

**FLOOD HAZARD ANALYSIS FOR LANDUSE
PLANNING IN PENAMPANG AREA, SABAH**

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ABSTRACT

Flooding is one of the major natural disasters in Sabah, Malaysia. Several recent cases of catastrophic flooding were recorded especially in Penampang area, Sabah (e.g. July 1999; October 2010; April 2013; October & December 2014). Heavy monsoon rainfall has triggered floods and caused great damage in Penampang area. The 2014 floods have affected 40,000 people from 70 villages. The objectives of this research are (i) To determine the factors contributing to the flood occurrences; (ii) To analyse the Flood Susceptibility Level (FSL); and (iii) To identify the flood hazard in the study area and produce the flood hazard map. In this study, eight (8) parameters were considered in relation to the causative factors to flooding, which are: rainfall, slope gradient, elevation, drainage density, landuse, soil textures, slope curvatures and flow accumulation. Flood Hazard Analysis (FHAn) map were produced based on the data collected from the field survey, laboratory analysis, high resolution digital radar images (IFSAR) acquisition, and secondary data in three (3) different period (2002, 2008 and 2014). FHL were defined using Multi Criteria Evaluation (MCE) technique integrated with GIS software. Based on the FHAn, approximately 3.17% of total study area classified as Very High Hazard (VHH), 4.55% as High Hazard (HH), 15.52% as Moderate Hazard (MH), 15.72% as Low Hazard (LH) dan 61.04% as Very Low Hazard (VLH) respectively. As a result of the calculation and interpretation, the average ratio of the areas under the curve were 0.839, and thus can be argued that validation prediction accuracy was 83.90%. The developed model will be a very valuable resource for consulting, planning agencies and local governments in managing risk, land-use zoning and remediation efforts to mitigate risks. Moreover, the technique applied in this study can easily be extended to other areas, where other factors may be considered, depending on the availability of data.

ABSTRAK

ANALISIS BAHAYA BANJIR UNTUK PERANCANGAN GUNA TANAH DI KAWASAN PENAMPANG, SABAH

Banjir merupakan salah satu bencana alam yang major di Sabah, Malaysia. Beberapa kes terkini tentang katastropik banjir telah direkodkan terutamanya di kawasan Penampang, Sabah (contohnya Julai 1999; Oktober 2010; April 2013; Oktober & Disember 2014). Hujan lebat mencetuskan banjir dan menyebabkan kerosakan besar di kawasan Penampang. Banjir 2014 telah memberi kesan kepada 40,000 orang dari 70 buah kampung. Objektif kajian ini adalah (i) untuk menentukan faktor yang menyumbang kepada kejadian banjir; (ii) Untuk menganalisis Tahap Kerentanan Banjir (FSL); dan (iii) Mengenal pasti bahaya banjir di kawasan kajian dan menghasilkan peta bahaya banjir. Dalam kajian ini, lapan (8) parameter yang berkaitan dengan faktor penyebab kepada banjir telah diambilkira, iaitu: hujan, kecerunan cerun, ketinggian, ketumpatan saliran, guna tanah, tekstur tanah, kelengkungan cerun dan akumulasi aliran. Peta Analisis Bahaya Banjir (FHAn) telah dihasilkan berdasarkan data yang diperolehi daripada kajian lapangan, analisis makmal, perolehan imej radar digital (IFSAR) beresolusi tinggi dan data sekunder dalam tiga (3) jangka masa yang berbeza (2002, 2008 dan 2014). FHL ditentukan berdasarkan kepada teknik Penilaian Multi-Kriteria (MCE) yang berintegrasi dengan perisian GIS. Berdasarkan FHAn, kira-kira 3.17% daripada jumlah kawasan kajian diklasifikasikan sebagai Bahaya Sangat Tinggi (VHH), 4.55% sebagai Bahaya Tinggi (HH), 15.52% sebagai Bahaya Sederhana (MH), 15.72% sebagai Bahaya Rendah (LH) dan 61,04% sebagai Bahaya Sangat Rendah (VLH). Hasil daripada pengiraan dan tafsiran, nisbah purata kawasan di bawah lengkung adalah 0.839, dan ini boleh dikatakan bahawa ketepatan pengesahan ramalan adalah 83.90%. Model yang dibangunkan akan menjadi sumber yang sangat berharga kepada perundingan, perancangan agensi dan kerajaan tempatan dalam mengurus risiko, zon guna tanah dan usaha pemulihan bagi mengurangkan risiko. Selain itu, teknik yang digunakan dalam kajian ini boleh diperluaskan ke kawasan lain, di mana faktor-faktor lain boleh dipertimbangkan, bergantung kepada ketersediaan data.

