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PUBLIC PERCEPTIONS OF FLASH FLOODS IN KELANTAN : CAUSING BY TOPOGRAPHY OR CLIMATE CHANGE

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ABSTRACT

Flashfloods is one of the most common natural disaster and circumstances beyond one's control which causes severe damage to the nature life, properties, and human well-being. The topography itself usually play an important role in controlling the climate change. However, it happens beyond of our control and became the main or annual natural disaster in Kelantan. Kelantan was selected in this case study due to the record setting flood in 2014 where the floods turn into 'tsunami-like disaster'. Natural Disaster Management Agency (NADMA), The Malaysian Meteorological Department (Met Malaysia) website and secondary data which included a direct interview of local people were used to evaluate the flood risk area and the factor that occur in this disaster. However, several districts have been identified as the most flood-affected areas in Kelantan which include the district of Gua Musang, Kuala Krai and Rantau Panjang. This paper is focus on studying to determine between the two factors that cause floods in Kelantan, either topography or climate change or both are related to. Due to the survey conducted during two days in Kelantan, the result shows that respondent answered has plunged into both topography and climate change are related based on the issue arises and discussed with the respondents.

Keywords: *floods, natural disaster, climate change, topography*

1.0 INTRODUCTION

Flash floods is known as an annual disaster that often occurs in Kelantan that appeared with different levels of danger. Flash flood also are ongoing threat to the life and property in Northeast US and have been generally studied as natural phenomena resulting from extreme weather (Marjerison, R. D.,2015). However, based on the previous flood's tragedy including 1927 and 1967, it was considered consequential in Kelantan's history. In addition, flash floods in 1967 have gave a deep impact on the Kelantan population which been estimated that 70% of the several villages and nearly half of the state's population were affected (Baharuddin KA, Abdull Wahab SF, Nik Ab Rahman.,2015). The natural hazard occurrence mostly due to climate change which results in extreme phenomena such as flash floods and droughts in Kelantan (Salleh & S Ahamad, 2019). However, in a global perspective, topography and climate changes may be closely related which topography can also be the cause of climate change in the State of Kelantan due to severe damage to the surrounding environment that led to the major flash floods. In a nutshell, flash floods act as a product of atmospheric and landscape variables, such as rain rate and amount (depth), developed impervious surfaces, topographic slope, and soil properties. People nowadays often think that natural hazard such as flash floods as the result of environmental factors outside our control, human changes to the landscape contribute to flood risk by enhancing storm runoff and placing infrastructure in flood-prone locations (Marjerison, R. D.,2015). The risk from this flood disaster will affect and gives threat to human well-being, from health, economy, infrastructure, and the environment (Salleh & S Ahamad, 2019a). The objective of this study is to investigate the major factor and impact between topography and climate change that led to the flood disaster in Kelantan. This study also aiming to collect the information and data of public perception towards the factor of flash flood in Kelantan especially those who experiences the incident.

2.0 LITERATURE REVIEW

2.1 Flooding Factors Related to Topography and Climate Change

Flood can be split up into three main categories which is flash flood, river flood, and coastal flood. However, flash flood known as the most fatal type that typically occurs in Texas, which officially defined by National Weather Service as “a flood that caused by heavy or excessive rainfall in a short-term period of time which generally less than six hours” (Jackson, T. L.,2009). The average of precipitation is expected to become increase due to the effect of climate change on acceleration in global hydrological cycles. In addition, extreme flash floods event can be prevalent, or can be short fused (forming quickly) and of small spatial extent (Yatheendradas, S., 2007). The six-hour indicator is something that related to typical timestep of hydrologic models at National Weather service that predict floods in large basins and is too coarse for the purposes of flash flood prediction, since such floods can peak in even less than 15 minutes (Yatheendradas, 2007). A fast moving water can lift people off their feet in only a few minutes and only needed a depth of 0.3m – 0.6m to sweep cars away (Ranapathi Arachchige, D.,Jeewandika Perera, 2015).

2.1.2Climate change

Climate change, referring to the long – term shifts in temperatures and weather patterns or a significant change in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or no longer.

- Problem of climate change

  Climate change caused by the greenhouse gas (GHGs) emissions which affect both global hydrological cycle and regional hydrological worldwide, which going to continue in the future. However, precipitation is sensitive in increasing the greenhouse gas emissions and it is directly influenced by an increase in the global surface temperature that hype the rate of evapotranspiration, thereby increasing the concentration of water vapor in the atmosphere (Perera & Arachchige, 2015).

Bangladesh known as one of the most vulnerable countries in the world that having a climate change issues. It has been predicted based on changes in climate trends, variability and extreme events in Bangladesh including increasing average temperature, annual mean rainfall, severe floods, intensity of cyclones, frequency of monsoon depressions, salinity on the estuaries and water shortages (Mohammad, S. M., 2016)

2.2.2 Topography

Topography is the study of a land surface which referring to the shape, height, and depth of the features of a place. In a particular, it lays the underlying foundation of a landscape. Topography is referring to the mountains, valleys, rivers, or craters on the surface.

