

**DETERMINING EMERGENCY EVACUATION AID FOR FLOOD
DISASTER PREPAREDNESS**

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**A project report submitted partial fulfilment of the
requirements for the award of the
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DEDICATION

To My wonderful Father Hj Kamal bin Ali
For his worship and faith in me

My dear Mother Hjh Habiah binti Rejab
For her endless love and guidance

My dearest Sibling Nurliyana, Mohd.Harith and Aina Ameera
For their everlasting encouragement in my education

My Special One, My Fiancee Muhammad Khalis bin Aris
For motivating and believing in me

My Best friend, Che Wan Nabihan binti Che Wan Mohd Amil
For always stand beside me

My dearest people in UTM Campus Sustainability
For giving me chance and opportunity to join you guys

My Friend
For the assistance and support

This dissertation is dedicated to them

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ABSTRACT

Flood is one of natural hazard that gives a significant impact to the environment and society. East Coast area of Malaysia in December 2014 was shocked by worst flood disaster history within 100 years. Flood occurred had resulted significant losses and threatening the population when more than 4.82 million people across six states were sink flooded. In order to reduce the risk of flood disaster, appropriate plans and methods must be developed. In this case, the Geographic Information System (GIS) application can be used to assist in flood management in response to disaster vulnerability for risk reduction among society who living with flood. Pilot study was conducted in Kuala Krai district, Kelantan to determine an Emergency Evacuation Aid for flood preparedness management by using GIS. In this study, digital elevation model (DEM) data, GPS data, Flood Model data and land use data were used in the production of flood risk vulnerability map for the study area. On the map, location of evacuation centres which endorsed by Department of Society Welfare (JKM) were identified and plotted out. Analysis to determine vulnerability of each evacuation centres are being conducted based on five flood hazard level by JPBD standard. As a result, evacuation centres that located within green zone (very low hazard), yellowish green zone (low hazard), light brown (moderate), dark brown (high hazard) and red zone (very high hazard) can be pointed out. To reduce the risk, suggestion of mobilization options from high and moderate hazard area to evacuation centres located within five kilometres buffer radius from low hazard area are proposed. It is expected that this vulnerability map and evacuation aid plan will be able to assist the responsible parties to communicate and give an option to those affected people to ensure the effectiveness of the emergency response assistance and aid to victims for better preparedness capability.

ABSTRAK

Banjir merupakan satu bencana alam yang memberikan kesan yang besar terhadap alam sekitar dan manusia. Pada Disember 2014, Pantai Timur Malaysia telah dikejutkan dengan sejarah bencana banjir terburuk sepanjang 100 tahun. Banjir yang berlaku telah menyebabkan kerugian yang besar dan mengancam penduduk apabila lebih daripada 4.82 juta orang di enam buah negeri telah ditenggelami air. Dalam usaha mengurangkan risiko bencana banjir, rancangan dan kaedah yang sesuai perlu dibangunkan. Dalam kes ini, aplikasi Sistem Maklumat Geografi (GIS) boleh digunakan untuk membantu dalam pengurusan banjir sebagai tindak balas kepada keterdedahan bencana untuk mengurangkan risiko dalam kalangan mangsa banjir. Kajian ini telah dijalankan di daerah Kuala Krai, Kelantan bagi menentukan bantuan kecemasan untuk persediaan pengurusan banjir dengan menggunakan GIS. Dalam kajian ini, data model ketinggian berdigit (DEM), data sistem kedudukan global (GPS), data model banjir dan data penggunaan tanah telah digunakan untuk pengeluaran peta risiko banjir bagi kawasan kajian. Di dalam peta ini, lokasi pusat pemindahan yang disahkan oleh Jabatan Kebajikan Masyarakat (JKM) telah dikenal pasti dan dikeluarkan. Analisis bagi menentukan kelemahan setiap pusat pemindahan dijalankan berdasarkan lima tahap bahaya banjir berdasarkan piawaian JPBD. Oleh itu, pusat-pusat pemindahan yang terletak dalam zon hijau (sangat kurang bahaya), zon hijau kekuningan (kurang bahaya), coklat muda (sederhana), coklat gelap (bahaya) dan zon merah (sangat bahaya) boleh dinyatakan. Untuk mengurangkan risiko, pilihan pergerakan telah dicadangkan dari kawasan sangat berbahaya dan sederhana bahaya ke pusat pemindahan di kawasan kurang berbahaya yang terletak dalam kawasan lingkungan lima kilometer. Dijangkakan bahawa peta keterdedahan dan pelan bantuan pemindahan banjir ini akan dapat menjadi petunjuk kepada pihak-pihak yang bertanggungjawab untuk berkomunikasi dan memberi panduan pilihan kepada mangsa yang terlibat. Hal ini bagi menjamin keberkesanan bantuan tindak balas kecemasan dan juga membantu mangsa-mangsa untuk persediaan yang lebih baik

