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Flood Management Using Data Driver Index: A Case Study in Kelantan, Malaysia

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Abstract
The deterioration of nature's quality is among the contributing factors to environmental disasters arises from human attitude, which greedily developed the necessities of life without evaluating the risk of environmental damage including natural disasters such as floods. This will be more serious and life-threatening due to the changing surface and sub-surface of soil structure by human activities. This has caused the rain balance and running water to be disrupted. The river basins that are experiencing the rapid development such as in Kelantan, Terengganu, Pahang and Johor, will serious face environmental problems. Hence, the aim of this study is to identify the level of flood disaster management preparation in Kelantan state, December 2014. It involves three levels of preparation which are before, during and after at eight districts in Kelantan. According to Kelantan Strategic Research Centre, large flood events are due to the overflow of the Kelantan River which is the main source for the population around the river basin. The flood events have recorded the value of public utilities and property losses of almost 1 Billion Malaysian ringgit. This research used group sampling as the survey method, where the questionnaire was distributed to 434 respondents who were involved in the flood. The data analysis method uses *principal component analysis* (PCA) to determine the index value (MOF =.$\sum_1^N F_i W_i$). The results of the analysis show that the highest indices of the pre flood recovery index is Mukim Melor, 1.11 while the lowest are Manek Urai and Ghucil, -0.62. The preparation during the Kadok flood is recorded as the highest at 0.96 and Ghucil the lowest, -0.80. While the post floods in Bunut Payung and Pasir Tumboh are recorded as 0.96 and -0.50 respectively. Hence, the documentation of flood management systems should be reconstructed at multi-tiered phases to minimize the management risk of natural disasters.
Keywords: Management preparation, Kelantan flood disaster 2014, Flood monsoon, Flood Management Index

Introduction
Natural disaster is always associated with modernization and rapid development of a country to cater the increasing population density. This encourages deforestation for venturing to new

areas like the residential, industrial, agricultural, and mining (Kamarudin et.al, 2015). One of the most obvious impacts of it is flood. According to S.Hussain et.al (2011), uncontrollable the human interaction with physical elements in the river basins caused floods, landslides, and such because it creates the imbalance in utilising this natural ecosystem. Hence, a thorough research should be highlighted by the government to construct an efficient flood management in addressing the problem.

Hamzah et.al, (2011) quoted that governance is defined as a process of aiming in accelerating and achieving development objectives among members of the organization and goal setting. An efficient management can balance the uniformity of duties; implement the suitable systematics internal and external systems to achieve the organization's mission. On the contrary, the University of Philippines (2007) defines environmental governance as involving multiple levels (local, national, and international) whether formally or informally. It does not depend on market demand and local communities in enacting and implementing environmental policies. However, it is seen as a respond to request relating to environmental disaster management and this information is classified from the public because it is bound by the rules, policies, and procedures that are aimed for building good governance features with the goal of achieving sustainable environment.

For instance, Thailand country has implemented the integrated management system of flood to reduce a risk to their community and avoid total loss. According P.Otten & R. De Blois (2006), Thailand is using a low cost warning system to reduce the risk of flooding, simple rain gauges, and manual warning sirens have been installed in the village of Mae Kampong. These equipments are used for observing local flood condition, issuing forecasts and warnings to villagers. Volunteers from the village are trained to measure, record and read the daily amount of rainfall. When the amount of rainfall exceeds the predefined normal level, the volunteer in charge will issue a warning by using the manual siren. The village chief will then spread the warning through the village news broadcasting tower. Hence, the Malaysian government needs to review the country's flood management system, which should be aimed at reducing the risk of loss of life, property damage and the loss of local ecosystems.

Dutch success in facing the flood disaster is listed as the seven wonders of today's world of technology. 60 percent of the country's surface is located below the sea level. The cause of the floods in Dutch will be most likely due to the current world climate change. The Dutch government has set up a special ministry to gather expertise in various fields, aimed to overcome the flood disaster such as the delta system in the delta, artificial lake to hold water, blockage of the sea and also the Cultivation project of farmland height. The Dutch flood management model has attracted the attention of developing countries such as America, Japan, and Britain to be holistic governance references in curbing natural disasters (Ismail, 2015).

In the context of environmental governance, the federal and state administrators have significant roles in business development and protecting people's lives effectively to reduce the threat and also take care of human welfare, safety and the environment. The total number of

flood losses in 2014 valued at RM932 million which involved life lost, agricultural damages and repairing the damaged infrastructure including schools, roads and bridges (Bernama, 2015). However, the total loss amount is estimated more than RM 1 billion after considering the value of damage in the plantation sector, agriculture, livestock, buildings, and places of worship and public property (PKS, 2015).

