Improving Flood Management, Prediction and Monitoring

Flood Disaster Management in Sungai Pahang Basin: Case of Temerloh

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ABSTRACT

Flood is one of the most common disasters in Malaysia especially during northeast monsoon season (November–March). This chapter analyses flood disaster management strategies in Pahang on preparations and vulnerabilities of the local communities along the Pahang River Basin, especially in Temerloh. In Malaysia, the National Security Council (MKN) is the organisation that is fully responsible in managing the national disaster management system, which provides an effective relieve mechanism for flood disaster. This study utilises two type of sources which are primary and secondary sources to collect the data. The primary data were collected in June 2015 through a survey of 202 respondents affected by the flood by using semi-structured questionnaires through an interview conducted in person. Meanwhile, the secondary data were collected from the local authorities. From both sources, the survey shows that 31% of the population in Temerloh did not get an early warning notification, more than half involving those in the rural area. Lack of efficient early warning system became one of the vulnerability factors affecting local community. About 78% of respondents have been relocated to the relief centres around Temerloh. Agricultural income dropped by 31.2% as the result of damaged crops and cessation of small businesses, which contributed to the increase in hardcore-poor category by 6.5%. The study concludes that it is essential to review the effectiveness of flood disaster management

Improving Flood Management, Prediction and Monitoring: Case Studies in Asia
Community, Environment and Disaster Risk Management, Volume 20, 91–102

ISSN: 2040-7262/doi:10.1108/S2040-726220180000020017

strategies in Pahang to minimise the aftermath impact of flooding to the community.

Keywords: Floods; flood in Pahang; flood management; disaster management strategies; preparedness; vulnerability

INTRODUCTION

Flood can occur from various sources, including from the sea (coastal and estuarine flooding), from watercourses (fluvial flooding), from overland flow of water that has not reached a natural drainage channel (pluvial flooding), from rising groundwater and from the failure of artificial water system (Lancester, Preene, & Marshal, 2004). River flood poses a serious threat to millions of people living in river basins worldwide. It is one of the effects of climate change that brings about damage and destruction of large and/or significant loss of human life (Chan, 2012). Flood disaster is one of the most common disasters in Malaysia especially during northeast monsoon season (November–March). The weather is usually rough at these months with maximum precipitation volume in east coast region such as Pahang, Terengganu and Kelantan. There are several series of floods in Malaysia since 1971.

In Malaysia, floods are caused by a combination of natural and human factors. Coupled with natural factors such as heavy monsoon rainfall, intense convection rain storms, poor drainage and other local factors, floods have become a common feature in the lives of a significant number of Malaysians. Malaysia exhibits annually increasing trends in temperature per decade, by 0.15–0.25°C, lower than the global average which is 60°C by 2100 (Tangang et al., 2012). However, the rates of warming for the last 40 years were as high as 40°C per decade for several locations in Malaysia (Tangang, Juneng, & Reason, 2007). The increasing temperatures have led to significant impact on the livelihood of locals due to the resulting high rate of melting ice, glacier retreat, drought and floods.

Climate events related to the disasters and shocks are even more prominent if we look back at the records in Malaysia. Large numbers of human lives have been affected by the floods, namely in Kelantan, Terengganu and Pahang. Similarly, greater numbers of livelihood assets of the poor have been severely damaged by climate-related disasters which are found to be still unreported.

Flood disaster management in Malaysia is based on the National Security Council (NSC). Directive No. 20 NSC is the main driver agency of national disaster management. NSC is one of the organisations that is fully responsible to coordinate flood relief operations at every stage of national, state and district levels with the combined aims of reducing flood damage and to prevent loss of human life. According to NSC (2012) and Khalid and Shafiai (2015), there are three levels of disaster management in Malaysia where every committee in every level has its own responsibility. In level I, the committee ensures coordinated actions, with sufficient asset and human resources, in relation to the media. Level II must provide the district assistance with financial aid, assets and human

resources. For the third level, the committee must determine the national disaster management policy, finance, assets and human resources.

