[SV 13] PRIORITIZING CRITICAL FACTORS OF FLOODS IN KEDAH USING PAIRWISE COMPARISON APPROACH

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ABSTRACT

In recent years, flood is one of the most frequent natural disasters impacting Kedah, a northern state in Malaysia famously known as the rice bowl of the nation. Kedah is the largest local supplier of rice production in Malaysia. It is also famous for its tourism industry. However, some parts of the state, if not all, had been affected by floods every year albeit various mitigation efforts by the authorities. Finding causes, both main and peripherals, is therefore essential to find better solution. Hence, this study aims to determine main causes of floods in Kedah. In doing so, the Analytical Hierarchy Process (AHP) method is employed in which pairwise questionnaire is developed and distributed to selected respondents. Findings show that human factors are perceived to be more critical than natural causes. Overall, respondents had also identified poor drainage system as the most critical causes of floods in Kedah followed by blocking of water channels and improper land use. Findings from this study can potentially be used by relevant authorities such as the irrigation department as well as local councils to minimize probability of floods from happening. In all, the study can be improved further by increasing the number of expert respondents from various parties in Kedah.

Keywords: *Kedah, disaster, floods, causes, Analytical Hierarchy Process (AHP)*

INTRODUCTION

Overview of floods in Malaysia

Malaysia located in a stable geographical region which is free from earthquakes, volcanic action, and strong winds such as tropical typhoon which sporadically influence some of neighbour's countries. Malaysia located outside from the "Pacific Ring of Fire". Malaysia is not thoroughly 'free" from natural calamity since Malaysia additionally regularly hit by floods, landslides, haze, tsunamis and human-made disasters (Parker et al, 1997). Flood disasters in Malaysia have become a common incidence due to global warming and climate change. Flood is always happen in Malaysia after heavy rainfall. The amount spent on assisting the flood victims have also increase more than RM45 million (Department of Irrigation and Drainage, 2012).

Overview floods in Kedah

Kedah is the one of the state in Malaysia, which always hit by floods beside Kelantan and Pahang. There also are among the state that is affected by floods almost every year. Many of victim property loss include houses, clothes, important stuff and paddy fields which are the main agriculture activity in the Kedah also destroy (Katuk et al, 2009). From the reports, Kedah has shown the one of the highest amount in annual average

damage in 2012 after Johor and Kelantan. Padang Terap is the most affected area in Kedah during flood disaster since year 2000 until 2010. Padang Terap district covered around 135,684.41 hectares and the population are 72,318 consists of Malay and Malay-Thai (Jabatan parit & Saliran Negeri Kedah, 2010). Kedah, Perlis, Penang and Selangor were frequently experienced the storms in the west coast states. On 26 December in 2004, tidal wave or tsunami activated by the most powerful earthquake hit in the North West conditions of Pulau Pinang and Kedah. The tsunami brought about 68 deaths, 6 missing and 73 individuals were in-patient and 694 were out-patient and make the total is 841 (Asian Disaster Reduction Center, 2005).

In 2010, the floods happen was affected all the land transportation in and around Kedah and Perlis, government closing down rail and roads including the North-South Expressway and Alor Setar's Sultan Abdul Halim Airport, helicopters as the only mode of aerial transport into Kedah and Perlis on that time. On that time, hard to get clean water, and government ask help from the other state to receive water supplies from the neighbouring state of Perak. There are at least four people were reported killed and almost 50,000 have been dislocated as flood waters hit northern Malaysia according to state media. This flood also spread to UUM areas. Due to happening flash floor, UUM was shifted examination period and last day of the 2010 Convocation had been postponed (Sharif et al, 2012).

This study is to aim the causes and critical causes of floods in Kedah by using pairwise comparison approach. This remaining part of this article is organized as follows: literature review in section 2 follow by problem statement in section 3. In section 4 and 5 will be methodology and determination of main and sub-criteria. After that finding in section 6 follow by section 7 discussion and implementation. And the lastly is conclusion is section 8.