Therefore, the Malaysia government should review the flood disaster mitigation plan, disaster education as well as re-structure the documentation management needed. In addition, it is recommended to focus on physical developments to curb flood disaster especially along the river basin of Kelantan and also near the Golok River. The collaboration between various parties and experts are important in order to overcome the high risk of life loss and maintain the quality of life of the world's inhabitants. From that, this study is significance to identify the level of flood disaster management preparation in Kelantan state, on December 2014 flood disaster with flood management using data driver index.

Area of Study

The state of Kelantan is located in the north-eastern part of Peninsular Malaysia, between latitudes 4° 30' - 6° 5 'North and longitude 101° - 102° 45' East. It is bordered by Terengganu (North), Pahang (South), Perak (West), and Thailand (East). It covers 15,105 square kilometres, 185.6 kilometres long, 104.8 kilometres wide, and 78 kilometres long coast. It is also the sixth largest state in Malaysia and the fourth largest in Peninsular Malaysia with the population according to the census of the Department of Statistics Malaysia in 2013 is 1,665,900 million people. 750,400 residents live in urban areas and 915,500 rural residents (Refer figure 1).

The geographical position that is near to the South China Sea is the cause of a catastrophic flood due to the heavy rain that resulted from the northeast monsoon movement. Generally, monsoon flood is a natural occurrence as a result of the circulation of the earth in its axis which produces different wind movements, in which wind circulation (known as the northeast monsoon wind) which contains many steam vaporous moves from high pressure areas to low pressure area (Ooi et al., 2013; Braesicke et al., 2012).

Chang.R (2015), the weather in the South China Sea region is characterized by two monsoons: the Northeast and Southwest monsoons, so called because the predominant wind direction is from the northeast and the southwest respectively. The Northeast monsoon (Nov - Mar) occurs during the northern hemisphere winter, when the sun is nearer the Equator, while the Southwest monsoon (May - Sept) takes place during the northern hemisphere summer. Hua (2016) refers to physics theory, the monsoon floods that occur are from November to March or winter only because of the sun's rays falling on the Southern Hemisphere and forming a low pressure area in Australia, while in the Northern Hemisphere it forms a high area In Central Asia. Therefore, Kelantan's, should be given attention in terms of management of flood preparedness, whether physical or humanitarian, regarded as vulnerable to such natural disasters every year.

Figure.1. Map of Peninsular Malaysia.

Methodology

The disaster of flood in Kelantan, 2014 was the worst in history recorded since 88 years ago. The total loss of live is recorded as 2805 victims for eight districts in Kelantan. This study covered the eight districts in Kelantan that were selected as the study area based on the data collected by the Social Welfare Department of Malaysia (2014). The eight districts that were chosen are Jeli, Gua Musang, Kuala Krai, Tanah Merah, Machang, Pasir Mas, Kota Bharu and Tumpat. The highest number of victim is recorded at Kuala Krai (70,035 people) and the lowest is at Jeli (3,269 people).

The total number of victims in Kelantan is 110,747 which is involving 28,080 families (PKS, 2014). The data for this research is collected using quantitative method. The questionnaire based surveys were distributed to 434 respondents based on the *Krecjie Morga*n, sample size. The type of questionnaire is based on structure and focus group. The result were measured using the Likert scale 5 to 1 (5 is very well-prepared. 4 is well-prepared .3 is middle prepared. 2 is not prepared and 1 is much unprepared).

This questionnaire was disseminated to collect the feedback from the community in Kelantan that were affected by the flood from 32 different locations. It consists four sections which are demographic, situation during the flood, management of the incident happened before, during and after the flood and the feedback based on the perception before, during and after flood were taken. This article discusses about the result of flood management based on the ten items of flood preparation that are listed in section D, E and F. The cluster analysis are used whereby the respondents are grouped into three different demographic group which are families (self and family), administrative (politic party, member of party, federal government and state government) and agency (non-government organization, headman, rescue and social department of welfare).

The data obtained from the questionnaire were analysed using XLSTAT statistics application. The data collected is further analysed using 'principle component analysis' (PCA) which forms *'data driver'* that is known as index value, by calculation. According to A.Fazillah et.al (2017), the Factor Analysis (FA) is used to develop the quality of life index using equation (1):

$$QOL = \sum_1^N F_i W_i \qquad (1)$$

Where: $F_i W_i$ the number of factors selected is, F_i is the score factor, W_i the percentage variance.

