	03 55 00	103 02 10
3933003	Balok	03 56 40	103 23 00

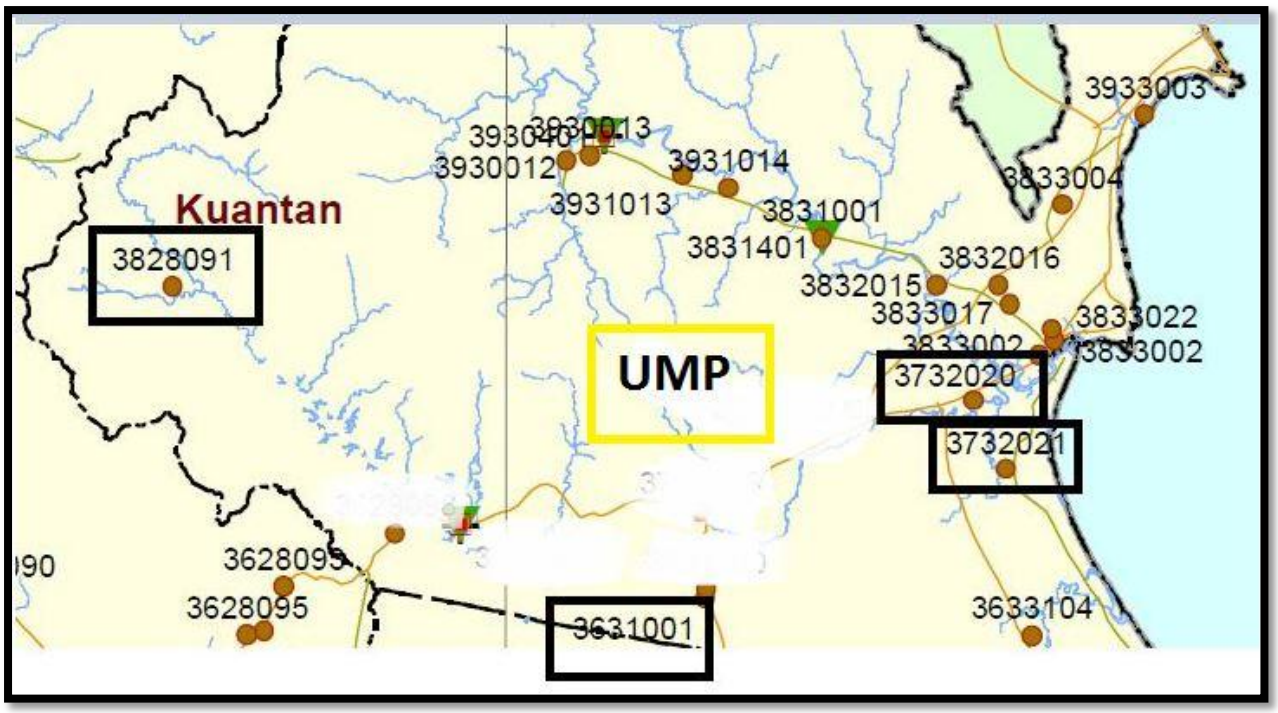

Figure 3.3 : Location of selected Hydrological Station

3.3 LOCATION OF WEATHER STATION AT UMP GAMBANG

The weather station was set up at the field at Kolej Kediaman 2 (KK2) in Universiti Malaysia Pahang (UMP) campus Gambang. The location both tool are same place on next position.

Figure 3.4: Location of weather station at UMP Gambang

The field at Kolej Kediaman 2, Universiti Malaysia Pahang (UMP) is chosen due to the stability and compromise to fulfill the ideal criteria to set up a weather station. The ideal location of the site should be free from obstacle, building and steep slopes which will be effect the data collection of the weather station. This weather station and rain guage were installed at field at Kolej Kediaman 2 in Universiti Malaysia Pahang, campus Gambang at 2014. The located between weather station and rainfall at one meter.

CHAPTER 4

METHODOLOGY

4.1 INTRODUCTION

In this chapter, it is all concern about the gathering of data for achieve the objective research. There are several methods for data collection to achieve the established objectives. The knowledge from literature review which reviews the article, handbook, conference paper, books, and website is interconnecting to this chapter. The information from the previous chapter serves as a guideline to run the study. There are three parts for the data collection, which is the data collection from the weather station that set up in Universiti Malaysia Pahang (UMP) campus Gambang whereas the other one is data from rainfall station from the Department of Irrigation (DID). Besides that, the data such as rainfall, wind speed, temperature and humidity from Malaysian Meteorological Station (MMD) is collected. The data will be analysis and the result will be compare based on the data obtained.