Based on Kelantan's topography, the terrain characteristic of land of the region may be the main natural factors relate to the monsoon that frequently happen. Terrain generally can cause an extreme flood disaster. There are several huge rivers flowing from the higher elevation of the south and south-west of Kelantan. As it moves towards the lower elevation, which is at northern Kelantan, the volume of water getting bigger as the river meets with another smaller river (A H Salleh and M S S Ahamad 2019). Related to heavy rainfall events with high magnitude, it can give an impact likely to control over rainfall erosivity and possibly increase with higher storm intensities. It has been reported based on the rainfall with heavy erosivity which combined with the slope gradient of 45% will increase the chance of soil erosion happen and induce landslides such as in a Cameron Highlands (Nasidi et al., 2021). These issues considered based on the main triggering factors of landslides and soil erosion due to changes in precipitation patterns. In addition, the main factors that influence the changes of topography such a slope stability and landslide risk is the climate, especially the changes of temperature and precipitation pattern. Climate also include an infiltration increase which causing a loss of soil suction, a reduction in effective stress due to the water rising of groundwater levels and loss of root reinforcement in a vegetation (Nasidi et al., 2021).

3.0 METHODOLOGY

3.1 Complementary Quantitative Assessment

In this study, these questionnaires have often been used to make a survey about the factor of flash floods happen in a several district at Kelantan. The overall result of this survey assessment about flash floods factors that have been carried out in three selected districts which include Kuala Krai, Rantau Panjang, and Gua Musang, as well as other additional data (Dong et al., 2023). The survey data has been obtained from the villagers by the three districts in two days (Azize Minaz et al., 2022). This survey is aimed to seeking the factor that related to the flash floods that hit the districts in Kelantan and to identify the relationship between topography and climate changes due to both is the main factor discussed in this study. The study area was selected based on several reason which there is a frequency of severe and recurring floods on that area (Sinun, W., (1995).

4.0 RESULT & DISCUSSION

This study has been conducted in the State of Kelantan which covered the three-district starting from Kuala Krai, Rantau Panjang and Gua Musang. Kelantan is known generally hot and humid all the year around, with its average low temperature shows 21 °C until 32 °C (Salleh & S Ahamad, 2019) .

4.1 Demographic Information

The details recorded for demographic section are included about gender and location of each respondent in three districts.

1. Gender

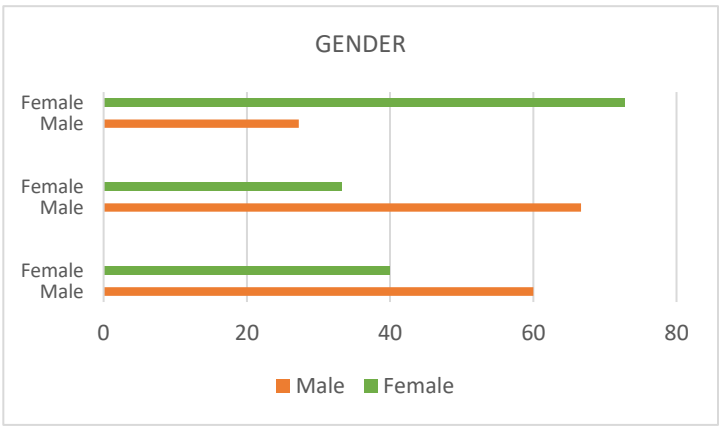

Figure 1: Gender of the respondents

Figure 1 shows the gender of the respondents. Started with Kuala Krai, it shows (60%) of male and (40%) of female respondents. Rantau Panjang shows (66.6%) of male and (33.3%) of female respondents. Also, Gua Musang shows (27.2%) of male and (72.7%) of female respondents.

2. Location / District

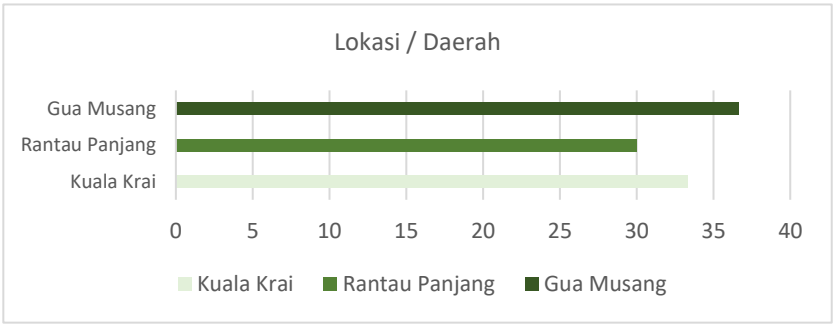

Figure 2: Location / District of each respondent

Figure 2 shows the location of each respondent in this study. Started with Kuala Krai, it shows (33.3%) respondents involved while Rantau Panjang shows (30%) of respondents. However, Gua Musang shows the highest respondents which is (36.6%) of them.

4.2 Flash Flood Factor Data

The details recorded for this section are focused on the flash flood factor that usually occurs in several district of Kelantan.

3. Flash flood signs

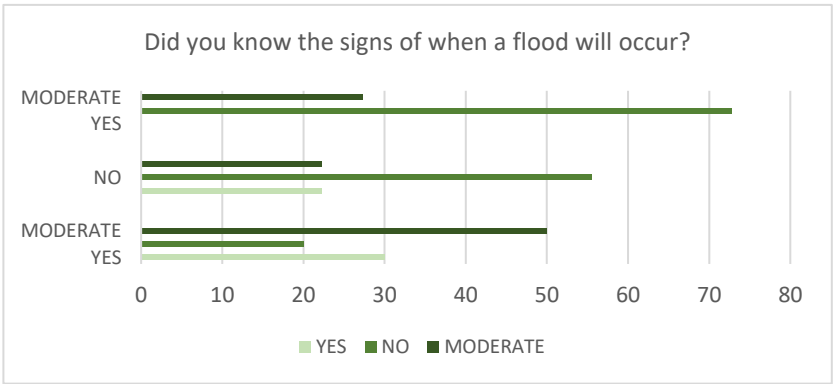

Figure 3: Signs of flash flood happens

Figure 3 shows the knowledge of each about the signs of flooding to happen in their district based on the past experience. Based on the respondents from Kuala Krai, it shows (30%) of the respondents agreed, (20%) of the respondents not agreed and the rest (50%) of them are moderated. Rantau Panjang shows (22.2%) of the respondents agreed, (55.5%) of the respondents not agreed and the rest (22.2%) of them are moderated. Meanwhile, Gua Musang shows (72.7%) of the respondents not agreed and the rest (27.2%) of them are moderated.