One of the worst flood events which occurred in Temerloh, Pahang, is on 2014/2015 compared to previous flood disaster event. According to the report published by Municipal of Temerloh there were about five series of flood events which occurred in Temerloh within the time period between 2007 and 2015. Referring to the data from Municipal Office of Temerloh on 2016, flood series have been occurred in Temerloh in 2007, 2008, 2011, 2014 and 2015. However, there are no flood event on 2009, 2010, 2012 and 2013. The flood event on 2014/2015 has been recorded as the longest flood period with a total of 23 days starting from 28 December 2014 to 15 January 2015. A huge number of flood victims had been recorded on 2014/2015 flood event with 7,052 households and 29,204 victims. That figure is the highest and seven times worse compared to the previous flood series since 2007. However, there were times where no flood disaster event struck Temerloh, Pahang, as well, which is in the years 2009, 2010, 2012 and 2013.

MATERIALS AND METHODS

Study Area

Pahang River Basin is in the central part of the Peninsular Malaysia sandwiched by the Titiwangsa range in the west and Timur range in the east, both of which expand in the north-northeastern direction, at latitude N20 48′45″−N30 40′24″, E1010 16′31″−E1030 29′34″. With the length of 435 km, it covers about 29,300 km^2 of catchment area, of which 27,000 km^2 is in Pahang and 2,300 km^2 in Negeri Sembilan and provides ecosystem services to 1.9 million residents who live along the river to sustain their livelihood (JICA, 2011). The annual rainfall varies from 1,700 to 2,800 mm within the basin (mean annual rainfall obtained across 10 years). The high intensity of rain (>60 mm/hour, 200−450 mm/day) at the upstream river increases the quantity of water in the river and causes it to overflow. Most of the residential areas are located at the lowland and the flood plain region and amidst the bad irrigation system especially in big residential areas. Temerloh faces a larger magnitude of floods because it is located at the confluence of main tributaries (Sg. Jelai and Sg. Tembeling) at the mid-stream area.

Methodology

This study was conducted in Temerloh district which is located in the middle of Pahang state. Temerloh is situated at the junction of Pahang River and Semantan River. This area is the most affected flood areas in Pahang as encountered with the adverse impact of 2014/2015 flood. The data collected for this study were from the primary and secondary sources. The secondary data was collected from the local authorities which are Land and District Office of Temerloh, and Municipal Office of Temerloh. The mixed method of quantitative and qualitative techniques was implemented along this study. The primary data were collected in June 2015 through a survey of 202 respondents who were affected by the flood by using a semi-structured questionnaire through an

interview conducted in person. Respondents were chosen through the stratified random sampling technique. The questionnaire administration was cross-sectional in nature. It was designed, tested and administrated at the household level. The questionnaire analyses for this chapter consist of a prevention measure to reduce the impact of flood which included the details about five items on vehicles, house/building, crops, livestock and others. Every single item will be represented by several prevention measure questions. Data obtained were analysed using Statistical Package for Social Science (SPSS) for Windows version 21. Descriptive statistics such as frequency distribution, observation scale as well as range and percentage value are widely used to quantitatively discuss and justify arguments. Due to the ordinal data, the analysis process will be done by using descriptive and non-parametric analysis. Descriptive analysis was done to discuss on demographic profile of respondents which related with strata, gender, age, occupations, education levels and household income. The selection of non-parametric analysis was due to the collected data as ordinal and non-normal distribution data. Wilcoxon *t*-test which referring to the non-parametric has been implemented to analyse the question related with preventive measure to reduce the impact of flood.

RESULTS AND DISCUSSION

Respondents Demographic Profile

Demographic characteristic of respondents has been shown in Table 1. There are about 202 respondents who involved in the survey. From the total respondents, there are about 128 respondents (63.4%) staying in the urban area. Meanwhile the rest of respondents are from rural area. Majority of the respondents were males amounting to 114 individuals (56.4%) and 88 were females (43.6%). Based on age aspect, 119 individuals (58.9%) were between the ages 41−65 years old, 44 individuals (21.8%) were between the ages 19−40 years old and the rest of individuals were more than 65 years old (19.3%). In average, the mean age for the respondents was about 52 years old.