LITERATURE REVIEW

Definition of flood

According to the article in title " Flood Management" by the Department of Irrigation and Drainage (DID), the flood define as body of rising, water, swelling and overflowing land not usually closed thus and also, overflowing of the bank of a stream, drainage system of water onto near land area as result of storm, tidal action, ice melt and channel obstruction (Department of Irrigation and Drainage, 2012). Meanwhile, Ching et al in 2013 define flood as the high of water flow that control the natural or artificial banks in any part of the river system. At the point when a river bank is exceed the high level of water, the water extends over the flood plain and become hazard to the society.

Type of floods

Type of flood in Malaysia can be divide into two; flash flood and monsoon flood. According to Musa Hasni, 2014 flash monsoon is happen because of heavy rainfall. This flood happens so quickly around few minutes to half an hour. It's happen immediately and unexpected. Flash flood also happen because the density of population and paved roads. The water there has no place to drain because the rivers were in landfills and replace with smaller drains. Meanwhile, monsoon flood comes in season. Monsoon flood divide into two; southwest and northeast monsoon. Southwest monsoon

happen late of May to September and Northeast monsoon also occurs in November to March.

Causes of flood

A huge number of individual in Malaysia have been evacuated in two northern states, Perlis and Kedah. These two states are experience flood with heavy rainfall so the possible reasons for reduction in metals concentration are natural precipitation and aeration. Other possible reasons of flood happen of reduction in metal concentration are palm oil plantation, arrangement of wetlands and the dilution factor of water as it flow downstream (Almayahi et al, 2012).

In Malaysia, floods are created by the natural and human fact. Malaysians are historically a riverine people, which the people stay near the river as early settlements developed on the banks of the major rivers in the peninsula. The causes of natural factors such as extreme convection rain storms, heavy monsoon rainfall and others local factors. Floods turned into a common feature in the lives of a significant number of individuals or group of family in Malaysia. Monsoon rains have a profound impact on many aspects of lives of the population in the east coast of Peninsular Malaysia (Monteiro, 1962). While the rains are required for agriculture and rice cultivation, they are also generally responsible for bringing floods. In this manner, rains and floods can be as hazards and at the same time as resources (Parker, 1991).

Climatology factor such as temperature, evaporation, rainfall distribution, wind movements and the natural terrain it's the causes of flood happen (Balek, 1983). In 2010, research by Kong et al, it has state 6 causes of flood happen; it's because of pollution, improper drainage system, management of urbanization, weather, environment factor and dam break.

Effect of flood

The flood disasters that have affected Malaysians are because of flash floods, monsoon storms and tropical storms. Floods normally happen in the rainy season on the East Coast of Peninsular because of the changes in the monsoon seasons (Chan, 1996; Jamalluddin & Sham, 1987; Rose & Peter, 2001), where there is a continuous and increased amount of rainfall, causing the river waters to overflow.

In Sungai Muda problems associated with the catastrophic floods including riverbank erosion, river pollution and a reduction of water resources. Beside, the declining water level is the one of the cause's trouble in drawing water from the river at the current intake points. Flood also will affect the economic activities which involve cost in term of flood planning, mitigation and response for society and the country (Adnan et al, 2014).

Floods impact human as well as surrounding environment areas either positively or negatively, such as floodplain, settlement, road, coastal plain as well as flora and fauna inhibited in floods affected area. A study by Vinet (2008) stated that, flooding will give many impact include damage victim's home, shops and industries. The author also state, flood victims have problem with the cost of repair their stuff and some small shops do not reopen after the disaster because not enough money as the capital. The research by Kong et al., (2010) more than 30% of people during their research admit

that water harm to house, stuff, structures and appliances are some of the causes of flooding.

Flood in Malaysia has given a bad effect to some part of the country's economy, especially in agricultural sector. Palm oil and rubber prices have escalated where the flood has disrupted supplies from Malaysia to other countries. The rubber output in Thailand and Malaysia has been said to be dropping at least 30 per cent and the prices are predicted to rise up as well. As floodwaters in Malaysia are not subsiding, the production of palm oil has been declining majorly (The Economic Times, 2014).