4. Flash flood effects

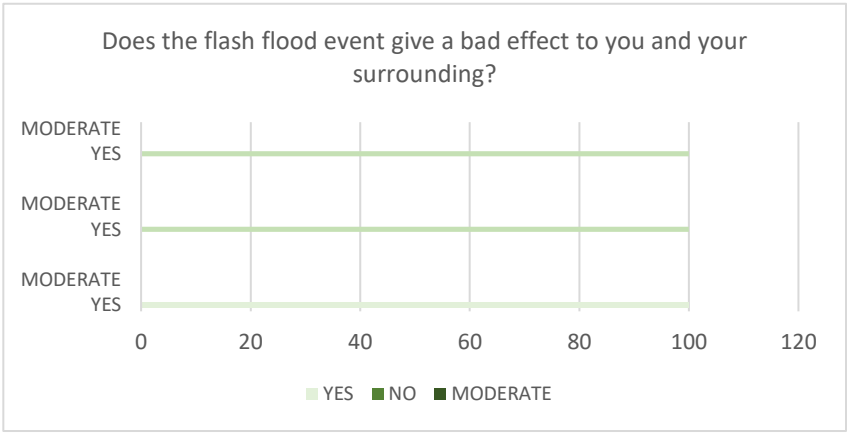

Figure 4: Flash flood effects to the respondents.

Figure 4 shows the respond of each respondent that affected by the flash floods. Based on data collection, it shows that (100%) of respondents from those three districts was affected by the flash floods.

5. Factors occur

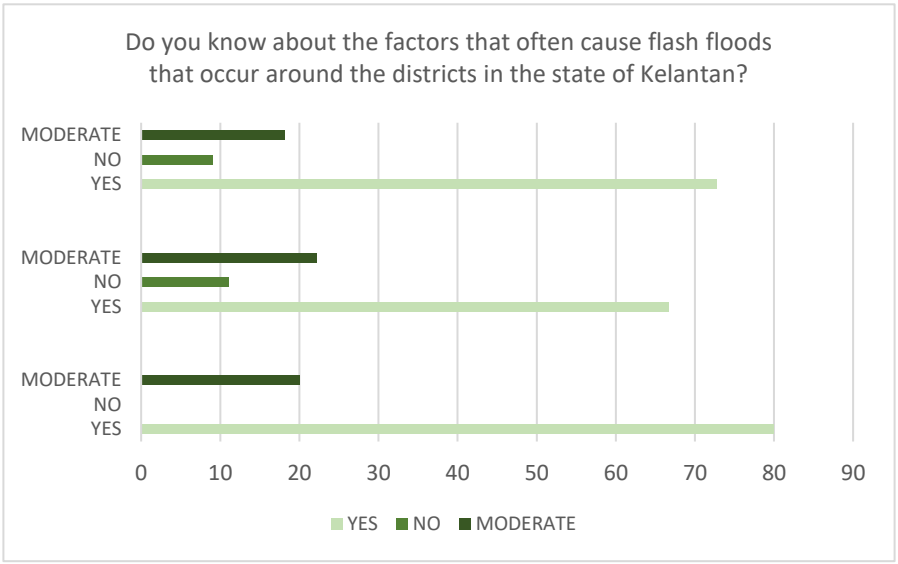

Figure 5: Factors that usually occur

Figure 5 shows the knowledge of each respondent about the factors that usually occur in these three districts. Based on the respondents from Kuala Krai, it shows (80%) of the respondents agreed and the rest (20%) of them are moderated. Rantau Panjang shows (66.6%) of the respondents agreed, (11.1%) of the respondents not agreed and the rest (22.2%) of them are moderated. Meanwhile, Gua Musang shows (72.7%) of the respondents agreed, (9%) of the respondents not agreed and the rest (18.1%) of them are moderated.

6. Climate change factors

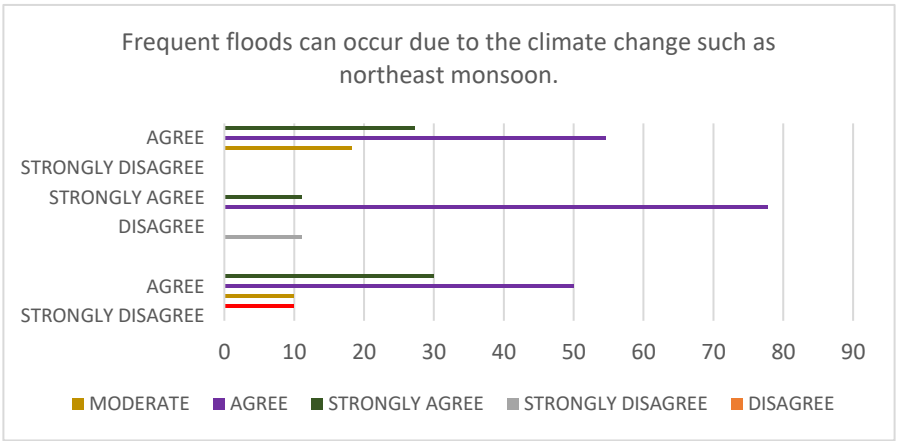

Figure 6: Climate change factors in each district

Figure 6 shows the data collected about climate change factors. Based on the data, the majority of the respondents from these three district are agreed that climate change be the factors of the flash floods. However, (11.1%) of the respondents in Rantau Panjang is strongly disagree and (10%) in Kuala Krai is disagree.

