



Exploring the managing of flood disaster: A Malaysian perspective

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Abstract

Flooding occurs periodically in Malaysia and has become a common occurrence. This annual occurrence of floods has given a big impact on lives of humans and other living being. Due to the negative impact of floods, we need to pay serious attention and take an alternatives way to reduce this disaster. This paper reviews previous articles relating to flood disaster management in Malaysia based on electronic databases which are subscribed by the university library. The flood disaster management in Malaysia involves four phases, which are prevention/mitigation, preparedness, response and recovery. The disaster prevention/mitigation and preparedness are the best way forward because if these two phases were successfully handled, the burden of the next phases will be reduced. Besides, the agencies responsible for the management of floods in Malaysia have been identified in this study. The usage of technology for managing flood events has also been reviewed. The role of communities affected by the floods is no less important. Their awareness and readiness in facing the flood disaster are indispensable so that the negative impacts resulted from the disasters can be minimised. Therefore, the community should be educated to improve their awareness regarding flood management especially on how and what to prepare for flood as well as how to react during the flood.

Keywords: disaster management phases, flood disaster management, flood preparedness, flood recovery, Geographic Information System, prevention/mitigation

Introduction

Over the last three decades, flooding is a major risk in the world and nowadays it is becoming common in Malaysia. It has caused loss of lives and destruction of properties(Kourgialas & Karatzas, 2011). It is one of the natural disasters that prevents the development of a country (Elias et al., 2013). The changes of flood trends are due to changes of climate, use of land, growth of urban and human activities such as deforestation and infrastructure development across the watercourse (Amini et al., 2011; Kourgialas & Karatzas, 2011).

In Malaysia, past researches showed that flood is the most common disaster affecting a number of areas especially the low area since 1920s. Past researches stated that almost 9% of the total disaster is caused by the widening of the area while almost 22% of the total population is directly affected by floods (Salleh et al., 2013; Othman et al., 2014; Aliagha et al., 2015; Khalid & Shafiai, 2015; Tan et al., 2015). Indeed, the flood disaster is expected to keep rising in line with the increase of migration from the rural residents to the cities, changes in the structure of soil which is caused by uncontrolled development, poverty and

other factors that threaten the floodplain areas (Mustaffa et al., 2014). Floods often occur in Malaysia due to the increase in the frequency of rainfall and the rise of the level of the sea in certain parts of the country (Aliagha et al., 2015). Furthermore, the condition of climate in Malaysia is experiencing rainfall with the average of approximately 2,500 mm a year in Peninsular Malaysia, 3,000 mm a year in Sabah and 3,500 mm a year in Sarawak (Tahir, 2009; Khalid & Shafiai, 2015; Tan et al., 2015) making it as a common natural disaster in Malaysia (Othman et al., 2014).

Specifically, there are two types of flooding that usually occur in Malaysia which are monsoon flood and flash flood. Monsoon flood normally happens around the month of May until August (Southwest Monsoon) and around the month of November until February (Northeast Monsoon) (Austin & Baharuddin, 2012; Tan et al., 2015). On the other hand, flash flood usually happens in the busy city. It is caused by the uncontrolled human activities such as infrastructure development near the river areas and uncontrolled littering causing clogged drains and waterways (Othman et al., 2014; Sipon et al., 2015). This situation is definitely worrying to the public as it has a negative impact on life, property, infrastructure, agriculture, human health and economic status which are affecting the community's quality of life (Austin & Baharuddin, 2012; Elias et al., 2013; Abram et al., 2014; Aliagha et al., 2015; Hammond et al., 2015). Therefore, efforts need to be implemented to resolve the problem. The effectiveness of flood disaster management should be given attention so that this situation cause by the disaster can be alleviated (Othman et al., 2014). Hence, this paper intends to get the information about how the flood issues have been managed in Malaysia as reported in the published literature.

Method and data extraction

The present researchers reviewed the information of flood issues by accessing the electronic databases subscribed from the university library (i.e. Ebscohost, Emerald, Proquest and Science Direct). The document and reports provided by the relevant agencies in Malaysia were also reviewed. The agencies involved are the Department of Irrigation and Drainage as well as the Department of Meteorology. In addition, the references in the manuscripts were also reviewed in searching for any additional study related to the current research. The limitation of dates has not been assigned so that most of the studies related to flood disaster management in Malaysia were identified. The titles and abstracts were then screened in order to achieve the required criteria that includes the full-text manuscripts available and discussions about flood disaster in the context of Malaysia. The method of study were not limited to either quantitative or qualitative. Table 1 provides the search criteria applied in this study.