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

A disaster is a phenomenon that cannot be avoided by any country even developed countries with high technology and sophisticated. Natural disasters occur every year, and its frequency is increasing effects (Hastings Shamaoma, 2005). While the flooding has been one of the natural disaster and flood disaster categorized as one of the most common, which bring disaster damage and destruction (IFRCRS, 1998; UN / ISDR, 2002).

Every year, Malaysia faced the flood hazard which this significant in terms of economy damage, social and population affected, ecology or environment pretentious include frequency, area extent, and flood duration. But in in the end of December 2014, several areas in the Peninsular Malaysia (Kelantan, Terengganu, Pahang, Perak and

Chapter 3: In this chapter, it will describe detail procedures that have to accomplish in order to achieve the results.

Chapter 4: Analysis that related to this study will be conducted to produce the flood risk map and analysis graph from the data.

Chapter 5: This chapter will discuss the achievement result of the study. The thesis write up will show the conclusion and limitation and lastly recommendations are discussed in this study

Phase III: Analysis geodatabase and questionnaire

This phase also will show the output of the analysis that have done from the previous phase. The map show the area that threatened by the flash flood and the evacuation centre that still survive from the disaster. Also in this phase will contribute to the analysis to prove the output by doing several questionnaire to the victim as the respondent. The graph, map and others analysis was the output from this study

Phase IV: Summary

Overall this phase will discussed about the finding of this study. The recommendation and conclusion also will discuss in this phase to improve for the future research.

1.9 Chapters Organization

In this study, the five chapters are introduction, literature review, methodology, analysis and results, conclusion and recommendations.

Chapter 1: In this chapter, it covers the introduction of the study, the problem background, the problem statement of the study, the aim of study, the objectives, and the scope of the study as well as the significant of study.

Chapter 2: In this chapter, it covers the literature that related to the study. The previous research that related to the study is identified. It also provides an idea and solution to discover the problem statement.

Pre-Phase: Preliminary study

Preliminary study is the initial exploration of the research. It will determine all the actions that will go to carry out in order to achieve the aims of this study. The objectives and scope of this study will also determine by this phase. In this phase also the literature review is explore and obtained to gain more knowledge. The purposes of having preliminary study are:

- To identify the problem, aims and objectives of the study
- To gain more idea and understanding about the study

Phase I: Investigation on existing study Area

Several procedures need to be conducted in order to accomplish the objectives of this study. Data was collected by searching from the previous research. But, the data that not enough and need to visit the study area to locate the evacuation centers and distribute the questionnaire and the others. During this phase the investigation on the data also information from the Department of Social welfare (JKM) and also NGO's will be conduct. This will make more understand and view the study area.

Phase II: Create new geodatabase and make the analysis from the data

This phase in the process where the GIS database will be created. This will include the concept of data model which is conceptual, logical and physical data model to perform in the geospatial database. In this phase the new geodatabase was created which involves feature dataset, feature class, relationship class, coordinate system and others. . After that, the processing from the data such as cleaning the data, make the analysis from the existing data was carried out.