Therefore, the index formula is implemented by researchers in this study of flood management in Kelantan as a MOF =.$\sum_1^N F_i W_i$.

Results can be acquired at point of the highest, medium, or lowest area index values for pre, post, and post flood levels. This discovery, capable of reducing the risk of death, damage to property, disrupt of ecology also physical damage of the river basin. Therefore, findings can be referred to by the authorities (federal government, state governments, agencies, and NGOs) as a measure to improve the governance existing toward effectively and systematically flood management.

Result & Discussion

Based on the data collected from the questionnaire in management of flood section, it is found that 32 point disaster areas use the index formulates to contribute in this study. Researcher has been classified to three sub topics, pre, current and post flood. The result analysis shows the highest index value of pre flood preparation is 1.11 in Melor, Bukit Tuku is medium, 0.64 while the lowest are Manek urai and Ghucil, -0.62. For current preparation flood recorded the highest reading of 0.96 is at Kadok, in the middle 0.61 at Kok Lanas and Ghucil at the lowest of -0.80.

Meanwhile the post-flood, Bunut Payung recorded 0.96, followed by Kok Lanas at 0.67 and Pasir Tumboh at -0.50. To regard, the study focused on aspects of flood management in Kelantan which will be explained at the sub topic. Figure 2 showed the three periods of time management floods at Kelantan.

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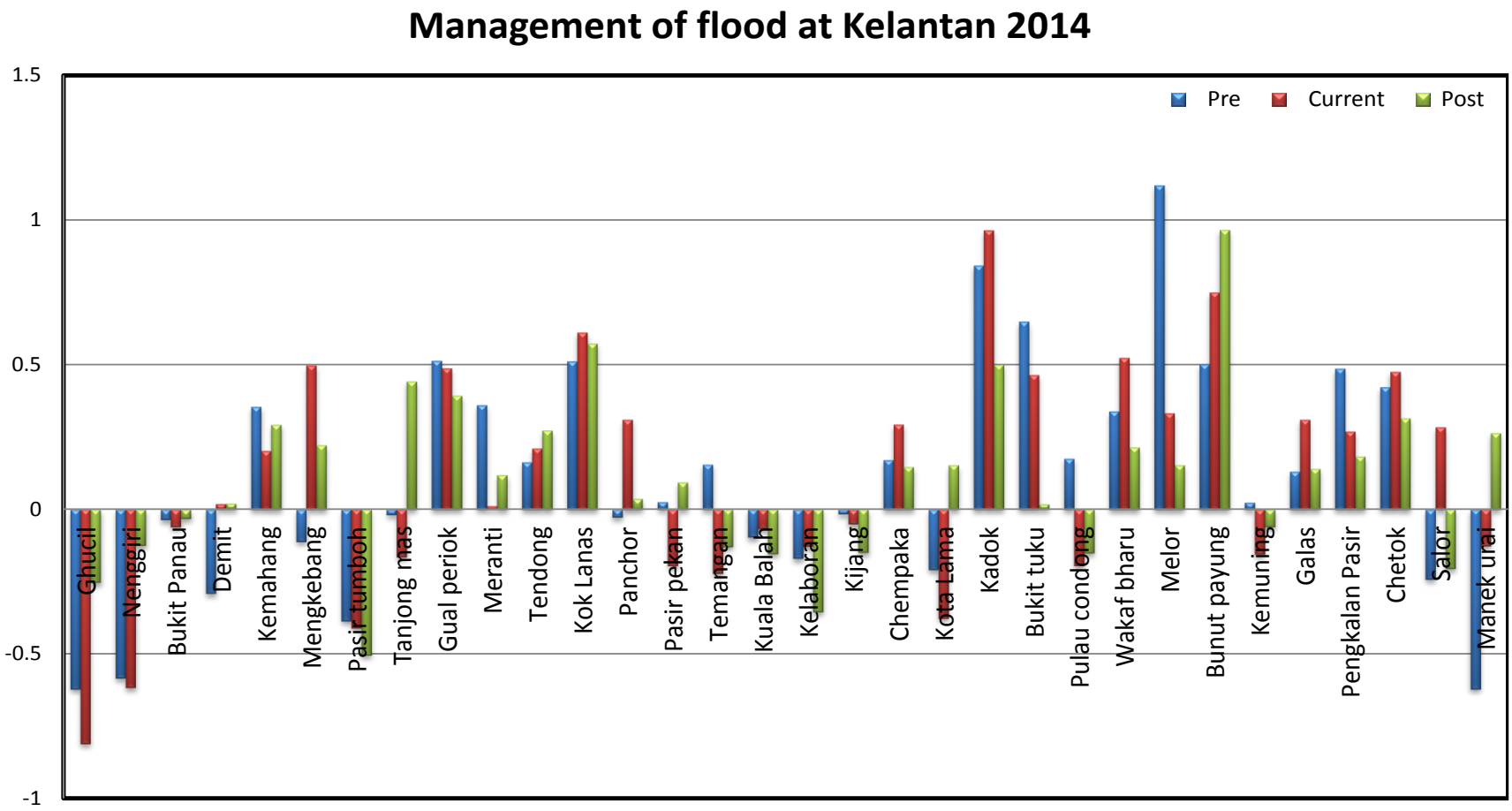