PROBLEM STATEMENT

Natural disaster is commonly known to be disasters caused by the nature. These natural disasters consist of volcano eruptions, earthquakes, tsunami, avalanches, lahars (volcanic mudslides), landslides, blizzards, heat waves, hurricanes, typhoons, tornadoes, floods and others. No matter what types of natural disasters it may be, it usually leads to financial, environmental and human loses. It is indeed a great danger for the earth if these sort of natural disasters tend to continue (United States Department of Health and Human Services, 2009). Flood make many affect to the individual, society and government. People cannot do their daily activity, all the activity will be stop because of this problem and many places will close because it becomes danger area. On that time, not all mobile affected. This will make difficult for family members to know the condition of their family members were trapped in the flood.

In addition, many stuff and structure destroy when the water increase to the uncontrolled level. This also has been state by Chan (1997) that floods occur annually in Malaysia causing damage to properties, houses, crops, livestock, property, public infrastructure and loss of life. In a major flood, people's coping mechanisms are totally ineffective and they rely on government relief for recovery. This is serious problems that we should determine the causes of this happen. If not, we will adapt this entire problem every year, and government will spend amount of money to rebuild the infrastructure. Floods happen annually in Malaysia and make many bad effects to many people. The costs prepared by the government in floods disaster preparedness, rescue and relief operation. Government spend a lot of ringgit to help the society. This study chooses Kedah as the scope of this research because Kedah is the one of the tourism attraction in Malaysia. In addition, Kedah also is the one of the biggest supplier and production of rice. Kedah also be known as a "Jelapang Padi" or "Rice Bowl". So in this study will attempt to answer the question: what are the causes and the critical causes of flood happen in Kedah?

METHODOLOGY

This study is overview all the places in Kedah. The respondent of this study is 4 lecturers of School of Technology Management and Logistic, University Utara Malaysia, which has knowledge in irrigation and drainage system. As the respondent of this study, they will fill the pairwise questionnaire that has been creating based on this study objective. This total respondent maybe or may not be accurate to represent all the people around Kedah due to lack of time and cost.

This study also used primary and secondary data. Primary data is the new information or data specifically collected directly from the respondent in this study. The primary data get by using Analytic Hierarchy Process (AHP) pairwise of questionnaire. A questionnaire design in to two stages. First stage is main criteria and the second stage sub criteria. The respondent need to circle the scale based on their experience and judgment. The measurement use Saaty's measurement 1-9 scale of the level of importance refers Table 1 for more detail. And the data analyzed by using the Expert Choice software. Meanwhile, the secondary data is data that already exist and which can be uses as a reference material to gain the knowledge and information. This study uses more journal and article from the previous researcher and also from the website.

Analytic Hierarchy Process (AHP)

This study use mathematical method, The Analytic Hierarchy Process (AHP) was introduced by Saaty, T.L. in 1980. This method deriving ratio scale from paired comparisons and it's also allows some small inconsistency in judgment. In this AHP process, there have several steps. In this study, firstly define the goals of this study; it's to identify the critical causes of flood happen. Step two, structure in group of criteria, sub-criteria and alternative (figure 2). Then, make a pair-wise comparison of elements in each group with respect to this study's objective. Forth, calculate weighting and consistency ratio, the result will be in percentage. Lastly, evaluate alternatives according weighting and will get the ranking. This step actually based on the three key step which are decomposition, comparative judgment and lastly is synthesis of priorities (Korpela and Tuominen). So in this study, will determine which factor will be the main causes or reason of flooding in Kedah and AHP uses to make the ranking according to prioritizing. This method is very effective and useful method to make decision making, thus can reduce the unbalance in the decision making process.

DETERMINATION OF MAIN AND SUB-CRITERIA

There are three levels in AHP, which is goals in the first level, the second level is main criteria and third level is the sub-criteria for the main criteria. The figure 1 shows the goals, main criteria and sub-criteria for the critical causes of floods happen in Kedah.

From the Figure 1 below, the goals of this study are critical causes of flood. The main criteria are natural and human factor. Hence the sub-criteria for causes of flood is heavy rainfall, high tides, sea overflow, land slide, storm, blocking of channels, improper land use, deforestation, poor drainage system and construction of building. All of the criteria and sub-criteria are the causes of flood happen but we want to identify the critical causes criteria and sub-criteria. In this study, we want to identify the critical causes of flood happen in Kedah.