7. Rising of water level

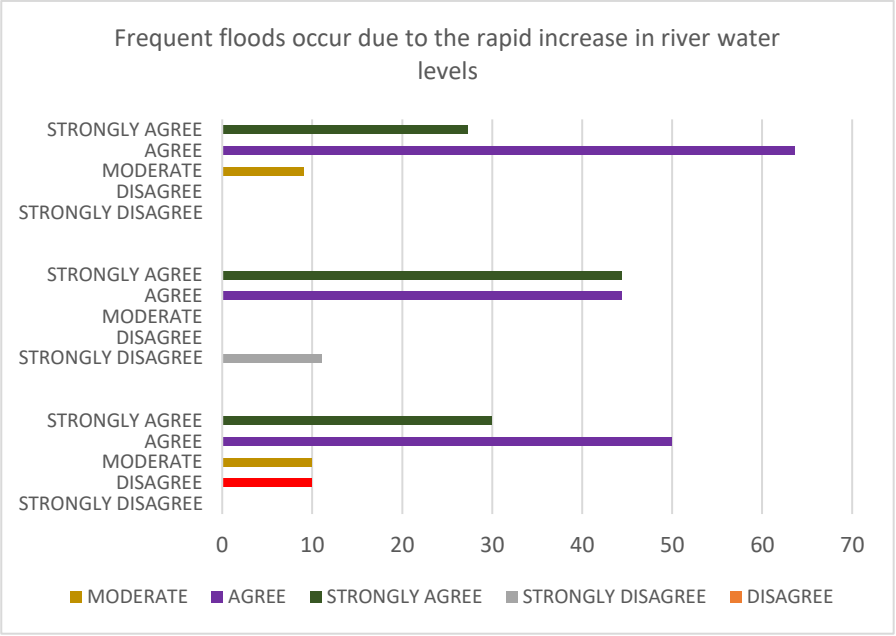

Figure 7: The rising of water level data in each district

Figure 7 shows the respond about the rising of water level that can causing the flash flood. Based on data, Kuala Krai shows that respondents (30%) strongly agree, (50%) agree, (10%) moderate and (10%) disagree. Rantau Panjang show that respondents (44.4%) strongly agree, (44.4%) agree and (11.1%) strongly disagree. However, Gua Musang shows that respondents (27.2%) strongly agree, (63.6%) agree and (9%) moderate.

8. Collision of river and sea

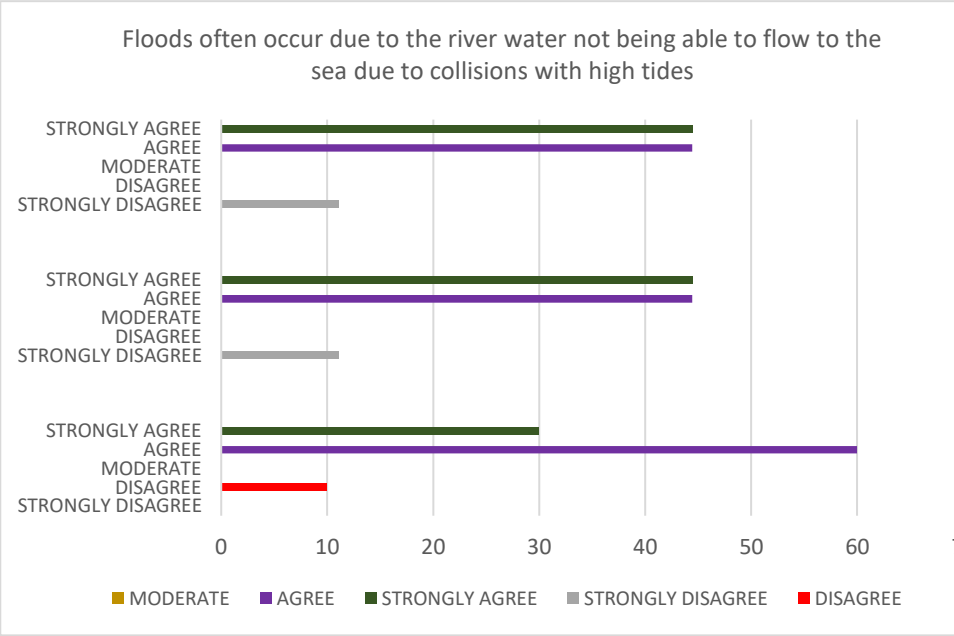

Figure 8: The collision of river and sea happens.

Figure 8 shows the respond about the collision of river and sea. Based on data, Kuala Krai shows that respondents (30%) strongly agree, (60%) agree and (10%) disagree. Rantau Panjang shows that respondents (44.4%) strongly agree, (44.4%) agree and (11.1%) strongly disagree. However, Gua Musang shows that respondents (44.4%) strongly agree, (44.4%) agree and (11.1%) moderate.