Table 1. Search criteria

Database	Search terms
EBSCOHOST	flood AND disaster AND management AND Malaysia [Refine results: Full text; Malaysia; Journals; and Academic Journals]
EMERALD	flood AND disaster AND management AND Malaysia [Refine results: natural disasters, disasters, floods]
PROQUEST	flood AND disaster AND management AND Malaysia [Refine results: social science, disasters, disaster relief, climate change, floods]
SCIENCE DIRECT	flood AND disaster AND management AND Malaysia [Refine results: full text]

The full-text data extractions of the manuscripts were then screened. The data extraction includes author, year, journal, database and purpose of study. As the purpose of this study is to identify the management of floods in Malaysia, the manuscripts were then reviewed to find three types of information which are flood disaster management phases, the agencies involved and the use of technologies.

The search on electronic databases produced 81 titles and abstracts. However, a total of 19 manuscripts were selected for full-text review for data extraction after going through the basic screening using inclusion criteria including full-text manuscripts available, flood disaster and within Malaysian context. Table 2 presents the search results of this study.

Table 2. Search results

Database	Search terms	#of titles and abstracts	# of titles and abstracts after screening
EBSCOHOST (Academic, Business, Education, Psychology, etc.) –Academic Search Complete	flood AND disaster AND management AND Malaysia [Refine results: Full text; Malaysia; Journals; and Academic Journals]	33	5
EMERALD	flood AND disaster AND management AND Malaysia [Refine results: natural disasters, disasters, floods]	14	7
PROQUEST	flood AND disaster AND management AND Malaysia [Refine results: social science – disasters, disaster relief, climate change, floods]	6	2
SCIENCE DIRECT	flood AND disaster AND management AND Malaysia [Refine results: full text]	28	5

The full-text was reviewed for data extraction which includes author, year, journal, database and the purpose of the study. The results of the data extraction are presented in Table 3. Based on the finding, the manuscripts were published between the years 1995 to 2016. The subsequent sections will discuss on the current flood management in Malaysia, the agencies involved and the use of technology in flood management in Malaysia found during the review process.

Table 3. Data extraction results

Author(s) / Year	Database / Journal	Purpose
Amini et al. (2011)	EBSCOHOST Arabian Journal for Science and Engineering	To assess the effects of land-use changes and predict the effects of two future land-use scenarios on the flood regime of the Damansara Watershed using hydrologic models and spatial data.
Austin and Baharuddin (2012)	EBSCOHOST Kajian Malaysia	To examine the agricultural risk factors and the policies in place for countering them.
Baharuddin et al. (2015)	EBSCOHOST Malaysian Journal of Medical Science	To highlight the experiences, challenges, and recommendations resulting from the true disaster event
Billa et al. (2004)	EMERALD	To highlight the spatial information technology in flood disaster management and its application in

Author(s) / Year	Database / Journal	Purpose
	Disaster Prevention and Management	Malaysia
Billa et al. (2006)	EMERALD Disaster Prevention and Management	To present a comprehensive flood management plan for Malaysia which includes various planning stages and the proponents of the plan as well as to expand and highlight the importance of spatial information technology in the strategy and to outline the critical decision-making at various levels of the plan.
Chan (1995)	EMERALD Disaster Prevention and Management: An International Journal	To examine the effectiveness of government-run permanent relocation schemes as a response to flood hazards in Malaysia.
Chan (1997)	EMERALD Disaster Prevention and Management: An International Journal	To discuss flood risk in Malaysia including the causes, the impacts and how floods can be controlled.
Darrien et al. (2011)	EBSCOHOST Water SA	To demonstrate a theoretical flood management framework inferred from Sarawak River modelling outputs.
Elias et al. (2013)	SCIENCE DIRECT Procedia - Social and Behavioral Sciences	To examine the English Flood and Water Management Act 2010 (Act for flood risk management in England and Wales) as a benchmark for the potential Malaysian legal counterpart.
Hamin et al. (2013)	SCIENCE DIRECT Procedia - Social and Behavioral Sciences	To examine the governing modalities coordinating and integrating the policies and programs to reduce flood-related disaster risks and then propose a single legislation for Malaysia in flood management.
Johari and Marzuki (2013)	PROQUEST International Journal of Social Science and Humanity	To discuss how stress, anxiety and depression are related to the quality of life and well-being of flood victims.
Katuk et al. (2009)	EMERALD Disaster Prevention and Management	To present the utilisation of a web-based support system for flood response operation in Malaysia.
Khailani and Perera (2013)	SCIENCE DIRECT Land Use Policy	To assess the extent to which the local development planning system in Malaysia has responded to the vulnerability reduction and resilience improvement needs of the civil society to adapt to climate change-induced flooding.
Khalid and Shafiai (2015)	PROQUEST International Journal of Social Science and Humanity	To discuss the issues relating to the role of the delivery system provided by the government to the flood victims in Malaysia, pre-disaster, during and post-disaster caused by flooding.
Mah (2011)	EMERALD Disaster Prevention and Management	To present a hydrodynamic river modelling by incorporating river flow and sea-level rise interactions.
Mansor et al. (2004)	EMERALD Disaster Prevention and Management	To develop a methodology to model disaster risk for flood risk management and in peat swamp, forest fires to assist in providing decision support systems for emergency operations and disaster