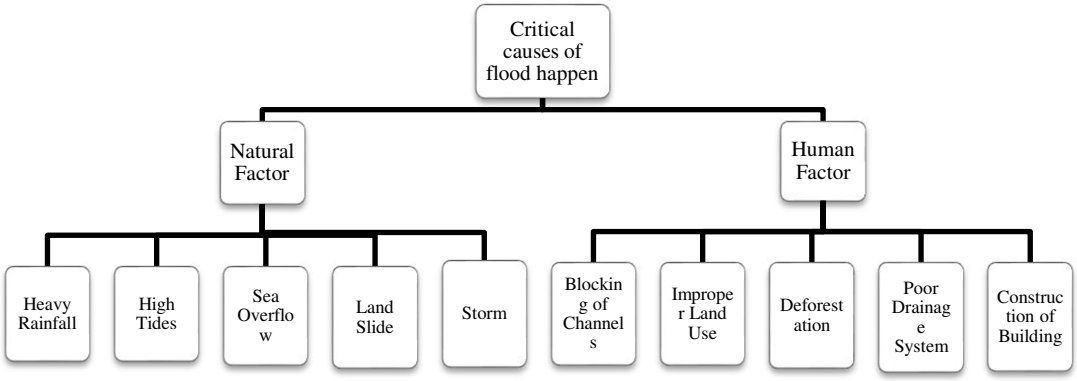

Figure 1
The goals, main criteria and sub-criteria

The pair-wise comparison is the process to compare the criteria and sub-criteria by using the Saaty's 1-9 scale. The respondent start compare each of them with focus on the goal by assign the most critical causes. In Table 1 defines the measurement scale of each level that is used in this study and adopted from Saaty (2000).

Table 1
Measurement scales the level of important (Saaty, 2000)

Level of importance	Denotation	Definition
1	Equally preferred	Both factors in consideration are equal importance
3	Moderately more preferred	Experience and judgement shows a slightly more preferences of one factor than the other
5	Strongly more preferred	Experience and judgement strongly favour one factor over another
7	Very strongly more preferred	An activity is favoured very strongly over another, its dominance demonstrated in practice
9	Extremely more preferred	The evidence favouring one activity over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values	When compromise is needed. Judgement can reveal an evenly matched preference between the levels of importance

Meanwhile, in Table 2 define all the criteria and sub-criteria.

Table 2
Definition of criteria and sub-criteria

No.	Criteria	Definition
1	Natural Factor	Existing in or caused by nature. Not made or caused by humankind. "Act of God". Short, high intensity leads to flash flood, heavy widespread rain leads to land inundation.
2	Human Factor	It's happen because of human activity or human-made. Disposal of solid wastes into rivers, sediments from land clearance and construction areas, increase in impervious areas and Obstruction and constriction in the rivers.
3	Heavy rainfall	Precipitation falling with intensity in excess of 0.30 inches (0.76) per hour.
4	High tides	The tide at its fullest, when the water reaches its highest level because water comes nonstop. It's also call as high water.
5	Sea overflow	Its happen, when a sea exceed the water level. And it will spill out to the near area.
6	Land slide	A large mass of rocks and earth that suddenly and quickly moves down the side of a mountain or hill.
7	Storm	An occurrence of bad weather in which there is a lot of rain and often strong winds.
8	Blocking of channels	Channels have been formed for the river to protect the fertile, low-lying lands from inundation and it does also provide for discharge of rainfall. But its have been block because of rubbish etc.
9	Improper land use	Modification of natural environment; land with the wrong ways and used with uncontrolled.
10	Deforestation	The permanent destruction of forests in order to make the land available for other uses. Destroy forest.
11	Poor drainage system	A lack of gutters or having downspouts disconnected from a proper drainage solution can dump lots of excess water into the soil surrounding the area.
12	Construction of building	The process of constructing a building or infrastructure. Its replacement of dense natural tropical forest with the artificial surface.

FINDINGS OF THE STUDY

Figure 2 present the percentage main criteria between human and natural factor. Human factor is the most critical causes of floods happen with the total aggregate weight of 78.8% than natural factor is 21.2%.