Figure 2: Result for period of time to sub section management of flood.

Pre flood preparation

The bar chart (refer figure 3) shows the highest index in Melor district for pre-flood preparation is 1.11. Based on the findings, the community in this district is very satisfied with the flood management at various levels. Adi et.al (2015) stated that the flood management involves various levels of agencies starting from the planning, current and post-flood stages. In addition to the community involvement, the authorities have facilitated all matters of assistance and understanding of union assignments. Hence, the flood disaster management can be managed efficiently by sharing information between the public and the authorities.

Index in Bukit Tuku was recorded as mid-level value which is 0.64. Bukit Tuku is located in the Pasir Mas area, where the geographical position is closed to two main river basins, namely Kelantan River at Salor (6° 1' 50.79" N, 102° 10' 49.53" E) and Sungai Golok, Rantau Panjang-Thailand border. (06° 01' 17.3" N, 101° 58' 27.4" E) (Refer figure 4). Initial inventory has been observed in this flood-prone area. However, the location of Bukit Tuku is quite far from the administrative center and the interior between the two way communication barriers holistically. Although the use of technology tools is increasingly extensive, the internet access is still inaccessible to the whole area as well as lack of ICT related education. Mustafa & Ghani (2008) mentioned that the use and mastery of ICT requires its users to have literacy, not just the basic literacy of reading, writing, calculating, but also ICT literacy.

Meanwhile, in Manek Urai, and Ghucil, the total destroyed area due to the second wave of floods has recorded the lowest reading index -0.62. The clashes of the three main rivers, namely the Galas River, Lebir River, and Kelantan River have caused the water level to increase in a short period of time. Aside from the extreme rainfall that lasts for 10 days, the river cannot accommodate the abundance of water, thus destroying the areas around the basin. Although, the amount of preparations is increased, it remains a threat to all levels as such incidents are unexpected and have never been encountered to during the critical natural disaster.

Current flood preparation

Index during the flood (refer figure 5) shows that Kadok has the highest value of 0.96, where there is a food aid depot based at the location under the Kelantan Amal agency. The network communication can still be accessed between the main locations of flood relief collection at non-critical areas. Kok Lanas, which is slightly affected by the flood, recorded an index value of 0.61. The community from Kok Lanas also helped distributed 5000 food packages daily to other flood victims without the help of the authorities. This is because the social awareness responsibility has been nurtured by the Kelantan State Government through community and volunteer ing activities by involving various societies such as Majlis Sukarelawan Rakyat Negeri Kelantan (MeSRA). Thus, the benefits of intensive programs being embodied have been diplomatic. According to Ismail (2009) in a community there is a sense of community which is defined as the feelings of cooperation, of commitment to the group welfare, of willingness to communicate openly, and of responsibility to and for others as well as to one's self. Most importantly, there are many quality leaders stood out which contribute to the success of the community events.

Lowest data is recorded at Ghucil which is at -0.80. The clashes between the three main rivers, namely Kelantan, Lebir and Galas Rivers, have resulted in a drastic increase of water level in a short period of time. Komo (2015) stated that the Kelantan Rivers, especially it's Galas River and Lebir Rivers, are streams formed by the recurrent floods. The rising of the rivers' water level up to 15m is a common phenomenon during the flood season. However, the 2014 flood is remarkable as on December 26, flood waters swirling dramatically in Dabong, Manik Urai and Kuala Kerai to a level of 10m from the flood plain. In the downstream area, the flood water reaches up to 4m when usually the water level does not exceed 2m. Highly sludge, silt, sand, and debris in the flood have destroyed homes, office buildings, bridges and various public utilities. The telecommunication network and the blocked road hub took almost two weeks to fully recover. Also, placement management and flood victims are badly affected by the barriers that existed during the disaster.