Author(s) / Year	Database / Journal	Purpose
		prevention by integrating high spatial resolution remote sensor data with Geographic Information System (GIS) data and multi-criteria analysis.
Mohit and Sellu (2013)	SCIENCE DIRECT Procedia - Social and Behavioral Sciences	To study the flood situation of Pekan town in terms of the intensity of the flood damages and the severity of flooding due to sea-level rise and propose the community-based sustainable flood mitigation policies and measures for the town.
Othman et al. (2014)	SCIENCE DIRECT International Journal of Disaster Risk Reduction	To propose COBIT which has been widely accepted and used in business enterprises, as an approach to governing natural disaster management projects by having well-defined governance over processes, the required information and related information technology.
Yahya et al. (2016)	EBSCOHOST Journal of Theoretical and Applied Information Technology	To identify the processes that are common and essential in the implementation of knowledge transfer from multiple senders to one receiver using the star topology as the architecture

Flood disaster management in Malaysia

Flood disaster management is a program that benefits humans. It involves the preparation and planning that must be given more attention before the flooding occurs so that the destruction of property can be definitely reduced (Hamin et al., 2013). In Malaysia, the flood management is governed by the National Security Council Directive No. 20 (Elias et al., 2013; Yahya et al., 2016). However, as stated by Elias et al. (2013), the National Security Council Directive No. 20 is not the corporation responsible for managing flood in Malaysia, but it is just a department that provides the policy and guidelines on disaster management.

Basically, a common and comprehensive approach of flood management should involve four phases as stated in Figure 1 which are (i) prevention/mitigation, (ii) preparedness, (iii) response and (iv) recovery (Weng, 1995; Padli et al., 2010; Hamin et al., 2013; Mohit & Sellu, 2013; Baharuddin et al., 2015; Khalid & Shafiai, 2015; Yahya et al., 2016). The first phase and second phase are preparations before a disaster occurs, then the third phase is the actions made when a disaster occurs while the last phase is the activities done after the incidence of the disaster which consists of disaster relief, rehabilitation and reconstruction (Billa et al., 2006). According to Baharuddin et al. (2015), two of flood management phases such as prevention/mitigation and preparedness phases are the most important phases and should be given more attention. The following sections discussed in detail about each phase of the flood management which are applied in Malaysia.