4.2 METHODOLOGY FLOW CHART

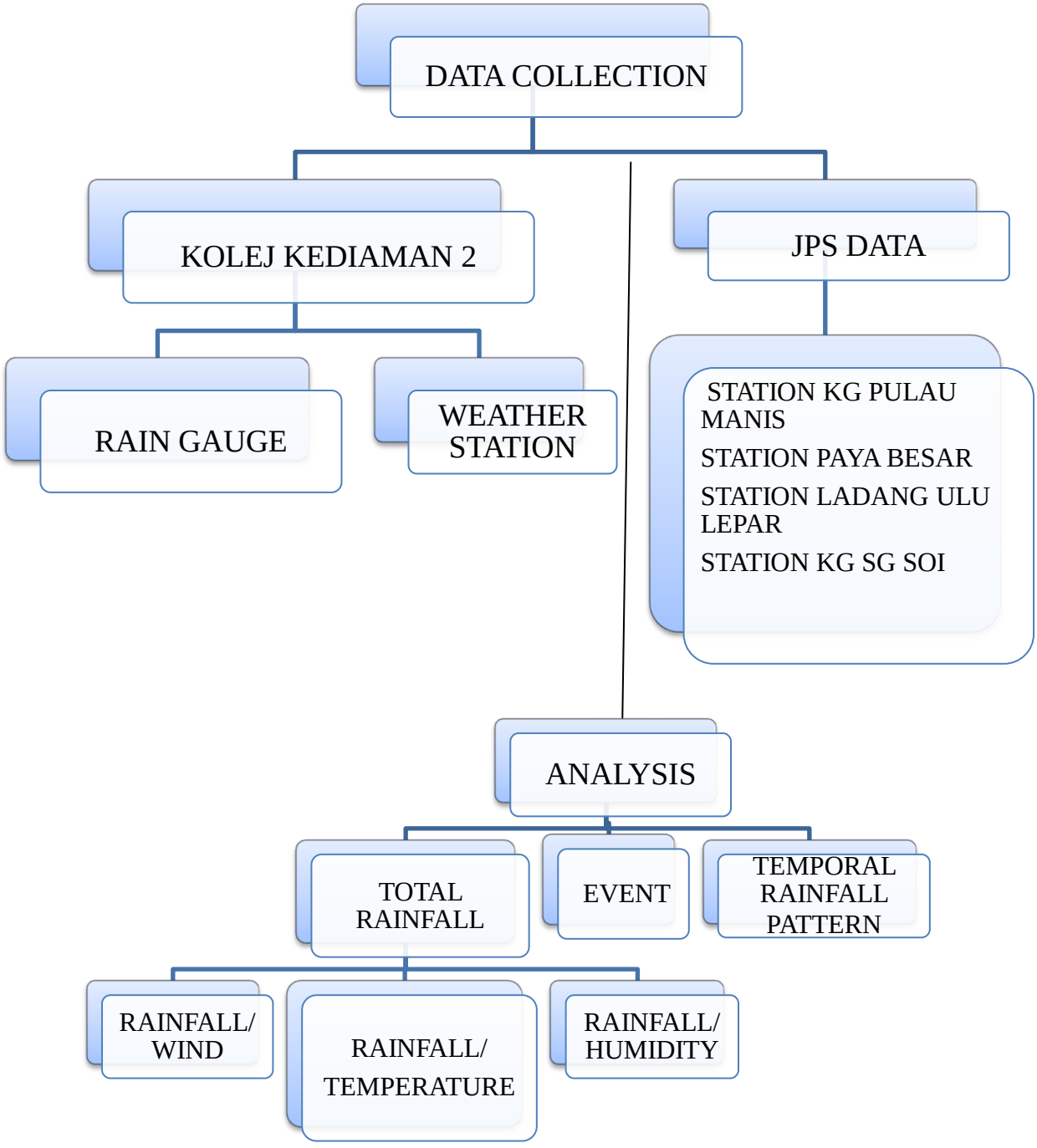

Figure 4.1 : Flow chart of methodology

4.3 DATA COLLECTION

The data collection in two part process that is data collection from weather station and Rain Guage at field Kolej Kediaman 2 Universiti Malaysia Pahang (UMP) campus Gambang and one was the data collection from hydrological station in Kuantan under Department of Irrigation and Drainage (DID). The data was collected from DID is daily rainfall data for 5 years at station Kampung Pulau Manis, Station Paya Besar Kuantan, Station Ladang Ulu Lepar and Station Kampung Sungai Soi.

	A	B	C
1	Site Name	Rainfall KK2	
2	Isco Quantity	Rainfall	
3	Label	Rainfall	
4	Units	mm	
5	Resolution	0.1	
6	Significant Digits	7	
7			
8	1/1/2015 0:00	0	
9	1/1/2015 0:05	0	
10	1/1/2015 0:10	0	
11	1/1/2015 0:15	0	
12	1/1/2015 0:20	0	
13	1/1/2015 0:25	0	
14	1/1/2015 0:30	0	
15	1/1/2015 0:35	0	
16	1/1/2015 0:40	0	

Figure 4.2 : Raw data from rain gauge.