9. Rapid development

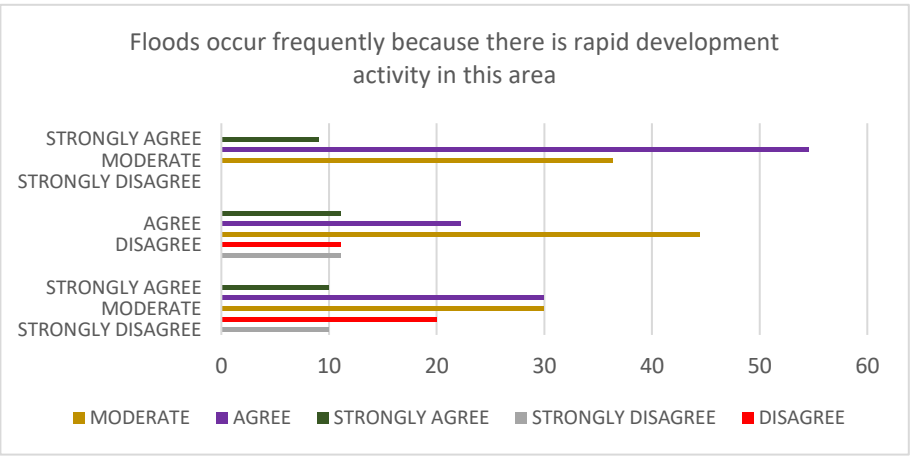

Figure 9: The rapid development activity

Figure 9 shows the respond about the rapid development activity factors. Based on the data, Kuala Krai shows that respondents (10%) strongly agree, (30%) agree, (30%) moderate, (20%) disagree and (10%) strongly disagree. Rantau Panjang shows that respondents (11.1%) strongly agree, (22.2%) agree, (44.4%) moderate, (11.1) disagree and (11.1%) strongly disagree. However, Gua Musang shows that respondents (9%) strongly agree, (54.4%) agree and (36.3%) moderate.

10. Topographic change

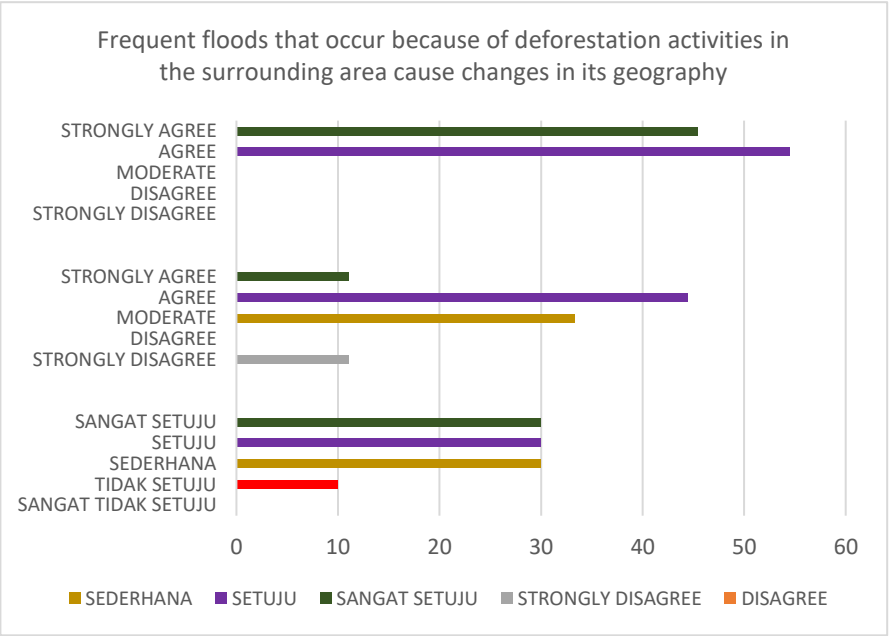

Figure 10: Deforestation cause topographic change

Figure 10 shows the respond that deforestation cause topographic change. Based on the data, Kuala Krai shows that respondents (30%) strongly agree, (30%) agree, (30%) moderate and (10%) disagree. Rantau Panjang shows that respondents (11.1%) strongly agree, (44.4%) agree, (33.3%) moderate and (11.1%) strongly disagree. However, Gua Musang shows that respondents (45.4%) strongly agree and (54.4%) agree.