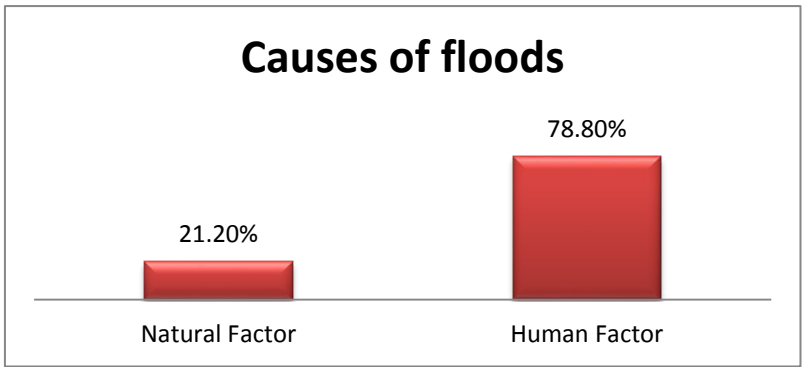

Figure 2
The resulting criteria with respect to main goal

Figure 3 show results for sub-criteria, where the most critical causes of floods happen. The most critical causes of floods happen is poor drainage system which is 23.5% follow by blocking of channels is 16.2%, improper land use is 15.7%, deforestation 15.1%, construction of building is 10.8%, heavy rainfall is 6.3%, storm is 4.2%, land slide is 3.3%, and the sea overflow also high tides causes together shown to be the last causes carrying a percentage only 2.4%. The overall inconsistency value is 0.01, this ratio is acceptable and the judgment are undoubtedly consistency because the ratio not more than 1. From the result, the critical cause of floods happen is because of human factor more than natural factor.

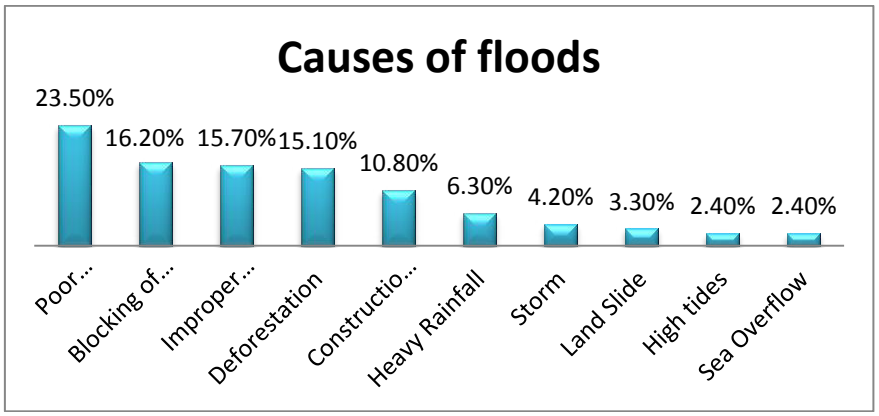

Figure 3
The resulting sub-criteria with respect to main goal

DISCUSSION AND IMPLICATION

In Malaysia, the floods always happen almost every year. Aim of this study to identify the critical causes of floods happens. This study satisfied the human factor is the critical causes of flood happen. Department of Irrigation and Drainage can overlook and focus more on these causes. In addition, they also need make more research and development (RnD) in flooding, to find out the best solution to overcome this problem. In future, we can avoid the floods problem from happen and our country can increase the infrastructure to gain the income. If this problem successfully completed, many people get their benefits especially society and government. If the flood problem can resolve,

flood victims can avoid their staff and their houses from destroy. In addition, government also can reduce production cost of repairing the affected area.

CONCLUSION

Flood is among dangerous disaster happen in Malaysia. Kedah also part of the Malaysia that receive flood almost every years. The some places in Kedah like Padang Terap, Sungai Muda and Sungai Raja is the place that flood always happen. From the researcher before, they state a lot of the causes of floods happen in Malaysia and also state from the foreign country. They also have some other ways to solve this problem in many aspects. Department of Irrigation and Drainage should take the most effective ways or actions to solve this problem. If this problem can be solve, Malaysia's government will save a lot of money and the society also can live in the peace. They also should take the big action and take note about all the rules and regulation in all industry and especially in construction industry to control the illegal action. This is also important to help Malaysia to reduce the flooding and at the same time can save the natural tropical forest.

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