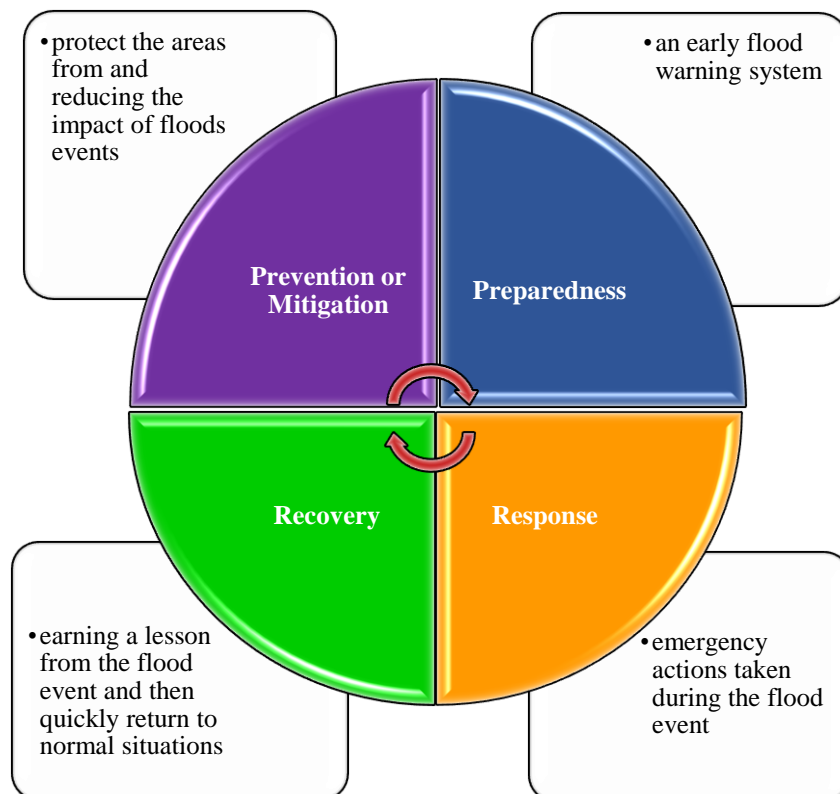


Figure 1. Flood disaster management phases

Flood prevention or mitigation

In Malaysia, the government has executed the various strategies in prevention or mitigation of the floods (Salleh et al., 2013) in order to avoid and reduce the destruction and loss of properties, death and spreading of infectious diseases (Hussain et al., 2014). Flood prevention or mitigation are the actions including structural and non-structural measures carried out to protect the areas identified as a flood area. The main purpose of flood prevention is to reduce the impact of floods on human and others (Khalid & Shafiai, 2015). As stated by (Mohit & Sellu, 2013), a structural measure of flood prevention refers to the procedures of applying engineering in controlling the flood issues and protecting of human settlements such as developing of dams, seawalls, revetments, levees and embankments. When the measure of flood prevention is applied, it can reduce the negative impacts of the natural hazards, environmental degradation and technological hazards (Othman et al., 2014). As seen in study of Hussain et al. (2014), they reported that the measures of flood mitigation have been built along the Kelantan River such as high concrete levees and pump. These measures have slightly reduced the number of flood victims in the year. In addition, Sidek et al. (2014) stated that the role of dams is not only as a generator to generate or produce hydroelectric energy power source for local consumption, but it is one of the structural flood mitigation measures that is applied in several countries including Malaysia.

While, the measure of non-structural refers to the pre-disaster planning involves the regulation of human activities and societies in order to reduce the damage of properties. Among the regulations implemented are the use of planning policies and the limitation of industrial activities near the flood-prone areas (Elias et al., 2013; Mohit & Sellu, 2013; Khalid & Shafiai, 2015). Besides, the measure of non-structural involve the task to inform the early warnings of floods effectively to the flood victims (Mohit & Sellu, 2013; Othman et al.,

2014), they stated that Pekan Town is one example of the measure of non-structural flood disaster management in Malaysia. In their study, they also provided several examples of structural and non-structural flood mitigation measures that are currently applied in Malaysia (Table 4).

Table 4. Structural and nonstructural flood mitigation measures in Malaysia

Structural Measures	Non-Structural Measures
<ul style="list-style-type: none"> • Flood Control Dams (FCD) Canalization and Related Works Poldering (Ring Bund) • Flood Diversion Channel or Tunnel Storage Ponds of Flood Attenuation 	<ul style="list-style-type: none"> • Integrated River Basin Management (IRBM) Preparation of Guidelines and Design Standard Resettlement of Population • Flood Forecasting and Warning System

Source: Mohit and Sellu, 2013.

Flood preparedness

According to Khalid and Shafiai (2015), flood preparedness is an early flood warning system which involves the process of providing relevant flood information to the public so that the public will be more aware about the flood risks and they will know how to react to the flood. Providing of flood information to the public will indirectly reduce the unwarranted impact of flood during and after. However, Billa et al. (2006) reported the cause of weakness in flood management is due to the awareness of dangers on flood among society which is still low.