Post flood preparation

Result analysis for post flood (figure 6) shows that Bunut Payung recorded the highest reading of 0.96 compared to Kok Lanas, 0.57, due to its proximity to Kota Darul Naim, the administrative Centre of Kelantan. In addition, this area is located strategically, near the main city, easy to access facilities, and highway as a main connection with other areas where one of the factors of management can be implemented effectively. In contrast to Kok Lanas, this is a geographically located 27 km from the city centre. However, this location was not adversely affected by the flood, thus the process of aligning information and other assistance between the community and the authorities went smoothly. However, Pasir Tumboh recorded the lowest value of -0.50 although it is located in a satellite city area where there was less damage and minor lost in the residential area.

The flood's victims in the area were able to survive (food aid or daily necessities) without any attention from the authorities. Besides that, most agencies and volunteers were focused on the remote areas (upstream) like Gua Musang and Kuala Krai. The minority victims in rural or urban areas are normally being paid less attention by the authorities if they are responsible in taking care of them. Beisdes that, the non-government organizations that channelled the donations for the victims receive insufficient information about the location that is badly affected and the victims necessities. This situation has caused uproar between the community and the superior. Thus, an information centre should be developed as an alternative to reduce the risk of missing information and assisting in the provision of holistic data.

Figure 3: Result for pre flood management base on index analysis

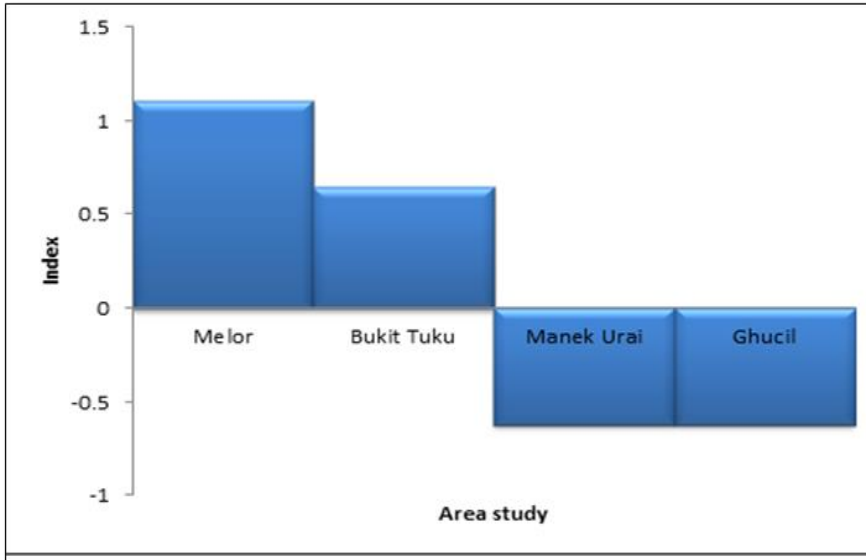


Figure 4: Flood area at Rantau Panjang (border of Malaysia – Thailand)