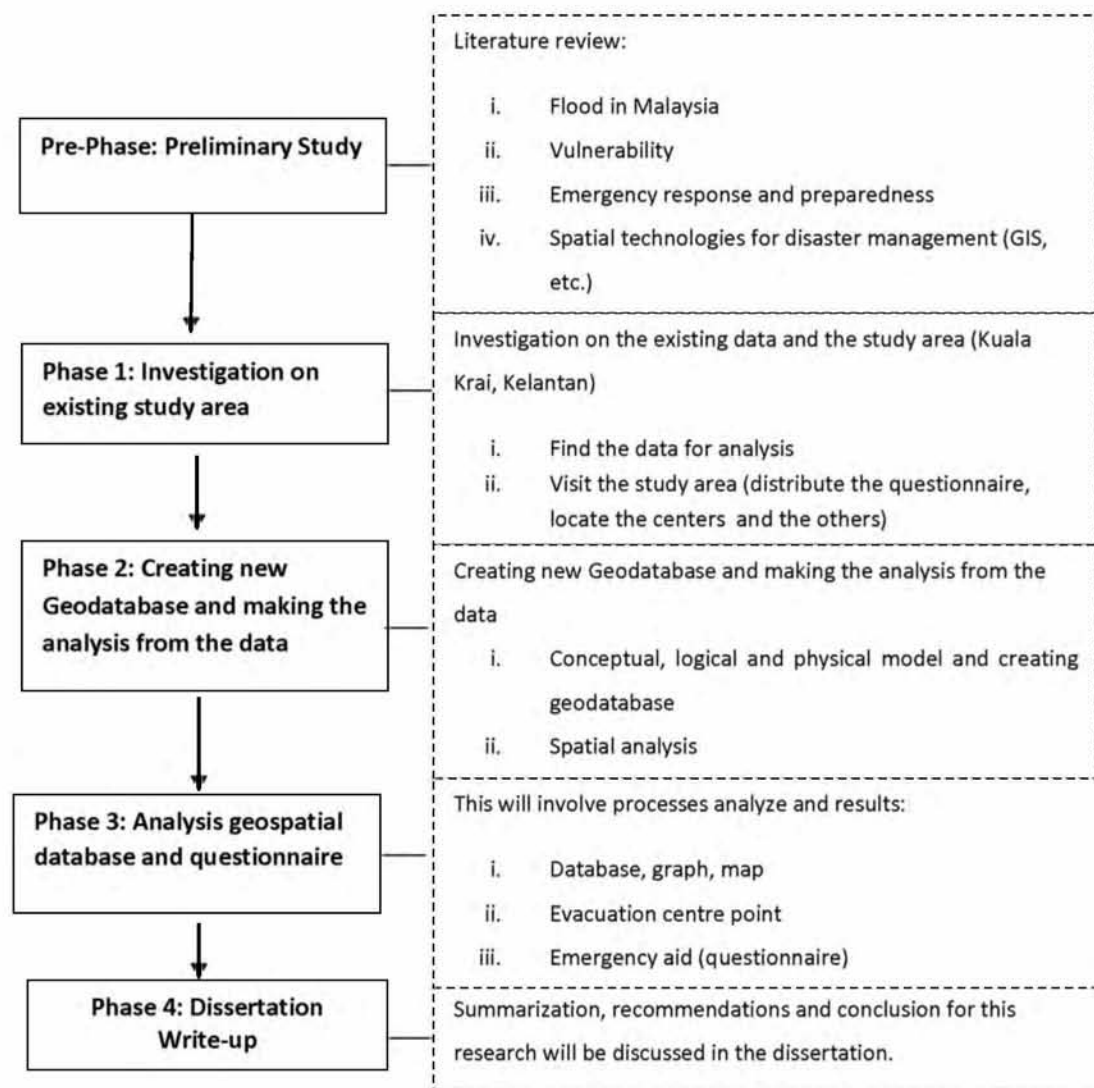
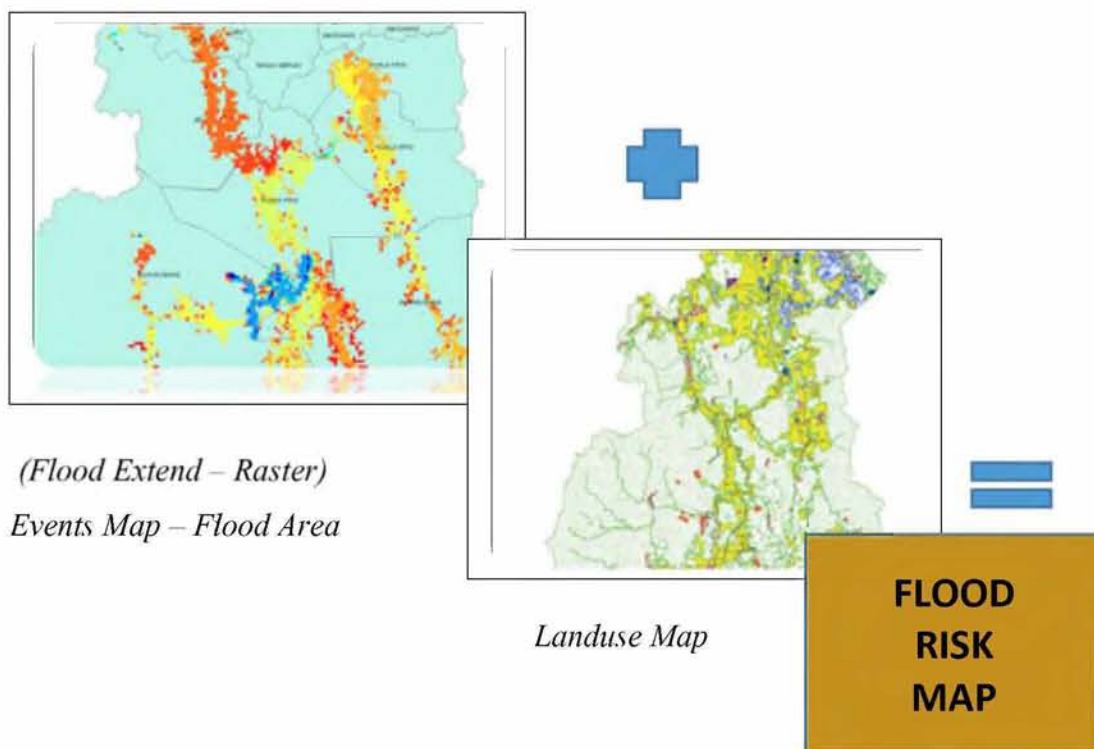