Therefore, the awareness on flood risk is the most important and needs to be spreaded to the societies, especially those who are living in the flood-prone areas. Education will increase public awareness regarding the natural disaster and preparedness especially among the neo-literate population (Padli et al., 2010). As indicated by Mansor et al. (2004), an effective of flood preparedness requires the responsible agencies to have relevant knowledge regarding the past floods as well as having the ability to anticipate impending floods which are (i) ability to anticipate a possible floods, (ii) ability to identify the population exposed to the danger of flooding and require that information communicated to them and (iii) ability to disseminate information to the population properly and efficiently that enable them to avoid negative impacts of flood events. They also suggested that several strategies can be done to acquire the knowledge needed which are assessing the hydrological system, monitoring the networks and information system, assessing flood risk and damage, forecasting flood and managing operational water systems, monitoring the river hydraulics and morphology system, and studying the land use and climate change.

Flood responses

The phase of flood responses involves the emergency actions that will be taken during the flood event (Khalid & Shafiai, 2015). Baharuddin et al. (2015) provided a case study of flood response during a flood disaster in Kelantan from the medical perspective happened in the year 2014. Based on the experiences and challenges, they encountered some problems during the flood events such as the lack of medical staff and treatment rooms to handle the flood victims. In addition, the communication system was also affected that caused the loss of contact with others. Therefore, they proposed several improvements including (i) flood disaster preparedness and response training to both administration and medical staff, (ii) standard operating procedures for every level of flood disaster responses and must be tested and drilled (iii) effective communication system to be used during rescue and relief operation.

Flood recovery

Flood recovery phase refers to the process of review about the past flood event and then back to normal situations quickly as well as mitigate of both the social and economic impacts of the flood event (Khalid & Shafiai, 2015). This phase involves the relief and rehabilitation support to the flood victims which include both material and moral supports. The flood relief teams should be provided with good training on the flood planning and maintenance in order to be better in managing of the recovery phase (Hamin et al., 2013). In this phase, it is not only the responsibility of the government agencies, but it must involve the developing countries including Malaysia, thus assistance from private and non-governmental organisations is also indispensable (Salleh et al., 2013).

Agencies involved in managing flood disaster in Malaysia

The managing of flood requires the cooperation between the responsible agencies and the community so that the implementation of flood management phases could be addressed equally (Elias et al., 2013; Khalid & Shafiai, 2015). In Malaysia, there are a few agencies involved and are responsible for the flood management including National Security Council (NSC), Police Department, Fire and Rescue Department, Civil Defence Department, Welfare Department, Public Works Department, Meteorology Department, as well as Department of Irrigation and Drainage (Billa et al., 2004; Katul et al., 2009; Ismail et al., 2012; Elias et al., 2013; Khalid & Shafiai, 2015). Each agency has different roles and response for different situations. Normally, in the prevention/mitigation phase, the Department of Irrigation and Drainage is the most important agency who will be responsible and this agency has done an extensive program of flood control and mitigation (Billa et al., 2004; Ismail et al., 2012). However, Othman et al. (2014) claimed that most of the agencies are frequently focused on the activities involving a warning, emergency relief, and rehabilitation which done during the disaster. Table 5 provides the roles of agencies involve in flood management in Malaysia as stated by Othman et al. (2014).

Table 5. Roles of the agencies involve in flood disaster management in Malaysia (during the event)

Roles	Agencies
Search and rescue: Search and rescue of victims	<ul style="list-style-type: none"> • Fire and Rescue Department • Royal Malaysia Police • Malaysian Armed Forces • Special Malaysia Disaster Assistant and Rescue Team (SMART) • Emergency Medical Services • Atomic Energy Licensing Board • Civil Defense Department
Health and medical: - Management of emergency treatment - Management of forensic - Management of public health	<ul style="list-style-type: none"> • Emergency Medical Services • Malaysian Armed Forces • Malaysian Red Crescent Society • St John Ambulance
Welfare: - Evacuating victims - Preparing foods for victims/duty officers - Provide/manage places of evacuation - Providing first aid and counselling services	<ul style="list-style-type: none"> • Welfare Department • Emergency Medical Services • Malaysian Red Crescent • St John Ambulance • RELA • Civil Defense

Roles	Agencies
Support: - Logistic support - Communication and other assistance for smooth control of operation and overcoming disaster	<ul style="list-style-type: none"> • District Office • Municipal/Town Council • National Electrical Power (TNB) • Malaysian Telecommunication (Telekom Malaysia /TMB) • Royal Malaysian Police • Malaysian Armed Forces • Public Works Department
Media: - Press coverage - Electronic and media coverage - Media control	<ul style="list-style-type: none"> • Information Department • Broadcasting Department
Security control: - Provide control at the scene of incident - Conduct investigation - Facilitate communication	<ul style="list-style-type: none"> • Royal Malaysian Police • RELA

Source: Othman et al., 2014.