11. Development on flash flood areas

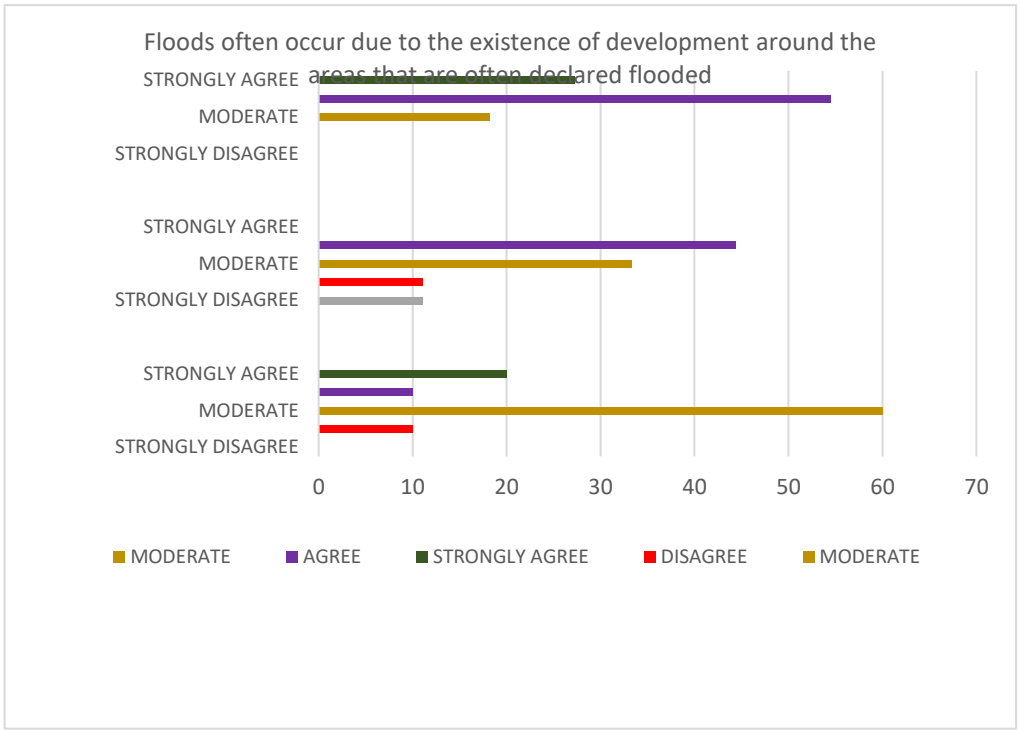

Figure 11: Development on the flash flood areas

Figure 11 shows the respond from each respondent about the development on the flash flood areas. Based on the data, Kuala Krai shows that respondents (20%) strongly agree, (10%) agree, (60%) moderate and (10%) disagree. Rantau Panjang shows that respondents (44.4%) agree, (33.3%) moderate, (11.1) disagree and (11.1%) strongly disagree. However, Gua Musang shows that respondents (27.2%) strongly agree, (54.5%) agree and (18.1) moderate.

12. Drainage system

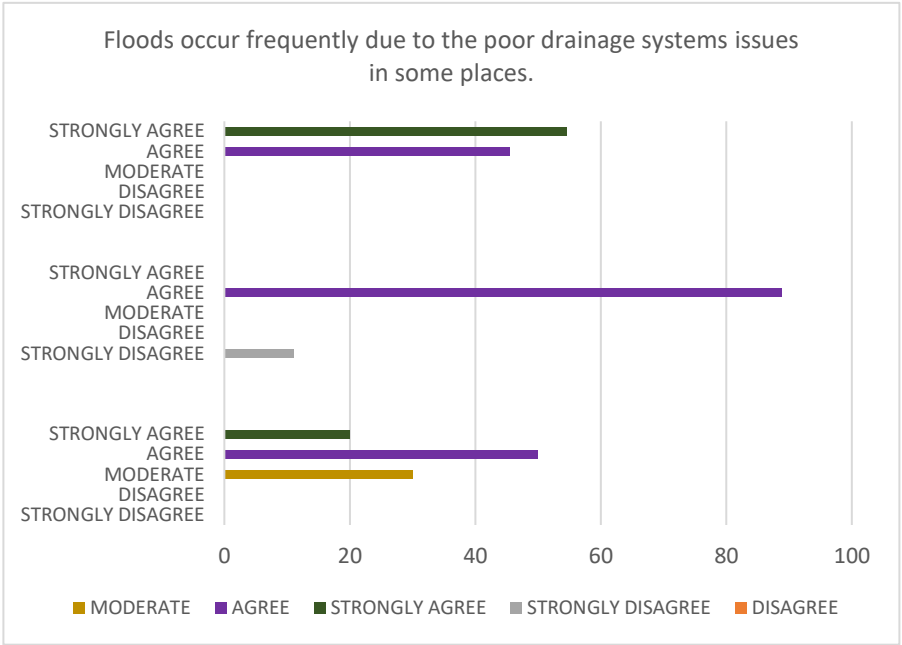

Figure 12: The drainage system issues

Figure 12 shows the respond from each respondent about the drainage system issues. Based on the data, Kuala Krai shows that respondents (20%) strongly agree, (50%) agree and (30%) moderate. Rantau Panjang shows that respondents (88.8%) agree and (11.1%) strongly disagree. However, Gua Musang shows that respondents (54.5%) strongly agree and (45.4%) agree.

13. Improper stormwater infrastructure

Figure 13 shows the respond from each respondent about the lacking stormwater infrastructure. Based on the data, Kuala Krai shows that respondents (20%) strongly agree, (50%) agree and (30%) moderate. Rantau Panjang shows that respondents (77.7%) agree,(11.1%) moderate and (11.1) strongly disagree. However, Gua Musang shows that respondents (45.4%) strongly agree and (54.5%) agree.