Figure 1.3: Research flow of this study

Generally there are five (5) phases to accomplish the objectives of this study. Figure 1.3 shows these phases i) Preliminary study, ii) Investigation on existing study area, iii) Creating new geodatabase and making the analysis from the data iv) Analysis geospatial database and questionnaire and v) Dissertation write up.



To identify classes of risk areas and evacuation centers were threatened

Figure 1.2: Process flow of flood risk map production.

1.8 Research Methodology

To ensure that the review process can be carried out properly, the methodology of the study has been set up to ensure that all processes follow the plans. Figure 1.3 shows the workflow of resulting research methodology.

1.6 Definition of Terms

Evacuation centre refer to point centre that requires victims to go to incase of disaster or emergency; gazette under the auspices of Department of Social Walfare (JKM). Flood hazard level in this study referred to level issued by Federal Department of Town and Country Planning (JPBD) divided into five levels include very low hazard, low hazard, moderate, high hazard and very high hazard.

1.7 Conceptual Framework Study

The conceptual framework of the study is to show how the main methods bag produce the final results of the study. Figure 1.2 shows the framework for the production of flood risk maps where there are two important parameters in the production of flood risk maps, namely flood extend maps, also known as a map of the flood (inundation map) model derived from extensive flooding which has occurred or wide flood forecast model flooding for a specific time period (return period). The other parameter is a vulnerability map derived from socio-economic data as well as current land use data. In this study data was used as a land use vulnerability map. Results from both of these parameters will result in flood risk maps.

- GDTS4.01

Used to determine the coordinates and the re-coordinate the point by follow the correct datum.