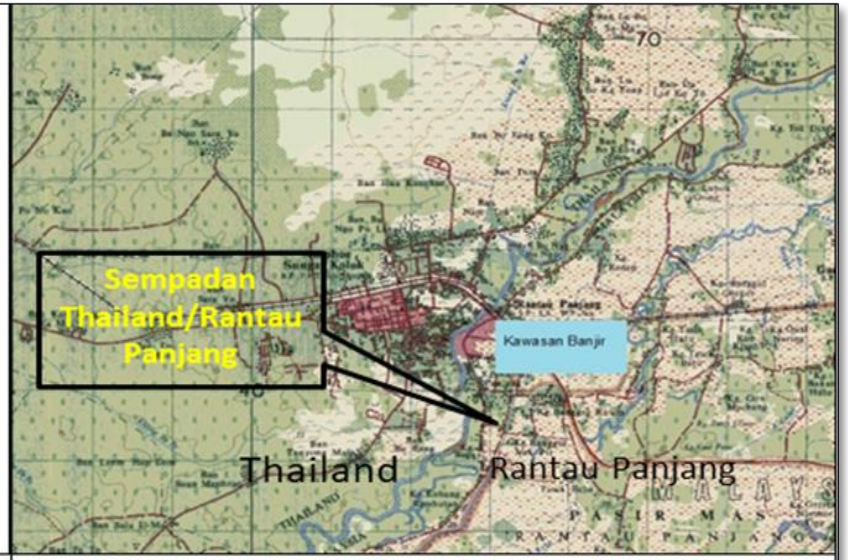


Figure 5: Result for current flood management base on index analysis

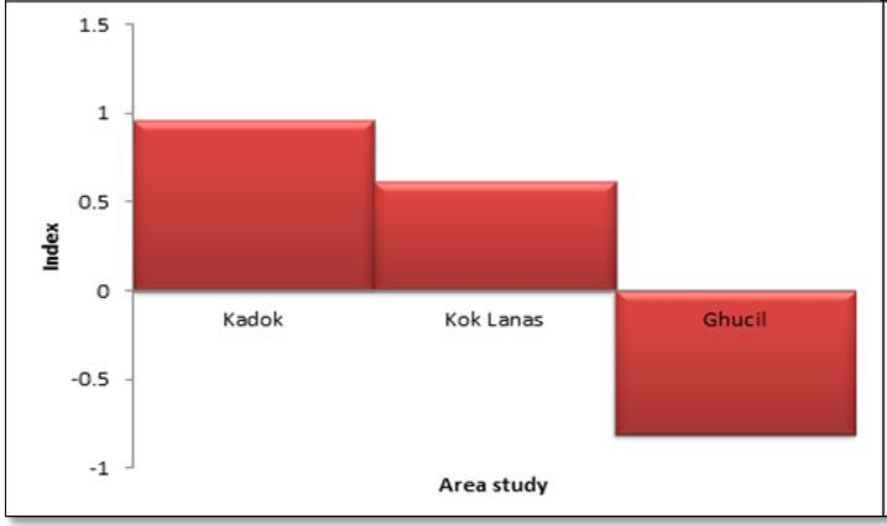
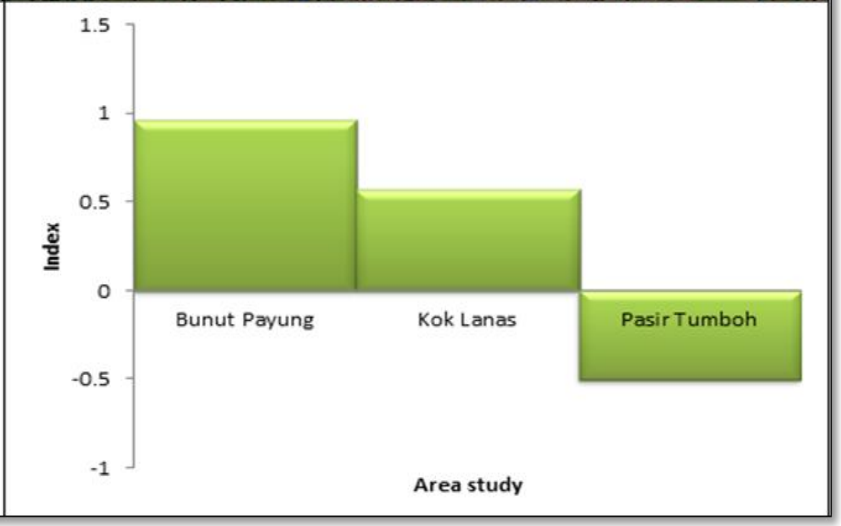


Figure 6: Result for post flood management base on index analysis



Conclusion

In conclusion, based on the analysis of this study, clearly monsoon flood is a natural disaster occurring in Kelantan from November to March every year. This has caused so many difficulties to the residents around the Kelantan River basin in term of the risk of death and loss of property which depending on the level of disaster. In addition, unsystematic management also contributes to the major factor of flood based on index value analysis either pre, current or post of flood. Besides that, the method that is applied to this study, namely principle component analysis (PCA) can reduce the minor factor of disaster in prevention of the flood which gives more impact to the citizen also government. Hence, the administrators are encouraged to take earlier action or approach, especially based on the governance effectiveness management studies that are conducted to address the problems arising from the federal and state governments and also agencies that are involved in managing the flood locations, victims and various other necessities. Additionally, it helps to synchronize the management from subordinates to a more systematic superior while minimizing conflicts that are existed during the disaster period.

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