According to Table 1, the highest percentage level of education among respondents is Higher Certificate Education (SPM) with 79 individuals (39.1%). Only 21 individuals (10.4%) have completed their tertiary education for STPM, Certificate and Degree level. Meanwhile, 102 individuals (50.5%) did not finish their secondary education and 2 individuals did not even have formal education in school. Almost 50% of respondents in Temerloh are self-employed in various sectors such as agriculture, small enterprises, craftsman, lorry driver, mechanic and others. The majority respondent (51%) have the household income below than RM1,000/month. Meanwhile, 2 individuals (1%) did not have any source of income, 21 of the respondents (10.4%) have the household income range between RM2,001 and RM3,000/month and 4% of individuals have income range between RM3,001 and RM4,000/month. Only two individuals (1%) have income more than RM4,000/month.

Table 1. Demographic Profile, Value of Financial Loss and Perception of Prevention Measures.

Demographic Profile	
Item	Temerloh ($n = 202$)
Strata	
Urban	74 (36.6%)
Rural	128 (63.4%)
Age	
19−40 years	44 (21.8%)
41−65 years	119 (58.9%)
>65 years mean	39 (19.3%)
	51.2
Level of education	
Degree	9 (4.5%)
Certificate	1 (0.5%)
STPM/Diploma	11 (5.4%)
SPM	79 (39.1%)
SRP/PMR	38 (18.8%)
Primary school	62 (30.7%)
No schooling	2 (1.0%)
Gender	
Male	114 (56.4%)
Female	88 (43.6%)
Occupation	
Government	16 (7.9%)
Private	19 (9.4%)
Self-employed	98 (48.5)
Housewife	25 (12.4%)
Student	2 (1%)
Not-working	19 (9.4%)
Others	23 (11.4%)
Household income	
No income	3 (1.5%)
<MYR1,000	103 (51.0%)
MYR1,001−MYR2,000	65 (32.2%)
MYR2,001−MYR3,000	21 (10.4%)
MYR3,001−MYR4,000	8(4.0%)
>MYR4,000	2(1.0%)
Value of Financial Loss (in Ringgit Malaysia)	
Value	Temerloh ($n = 202$)
<MYR100	1 (0.5%)
MYR100−MYR500	16 (7.9%)
MYR501−MYR1,000	6 (3%)

Table 1. (*Continued*)

Value of Financial Loss (in Ringgit Malaysia)		
MYR1,001−MYR2,000		15 (7.4%)
MYR2,001−MYR5,000		55 (27.2%)
MYR5,001−MYR10,000		45 (22.3%)
MYR10,001−MYR20,000		53 (26.25%)
MYR20,001−MYR50,000		9 (4.5%)
>MYR50,000		2 (1%)
Total		**202 (100%)**
Perception of Prevention Measures to Reduce the Impact of Flood		
Item	Value	
	z value	Asymp. Sig. (2-tailed)
To protect vehicle from flood damage		
Park vehicles at a high place	−0.565[b]	0.572
Prepare canoe/engine boat	−2.096[b]	0.036
To prevent inundation/damage of houses		
Build higher-storey houses	−2.471[b]	0.013
Increase floor heights	−1.892[b]	0.058
Build up structures with concrete material	−2.705[b]	0.007
Keep ditches clean	−1.817[c]	0.069
To protect households properties from flood damage		
Build the higher rack (under rooftop)	−0.004[c]	0.997
Build the loft to keep the things	−0.765[c]	0.444
To protect standing crops from flood damage		
Harvest premature crops	−0.691[c]	0.490
Store seedling	−2.61[c]	0.794
Build higher storage	−1.233[b]	0.218
Build concrete wall	−0.494[b]	0.621
To protect livestock		
Move to a high place/ hillside	−0.357[c]	0.721
Shift to relative área	−1.770[c]	0.077
Other		
Move to the new settlement.	−3.276[c]	0.001
Bamboo trees planting	−2.236[c]	0.025

Note: [b]; based on positive rank. [c]; based on negative rank.
Source: Field Survey, 2015.