1.5 Significance of the Study

This research involves the management of natural disasters, it is expected that the results of this study could clarify the scenario of how the problems related to flooding can be controlled in the future and planning can be made by referring to the results of this study. Through this research attempt to increase preparedness capabilities towards flood disasters and it is expected that the results of this study could clarify the scenario of how the evacuation aid related to flooding can be controlled in the future for better planning. With this evacuation centre analysis smooth victim mobility, fact aid distribution and optimum resource utilization can be determined from the words of the secretary general of the United Nations Association, which reads: -

“More effective prevention strategies would save not only tens of billions of dollars, but save tens of thousands of lives. Funds currently spent on intervention and relief could be devoted to enhancing equitable and sustainable development instead, which would further reduce the risk for war and disaster. Building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did NOT happen. ”

(Van Westen C., 2007)

1.4.2 Data Source

The second scope is the data used in this study is in analogue and digital format. It includes the flood model data, digital elevation model (DEM) data, GPS data, topology data include land use data and lastly the secondary data from JKM source.

1.4.3 Hardware and Software

The hardware and software used in this study are as follow:

i. Hardware

The hardware used to complete this study is:

Notebook / Laptop

- Model : TOSHIBA Satellite L840 series
- Operating system : Window 7 Home Premium (64-bit)
- Processor : Intel®core™i5-3210M CPU@2.50GHz
- Installed Memory : 8.00 GB

Handheld GPS

- Model : GARMIN eTrex 20

ii. Software

The software that used in this study are:

- ArcGIS 10.1
Used for database management to create model for personal geodatabase, spatial data attribute data entering, perform spatial analysis, for spatial data display and creating map.

1.4.1 The Study Area

The study area covers Sungai Galas and Sungai Lebir and Kula Krai, Kelantan as refer in Figure 1. As we all know that Kuala Krai and Kelantan is the worst district and state in Malaysia that having a worst flood disaster last year. Sungai Galas and Sungai Lebir was two of the river flows by Sungai Kelantan which length of Sungai Kelantan is 248km (154 miles). While Kuala Krai is one district in Kelantan with the size of 2,329km² with total population of 123,400 people (Department of Statistic, 2014).



Figure 1.1: Location of Study Area

communities in hazard-prone areas are well prepared and ready to act and are equipped with the information and capacities for actual disaster.

1.3 Objectives of the Study

To ensure that the study went smoothly and according to plan, some objectives have been created to facilitate the course and understanding of this study. The following is a list of the objectives:

- i. To facilitate the production of flood risk map by considering flood preparedness, management and topography in Kelantan river basin catchment at GIS database platform.
- ii. To determined vulnerability of each evacuation centres endorsed by Department of Society Welfare (JKM) towards flood risk map.
- iii. To reduce the risk of evacuation centre for high and moderate hazard area by identifying mobilization options.

1.4 Scope of the Study

The scope of this study may include the study area, data source, hardware and software that be used for completing this study.

Flood-prone areas, evacuation centre and supply network route should be mapped manually or using geographical information systems with overlying existing land use and flood hazard model facilities to identify unaffected areas. This is important for placing pre-planned emergency aid and safest evacuation centre to the responsible agencies at strategic sites for swift mobilisation to flooded areas.

1.2 Statement of the Problem

Most people in Malaysia are less concerned about environmental issues especially disasters, because they think that the issue is a unimportant issue which should be resolved by the district or local authority, and they expect the government to be the solitary wage-earner of flood protection when the disaster especially flooding occur (Sani et al,2014). Obviously people will respond to disasters, applying one of four options to accommodate, to protect, to retreat or to do nothing. Hence, they have no idea where is the nearest safe place that they should head. While the emergency response agencies such as Fire and Rescue Department (Bomba) and The People's Volunteer Corps (RELA) facing problem which less concern about disaster and the data they collect is not enough to save the flood victim especially in the rural area. The planning, preparedness and evacuation aid before and after the disaster happen are important to every agencies and people that living in the flood prone area. The early identification of flood-prone properties needs for the evacuation priorities to establish warning and public safety organizations. The public safety will improved if the flood map is accurately updated. This is because the most difficult thing to do is to find and rescue the victims at affected area due to the disconnected of the communication system (The Star,2014). Government agencies can initiate corrective and remedial efforts before disaster strikes and preparedness management if being armed with definitive information. Accuracy and current flood risk maps can be the most valuable tools for avoiding severe social and economic losses from floods. Impacts and losses can be substantially reduced, at times of disaster if authorities, individuals and