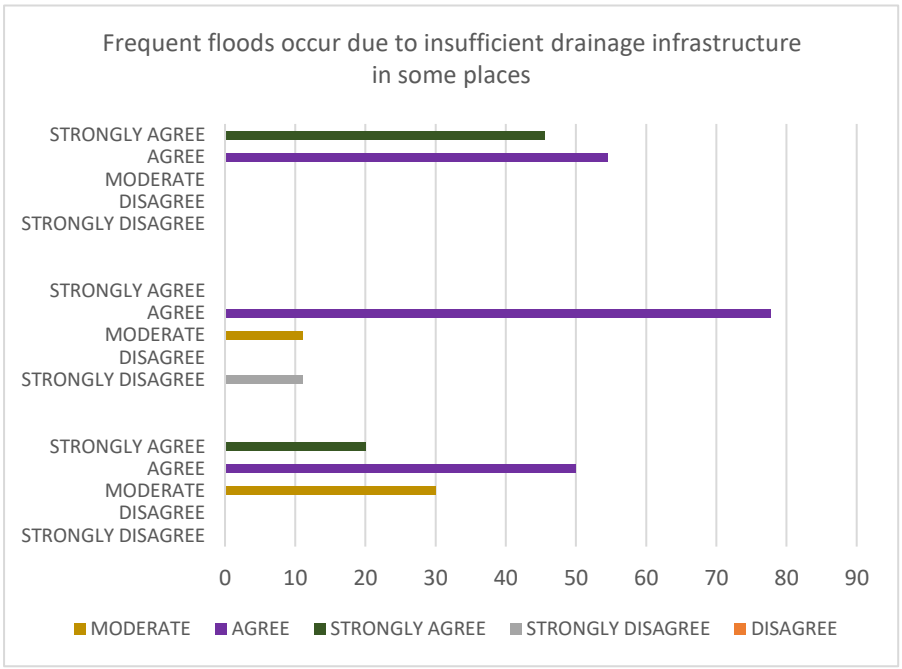

Figure 13: Lacking stormwater infrastructure

14. Extreme hot weather

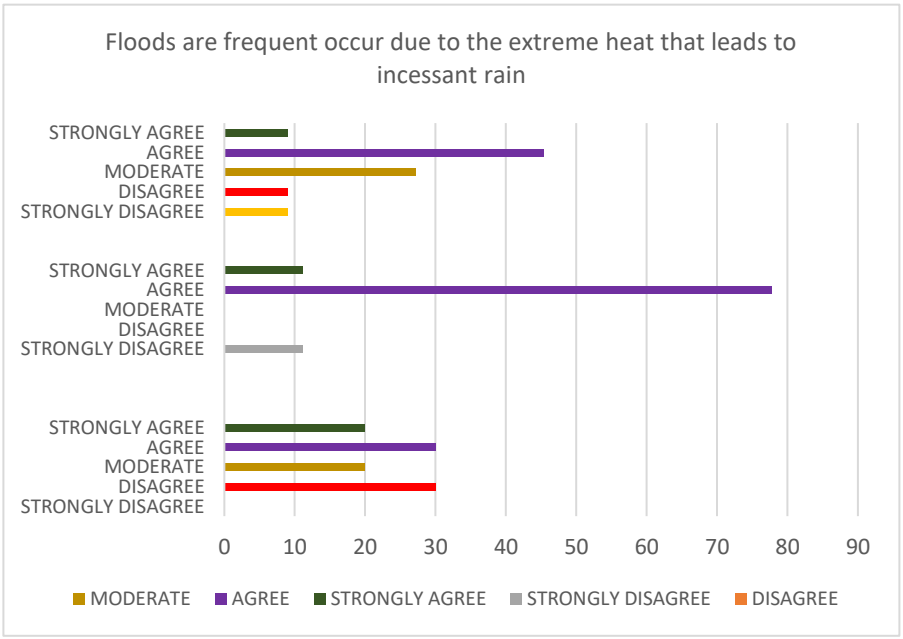

Figure 14: Extreme hot weather leads to heavy rain

Figure 14 shows the respond from each respondent about the lacking stormwater infrastructure. Based on the data, Kuala Krai shows that respondents (20%) strongly agree, (30%) agree, (20%) moderate and (30%) disagree. Rantau Panjang shows that respondents (11.1%) strongly agree, 77.7%) agree and (11.1) strongly disagree. However, Gua Musang shows that respondents (9%) strongly agree, (45.4%) agree, (27.2) moderate, (9%) disagree and (9%) strongly disagree.

15. Rain frequency

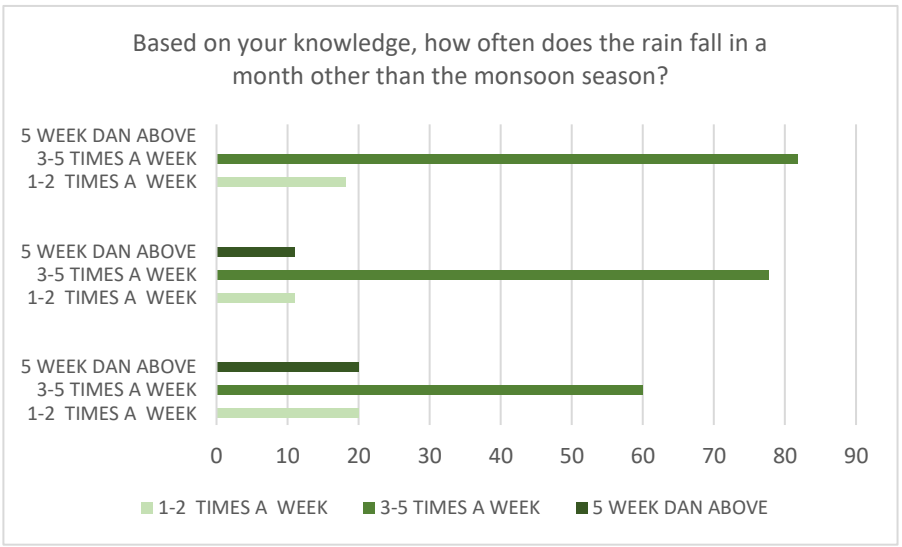

Figure 15: Rain frequency based on respondent

Figure 15 shows a respond from each respondent by the three different districts about the rain frequency. Kuala Krai shows (20%) of 1 to 2 times a week, (60%) of 3 to 5 times a week and (20%) of 5 week and above. Rantau Panjang shows (11.1%) of 1 to 2 times a week a, (77.7%) of 3 to 5 times a week and (11.1) of 5 week and above. Gua Musang shows (18.1) of 1 to 2 times a week and (81.8) of 3 to 5 times a week.