According to Table 1, for value of financial loss section, 23 individuals (11.4%) have financially loss value at MYR1,000 and below. A total of 15 individuals (7.4%) have financially loss value range between MYR1,001 and MYR2,000. The highest financial loss experience reported in Temerloh of 153 (75.7%) respondents is a financially loss average between MYR2,001 and MYR20,000 which in each range represent more than 20% of total respondents. Beside that 11 individuals (5.5%) experienced financial value loss for more than MYR20,001. The financially loss and damages incurred cause by flood is more than the annual household income for majority of the Temerloh respondents. The value of financial loss has been divided into three categories which are vehicles, building and agricultures. All those categories have been divided into several components to evaluate the number of total loss experienced by the selected respondent.

How Do We Manage Flood Risk?

Local Authorities' and Communities' Preparedness towards Flood Disaster

It is generally acknowledged that preparation and planning for natural hazards such as floods can help to avoid or reduce damage and losses and thus lessen many negative socio-psychological impacts (Tapsell, 2011). Preparedness is one of the crucial elements that should count in flood risk management programme. There are several preparedness actions which will be taken by the local communities which are: (1) preparedness at the household level, (2) signing up to receive flood warnings and (3) taking out insurance with the policy that will cover them for flooding. Preparedness action taken by households have range from keeping alert for flood warning during high-risk months, not keeping irreplaceable item on ground floors and acquiring sandbags, to moving valuables, personal property and cars. (Tunstall, Tapsell, & Green, 2006). More than 70% of Temerloh respondents had experienced and became flood victims previously. Although, the flood warning system have been installed around Temerloh district, however, there are still 31% respondents who did not receive flood early warning. In addition to that, majority of the respondents had also received early warnings regarding the flood from the main source of media such as television and radio. This is 50% higher as compared to other sources such as siren, through physical lookout (observation), flood benchmark, warning from local authorities, newspaper, website, and others. About 78% of respondents have been relocated to the relief centres around Temerloh during the flood.

In many countries, flood risk management is evolving from traditional approaches based on design standard to the development of risk-based decision making, which involves taking account of a range of loads, defence system responses and impacts of flooding. Flood risk management aims to reduce the likelihood and/or the impact of floods. According to NSC (2012), there are several preparedness actions should be taken by the Malaysia government agencies, statutory bodies and non-government organisations which get involved with Disaster management either individually or in collaboration: (1) observe and update the flood risk zone area; (2) prepare the infrastructure for early

warning system; (3) develop and strengthen the expert, manpower, competence, communication system, technologies, logistics, financial and others; (4) educate all segments of local communities to increase flood disaster awareness and (5) prepare Emergency Response Plan (ERP). According to NSC (2012), there are several preemptive counter measures that the Malaysian government had proposed through the relevant agencies, statutory bodies, and non-governmental organisations. This is because each of these stakeholders plays a role either on the individual or collective basis. The preemptive counter measures proposed comprises of: (1) To observe and update the flood risk one area; (2) To prepare the infrastructure for early warning system; (3) To develop and strengthen the expertise, manpower, competency, communication system, technologies, logistics, financial and others; (4) To educate all segments of local communities to increase the flood disaster awareness; (5) To prepare the Emergency Response Plan (ERP). Early action will be taken by the chairman of DDMRC if there is hazard at the district level as follows: assess the situation and determine level and scope of disaster, plan actions to be taken, capabilities of local agencies, determine relief needed, request assistance at higher level (state/federal) when required, and abide by the rules and regulations (Che Moin, 2008).