In regard to the United Nation guidelines, vulnerability can be appraised as a percentage of the assumed losses caused by threats which include two groups of direct damages (happening during the hazard) and indirect damage (results of direct damages,) hence reduce the vulnerability are vital for all of the communities include urban environments (Dall'Osso, 2010). Vulnerability designates the characteristics and conditions of a community that make it vulnerable to the damaging properties of a hazard which is involve in this four aspect physical, social, economic and environmental . Among Kelantan's ten districts, Kuala Krai has been recorded with the most evacuees during the flooding (Malaysian Institute of Architect, 2015). This monsoon resulted shut down of the area from outside traffic and delaying the rescue forces. Emergency aid has difficulties to reach the evacuation centres and victims were scattered trapped with low life support on water, food, energy and healthcare supply.

Consequently, integrated assessment of flood in the basin is paramount to seek for efficacious replications. Risk reduction includes measures designed either to eschew hazards from engendering risks or to diminish the distribution, intensity or sternness of hazards. These quantifications include flood mitigation works and congruous land-use orchestrating. The cognizance elevating, refining community health security, and relocation the avoidance centre or bulwark of vulnerably susceptible populations or structures is included as the susceptibility reduction measures. The long-term activities whose goals are to reinforce the overall capacity and or a community to manage efficiently all types of emergencies or capability of a country is the programmed for emergency preparedness. It is to establish an orderly transition from engagement through retrieval, and back to sustained development that require emergency plans be established, personnel at all levels and in all sectors be trained, and communities in peril be inculcated, and that these quantifications be monitored and evaluated customarily.

Nowadays more reliable technologies such as GIS, GPS, and remote sensing can be consider to create precise and current flood risk maps with better-quality efficiency and speed at a sensible cost to help the National Security Council. Accurate flood risks maps are the key to better disaster management especially flood disaster.

Johor) and Sabah faced the most extreme floods ever occurred in the decade. It was considered to be a “tsunami-like disaster” which this flood have high mud content and hence they called ‘Bah Kuning’ (yellow-coloured flood) (Kamarul, 2015). Based on the report from MKN (National Security Council) through the portal disaster official communication website, ‘Bah Kuning’ had caused 21 death, 250 000 victims lost their homes and damages cost approximately RM1 billion. Malaysian Meteorological Department (MMD) and Malaysia Department of Irrigation and Drainage (DID) from their statement indicated that the major factor might had caused this extreme flood is the continuous heavy rainfall due to the northeast monsoon, especially in the east of Peninsular Malaysia.

In Kelantan, the flood disaster was the most significant and biggest recorded flood in history. The chronology started when heavy rains falls on the December 17, 2014 has led to flooding and 3390 victims involuntary in Kuala Krai, Kelantan, to seepage from their households. Continuous heavy rain was followed by three days from the December 21, 2014 at Gua Musang had caused some areas in Kelantan submerged. This unnatural flood in Kelantan has been giving attention to the public and mainstream media (Zulkarnain, 2015). This event equivalent to the amount of rain usually seen in a span of 64 days or 2 month which the record-setting rainfall of 1 295 mm. As a result, the three major rivers namely Galas River in Dabong, Lebir River in Tualang and the Kelantan River water levels rise drastically above the dangerous water levels (Kamarul et al, 2015). The highest level recorded in Galas River was 46.47 metres compared to previous event which shows the level was at 38 metres danger level. Previously, the level of water has reaches dangerous level which was at 35m but during the flood event 2014, the water level was at 42.17m and it was recorded the highest water level in lebir river. At tangga krai point the setted danger level was at 25m but during the big flood occurrence the level was at 34.17m which has increased 9.17m from the danger level. On the other hands, at Guillemard Bridge Tanah Merah point, the level of water was 22.74m and it has exceeded about 6.74m from the danger level setted at that point. The highest level of Golok River at Rantau Panjang was 10.84 metres, which was over the danger level of 9 metres (ebanjir Main Portal of Kelantan 2015).

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