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CHAPTER 1

RESEARCH BACKGROUND

1.1 Introduction

Flooding is one of the major natural disasters in Malaysia. All over Malaysia, including Sabah and Sarawak, there is total of 189 river basins (89 of the river basins are in peninsular Malaysia, 78 in Sabah and 22 in Sarawak), with the main channels flowing directly to the South China Sea and 85 of them are susceptible to become frequent flooding (Sani,2014). Based on the results from Department of Irrigation and Drainage, it has been estimated that an area of 29,000 km² or 9 % of the total area in Malaysia are vulnerable to this disaster, a loss of RM 915.12 million and 4,915,000 people was evacuated in 2002 (Wong, 2013).

The Penampang District of Sabah has long been known as a flood prone area, is facing a rapid economic development which resulted in further pressure to utilize various purposes such as infrastructures, residential, commercial, tourism and agricultural activities in low lying area in Moyog river floodplain. Based on the flood histories in Kota Kinabalu vicinity from July 2005 until May 2015, a total of 38 flood cases and 5 deaths that caused by the monsoon flood had been recorded (Appendix A).

In October 7th to October 10th, 2014, Penampang suffered its worse flood ever since the last big flood in 1991 (Photo 1.1). According to Penampang District Officer, around 40,000 people from 70 villages were affected by this event. This catastrophic flood occurred coincidentally with continuous heavy rainfall and affected by the tail of typhoon Phanfone and typhoon Vongfong (Chris, 2014). Another recent flood disaster in Penampang occurred in September 2007 and May 2013 which were also affecting several villages.



Photo 1.1 : Some cases of flash flood in Penampang, Sabah

Sources : Penampang District Office, 2014

This research will focus on flood hazard assessment in Penampang low lying areas using Multi Criteria Evaluation (MCE) method and Geographic Information System (GIS). By the end of this research, several types of flood hazard severity maps will be produced. Although this approach looks like a general research, but it is very practical and relevance to delineate a clear flood hazard situation. These maps can help the authorities to identify the most cost-effective measurement for flood mitigation development plan. Generally, this research approach is a compulsory way in early stage for any development purposes activities and to ensure the sustainability of long-term development in low lying areas and to avoid an unplanned and mismanage development. It is hopes that the outcomes from this research can be an important reference document for the local authority and other relevant agencies for the purpose of urban planning and flood mitigation.

1.2 Problem Statement

Although millions of ringgits have been spent by the government to implement various mitigation works to solve this problem, yet it still cannot be mitigated effectively due to uncontrol floodplain development practice. Until recently, most of

the floodplain management only involved in structural approaches to modify the flood behavior.

Without proper mitigation plan, the structural flood modification only compensates for the poor development practice by restoring the flood behavior to pre-development conditions. Ultimately, there is no net benefit (Caddis et. al., 2011). State Agriculture and Food Industry Minister Junz Wong said that the structural measures would not be sufficient to overcome flooding problem as non-structural approach must also be taken to strengthen the control of land uses (Avila,2018). Lack of intensively non-structural mitigation research activities by local specific parties or researchers is also a huge constraint in delaying the effectiveness of mitigation actions in the flood prone area. Thus, a specific non-structural approach must be raised to mitigate effectively the floods phenomenon in Penampang District.

1.3 Aim

This study is aimed to produce a Flood Hazard Analysis (FHAn) map for landuse planning of the study area.

1.4 Objectives

This research will focus on studying the flood hazard assessment for land use planning at the low-lying area in Penampang district using Multi Criteria Evaluation (MCE) method and Geographic Information System (GIS) mapping software. Data in year 2002, 2008, and 2014 is gathered to assist on the analysis. By the end of this research, several types of flood hazard maps will be produced. The main objectives of this study are:

- i. to determine the factors contributing to the flood occurrences in the study area using AHP for landuse planning.
- ii. to analyse the Flood Susceptibility Level (FSL) in the study area.
- iii. to produce a flood hazard map using GIS technique.

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