Non-parametric Test – Wilcoxon t-*test on Prevention Measure to Reduce the Impact of Flood*

Flood disaster that occurred in Temerloh, Pahang, has given an impact to the affected individual who experiences the event. This flood disaster will affect the behaviour of the human in action. In this study, human behaviour will be assessed based on the importance of prevention measure to reduce the impact of flood within two different time frames which are referring to the pre- and post-flood disaster. The Wilcoxon *t*-test has been implemented to analyse the difference of human behaviour on preventive measure taken to reduce the impact of flood for pre- and post-disaster. The result will be shown in the Table 1.

The table below has shown the analysis of Wilcoxon *t*-test. The result had determined whether the flood event that hit Temerloh, Pahang, will give an impact on the individual behaviour during pre- and post-flood disaster. Overall, there are five preventive measures that show the significant difference between pre- and post-flood disaster. Wilcoxon statistic result shows that there visible differences in the behavior of the locals in preparation to face the flood such as by preparing the necessary maintenance of the canoe/sampan/boat and its engine, by building a more elevated houses structure (pillars), reinforcing the structure with concrete, planting more bamboo trees, and also by moving to a new location altogether.

Under vehicle item, Wilcoxon statistic result in Table 1 showed that there are differences of behaviour for preventive measure step during pre- and post-flood on preparation of canoe and boat with engine, $z = -2.096$, $p < 0.05$. The post-test mean that rank value (mean rank = 35.77) was lower compared to previous mean rank (mean rank = 47.80). Therefore, by preparing alternative methods of

mobilization/evacuation of the victims, the process of evacuation to the respective centres will have a higher probability of commencing smoothly and subsequently will ease the process of search and rescue.

In regards to structural properties and its characteristics, there are two prevention measures that have already been applied and can be observed with significant differences value; houses were built quite high from the ground level, and structures were then reinforced with concrete. The prevention measure to build up the higher storey house, $z = -2.471$, $p < 0.05$, is showing the mean rank of post-test (mean rank = 29.61) is lower compared to the previous mean rank (mean rank = 38.46). Meanwhile, the mean rank of post-test to build up structures by using a concrete material also show the same pattern by using the Wilcoxon statistic, $z = -2.705$, $p < 0.05$, the difference mean rank of post-test = 29.61 and previous mean rank is 38.46. It is necessary for the local communities in Temerloh to build the higher storey house to prevent the inundation during the flood season by referring to the last previous water level for flood disaster. Besides that, the concrete materials will ensure the house structure to survive with strong water current during the flood.

The other preventive measure that gives the significant difference during pre- and post-flood event is bamboo tree planting, $z = -2.236$, $p < 0.05$; the difference mean rank of post-test = 22.20 is higher compared to previous mean rank which is 18.68 by using Wilcoxon *t*-test. Bamboos are fast-growing woody grasses that grow mostly in the tropics and subtropics in mixed forests or as pure stands, and are cultivated in plantations, on homesteads and on farms. According to Kuehl, Hanley, and Lou (2011), the bamboo plant itself provides beneficial implications to the locals, such as by providing protection from extreme weather and natural disasters, reducing soil erosion, act as windbreakers and shelterbelts, and its resources (bamboo) could also be used to construct shelters (post-disaster).

Besides that, the element of moving to the new settlement also shows the significant differences in Wiscoxon *t*-statistic test, $z = -3.276$, $p < 0.05$ with mean rank value post-test (mean rank = 18.21) higher than the previous mean rank which is 11.38. According to the survey, 177 (87.6%) respondents in Temerloh would agree to not move to the new settlement. Resettlement is a passive response usually taken as an attitude of resignation that little can be done about disaster. Therefore, this action is a seldom popular solution in hazard and disaster management. The local communities living in that area for a long time already grow attached to their location, develop intricate and close kinship and others close ties with neighbour and friends and have a set pattern of life which they cherish and are reluctant to change (Chan, 1995). The resettlement process in Temerloh district will be costly and the government needs to acquire alternative locations and provision of housing for those resettled.