16. Monsoon season

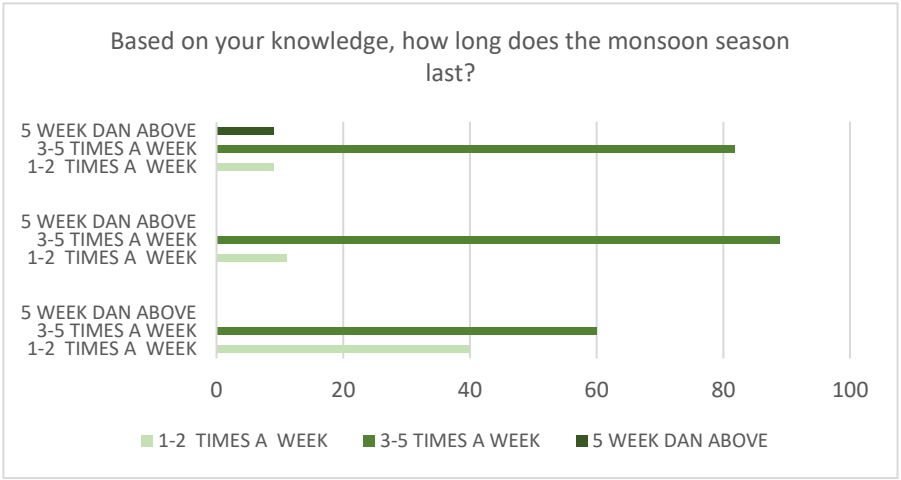

Figure 16: Monsoon season period occur

Figure 16 shows a respond from each respondent by the three different districts about the monsoon season period occur. Kuala Krai shows (40%) of 3 to 5 times a week and (60%) of 5 week and above. Rantau Panjang shows (11.1%) of 1 to 2 times a week and (88.8%) of 3 to 5 times a week. Gua Musang shows (9%) of 1 to 2 times a week, (81.8) of 3 to 5 times a week and (9%) of 5 week and above.

5.0 CONCLUSIONS

Kelantan has been recognized among the states that badly affected by the flash floods which caused the population to relocate to temporary relief centres (PPS). Flash flood tragedy make the population suffered losses due to the damaged of their properties such as houses, vehicles, important document and furniture. Kelantan has facing intense flooding with the rainfall ever recorded at 627mm, the highest since 1967. The most extreme flash floods tragedy was occurred at Kelantan in 2014, called ‘yellow flood’, which it give a big impact, especially in a areas that had never been flooded before. Due to the info given, people are not expecting the continuous heavy rain to cause the water level to rise so quickly and did

not have time to save their belongings during ‘yellow flood’ tragedy. Most victim at that time are not expecting their houses will be affected as it never happens around the area. People started to find the reason and factor that causes the flash floods in some villages which have never been flooded before, thus creating panic and confusion among them. Of that, several locations involved flooding are affected by collapsed slope, eroded roads, sunken roads, and damaged bridges.

Topography creates a difference in climate across very small distance and can influence the local climate. The higher elevations will experience a cooler temperature, slope orientations affect sunlight exposure and temperature variations, and mountains that can alter wind pattern and precipitation. Based on the topography data, Kelantan belongs to the lowland type. Lowlands in Peninsular Malaysia are located on the west coast and east coast of Kedah- Perlis, Hulu Sungai Perak, and Kelantan.

Based on the collected data, deforestation issues has being mentioned in the survey to identify whether it can be relate as a factor of flash flood occur. Deforestation has known can affected the physical of geography of the rivers, valley, ridge, mountain and in any natural areas. Most of the respondent has agreed due to these issues will affected the existing forest and the damage is cause around of 10% which led to the global warming. Deforestation also can change the structure of the soil which can give a bad impact towards the land use and topography. Plant cover has lost due to the deforestation which will led to erosion occurred and sweep the land into the rivers.

Monsoon season has known cause by the climate change which led to an increasing of river water. In addition, the increasing of water level will caused a clash between the sea rising water. Due to the data of rain frequency, three districts which is Kuala Krai, Rantau Panjang and Gua Musang has experienced a frequent rain between three to five times a week when the temperature is extremely heating. Several respondent that experience those flash flood events has agreed that monsoon season led to be the main factor of flash flood occurred. Due to the survey, poor drainage infrastructure

led to difficulties of rainwater to flow and unable to move. Factors that generally affected the drainage are usually because of topography of the land, climate, soil infiltration, gradient of the land, geological amount of water flowing and periodicity of the flow.

In short, due to the discussion and information received by the respondent, topography and climate change are related and both can be concluded as the main factor of flash flood occur in several district at Kelantan.

6.0 ACKNOWLEDGEMENT

This paper was supported in part by the 30 local villagers of three district in Kelantan which included Kuala Krai, Rantau Panjang, and Gua Musang. The authors gratefully acknowledge extremely valuable discussions with the local villagers for the information given.

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