The use of technology in managing of flood disaster

The findings of this review found that there are several technologies used in managing flood in Malaysia such as mobile phone short message service (SMS), web-based support system and Geographic Information Systems (GIS).

a. Mobile phone short message service (SMS)

SMS is an effective technology that supported the most of digital mobile phones and can distribute the information to everyone, anywhere and anytime (Sahu, 2006; Ayobami & Rabi’u, 2012) and it functional resilience to disaster (Khalid & Shafiai, 2015). Therefore, SMS is suitable for using in flood management that requires the responsible of agencies to share the important of information to the society. In a review of the delivery flood system in Malaysia, it was found that SMS is currently used as an additional tool for spreading and sharing of information during preparedness phase of flood management by the responsible agencies such as National Security Council, Police Department, Fire and Rescue Department, Civil Defense Department, Meteorology Department, and Department of Irrigation and Drainage among them and not spread for the society (Khalid & Shafiai, 2015). They further suggested that the agencies should also use this tool to spread the information and use SMS to communicate with the community to ensure they also receive the right information of the flood situation.

b. Geographic Information Systems (GIS)

According to Khatami and Khazaei (2014), GIS can be defined as follow:

“GIS is a system designed to capture, store, manipulate, analyze, manage, and ultimately present all types of geographical spatial data. In the simplest terms, GIS is the merging of cartography, statistical analysis and database technology”.

GIS is increasingly seen as indispensable in supporting disaster management activities (Pattusamy et al., 2014). Review from the analysis of the manuscripts found that GIS has been applied in overall flood disaster management. GIS is very useful during flood disaster

forecasting and mitigating (Billa et al., 2004) as it is able to manage a large volume of data for hazard and risk assessment (Mansor et al., 2004; Saher et al., 2015; Billa et al., 2006). In the preparedness phase, GIS is useful in evacuation routes planning, a centre for emergency operations designing as well as satellite and relevant data integrating. In the response and recovery phases of flood management, GIS is used to locate the devastated areas for conducting rescue operations, to organise the information regarding flood damages and post-disaster census as well as for evaluating the areas that need to be reconstructed (Billa et al., 2006).

Web-based system

Katuk et al. (2009) suggested that information and communication technology (ICT) needs to be applied in the flood management process especially during the flood response phase to ensure that the responsible agencies able to collaborate and make decisions more effectively and efficiently. In addition, by using the technology, the process of data documenting and reports generating can be carried out quickly and accurately. Meanwhile, a recent study by Khalid and Shafiai (2015) mentioned that ICT has been used in preparedness phase of flood management in Malaysia to display the real time information of rainfall and river water levels. This is done through Infobanjir website in which it has been claimed to effectively disseminate early flood warning to the public.

Conclusion

The findings of this review suggest that flood management in Malaysia involves four phases which are prevention/mitigation, preparedness, response and recovery. However, as mentioned by (Baharuddin et al., 2015), disaster prevention/mitigation and preparedness are without doubt the best way forward because if these two phases were successfully handled, the burden of the next phases will be reduced. This is consistent with the results of this review which found that most of the available studies focused on the first two phases. Besides this, this review suggests that various agencies responsible for the flood management and their collaboration are essential to ensure each phase will be carried out in the best possible way.

The use of appropriate technology will assist in this effort because the technology is believed to facilitate the human works, and lead to more effective and efficient problem solving. However, through the review of the included manuscripts, none reported the flood management in Malaysia involving all the phases. A case study on the real flood event should be conducted to illustrate the real flood management process currently practising in Malaysia from prevention phase to recovery phase. This is in line with the arguments made by (Elias et al., 2013) who stated that flood management requires integration efforts of all the responsible bodies so that all the flood management phases could be addressed equally. Nevertheless, the role of communities affected by the floods is no less important. Their awareness and readiness in facing the flood disaster are indispensable so that the negative impacts resulted from the disasters can be minimised. Therefore, the community should be educated to improve their awareness regarding flood management especially on how and what to prepare for flood as well as how to react during the flood.

Acknowledgement

The authors would like to express their appreciation to the USM Research University Grant for supporting this research entitled Designing E-River Basin Spatial Informative Nesting (E-BASIN) Framework for Flood Prediction using Geographic Information System (Account No.: 1001/PJJAUH/816293).

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