Without a doubt, it is really important to acknowledge and pay close attention to the five significant prevention measures taken to reduce the impact of flood disaster. However, there also non-significant results by respondent for pre and post of flood event have describing that there no significant action for pre-

and post-flood event on prevention measure to reduce the impact such as for build up the higher rack under the rooftop and loft to place all the belonging and conducting collaboration to clean up a ditches have increase the low z value with $p > 0.05$. The rationale for this decision is the step that takes approximately one action time and also an action that is always done (make sure the surrounding area keep clean / collaborative).

According to Wilcoxon test, most of the flood prevention measure for item under agriculture for crops and livestocks are not significant due to the low z value with $p < 0.05$. This situation could be explained through the demographic characteristic of respondents in Temerloh. Majority of the respondents were not involved in agriculture sectors. On the contrary, the result indicates that 48.5% of the Temerloh's respondents are self-employed. However, only 40 individuals out of 98 respondents were involved in small scale of agriculture sector.

Flood warning system is an essential tool in the management of floods, providing people with advance notice of flooding in an effort to save lives and help peoples prepare before it happens. Flood warnings are provided to reduce the impact of flooding on people's home and businesses. These actions contribute to saving money, stress and time during the recovery period after floods disaster. Even if effective warning systems are in place, there is still uncertainty over if or how recipients will respond upon receipt of a warning. Action taken by recipient often ineffective, many peoples will do something else which will reduce time that could be spent saving belongings.

Challenges Face by the Local Authorities

Although the local authorities in Temerloh already have an experience from several previous flood series, however, they still need to face few obstacles during the process to manage all the floods victims. There are several issues that will be the main obstacles to the local authorities during the flood event which are related with transportation, communication and capacity of flood evacuation centres (Temerloh Municipal Council, 2016). According to the report given by Temerloh Municipal Council, there are insufficient transportation capacity for air and water. Water transportation is really crucial during flood event. In relation to this, due to the lack of suitable and proper method(s) of transportation, the process providing aids to the deeper areas that were affected might be troublesome. This is simply because in order to go against the heavy flow or current in Sungai Pahang, the required boat must be equipped with an engine with the capacity of 60hp. For the air support, there is need of large-capacity helicopters to bring foods, and aids to the flooding location and disburse immediately in large quantities. Besides that, communication between local authorities and local communities also become a problem due to the misunderstanding of certain information, lack of line coverage during flood event and uncontrollable viral information that will affect the action of flood victims during the management process.

CONCLUSIONS

According to the analysed collected data, the biggest financial losses experienced by the local communities in Temerloh district caused by flood disaster event are between MYR2,001 and MYR20,000 for 75.7% who are badly affected by flood disaster. Self-employed respondents are the most affected group where most of them are involved in agriculture sector. Based on the prevention measures to reduce the future flood impact through the utilization of Wilcoxon t-test which identify both pre- and post-flood disaster actions taken, it shows that there are five measures/items in total that have been implemented by the locals; (i) preparing canoe/sampan/boat and its engine; (ii) elevating the structure of the houses to higher level from the ground level; (iii) the utilization of concrete to reinforce the building structural capacity; (iv) relocation to a new settlement; and (v) the utilization of the bamboo tree/plant. Transportation, communication and capacity of flood evacuation centres were the major issues to local authorities. As a conclusion, the long-term education mechanism at various levels of local communities is crucial to increase awareness and give early exposure for preparedness purpose in order to reduce the impact of future flood disaster.

ACKNOWLEDGEMENTS

The authors acknowledge the research grants provided by the Ministry of Higher Education (KPT) for the research on 'Socioeconomic, Wellbeing, and Health Impacts of Flood Disaster in the Pahang River Basin: Implication for Livability, Sustainability and Quality of Life' under project code (TRGS/1/2015/UKM/01/1/3). Author also wants to acknowledge the support given by the National University of Malaysia (UKM) for the research on 'An Integrated System Approach for Long-term Flood Disaster Management in Pahang River Basin' under project code (GUP-2016-025).

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