DEBRIS FLOW ASSESSMENT IN THE CROCKER RANGE AT ULU MOYOG AND BUNDU TUHAN, SABAH, MALAYSIA

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FACULTY OF SCIENCE AND NATURAL RESOURCES
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JUDUL: **DEBRIS FLOW ASSESSMENT IN THE CROCKER RANGE AT ULU MOYOG AND BUNDU TUHAN, SABAH, MALAYSIA**

IJAZAH: SARJANA SAINS (GEOLOGI)

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DECLARATION

I hereby declare that the material in this thesis is my own except for tables, figures, photos, equations, and references, which have been duly acknowledged.

23rd August 2018 .....

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CERTIFICATION

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DEGREE : **MASTER OF SCIENCE (GEOLOGY)**

DATE OF VIVA : **16 AUGUST 2018**

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23rd August 2018

ABSTRACT

Debris flows are quite common in Sabah especially in the mountainous area of the Crocker Range and they pose a great danger to the public. While the hazard posed by debris flow is enormous, their inventory and susceptibility assessment are still lacking in Sabah. In the absence of a proper study, the mitigation strategies to address the debris flow hazards appear to be carried out on an ad-hoc basis. Therefore, this study aims to determine the characteristics of debris flow, to assess the susceptibility level in a basin scale, and lastly to suggest appropriate mitigation strategies. The assessment was conducted by using various methods, which included fieldwork and data collection along the channel, calculation of flow discharge and velocity, analysis of material property based on soil investigation report, rainfall intensity-duration threshold analysis, and lastly susceptibility modelling at a basin scale by applying Frequency Ratio method in geographic information system environment. Two locations of well-known occurrence of debris flow at Jalan Penampang-Tambunan KM 38.80 (Ulu Moyog, Penampang) and Jalan Tamparuli-Ranau KM 83.90 (Bundu Tuhan, Ranau) were selected for the case study. The inventory showed debris flow characteristics as follows: The velocity is equivalent to 0.1 to 2.0 times the discharge, while the travel distance equals to about 3 times the height relief; the debris flow is of granular type which shows high kinetic energy and velocity, as well as shorter transportation distance and high sedimentation towards the deposition; the formation of debris flow involves liquefaction process which is controlled by low plasticity index of soil and higher moisture content, and; lower rainfall intensity-duration threshold of the debris flow ranges between 2.97 mm/h and 8.02 mm/h which is given by the equation of $I=9.9D^{0.52}$. On the other hand, the susceptibility analysis displayed that most of the study basin is covered by low debris flow susceptibility, in which the controlling factors are the distance to negative lineament, normalised difference vegetation index, and distance to stream. The mitigation strategies were proposed by using the combination of both active and passive measures.

Keyword: assessment, Crocker Range, debris flow, inventory, susceptibility.

ABSTRAK

PENILAIAN ALIRAN PUING DALAM BANJARAN CROCKER DI ULU MOYOG, DAN BUNDU TUHAN, SABAH, MALAYSIA.

Aliran puing adalah agak lazim di negeri Sabah terutamanya di kawasan pergunungan di Banjaran Crocker dan ia mendatangkan bahaya kepada orang awam. Meskipun bahaya yang disebabkan oleh aliran puing adalah tinggi, kajian tentang inventori dan kemudahrentanan aliran puing di Sabah masih belum banyak dilaksanakan. Disebabkan ketiadaan kajian yang teratur, strategi mitigasi untuk menangani bahaya aliran puing dilaksanakan secara ad-hoc. Oleh sebab itu, kajian ini bertujuan untuk mengenal pasti ciri-ciri aliran puing, tahap kemudahrentanan dalam skala lembangan, dan akhirnya mencadangkan strategi mitigasi yang bersesuaian. Penilaian tersebut dilaksanakan dengan menggunakan pelbagai kaedah yang merangkumi kerja lapangan dan pengumpulan data sepanjang alur air, pengiraan isipadu dan halaju aliran puing, analisis sifat bahan berdasarkan laporan penyiasatan tanah, analisis nilai ambang keamatan-tempoh hujan, dan akhir sekali pemodelan kemudahrentanan aliran puing dalam skala lembangan berasaskan kaedah Nisbah Kekerapan dengan menggunakan aplikasi Sistem Informasi Geografi. Dua lokasi yang terkenal dengan kejadian aliran puing di Sabah iaitu Jalan Penampang-Tambunan KM 38.80 (Ulu Moyog, Penampang) dan Jalan Tamparuli-Ranau KM 83.90 (Bundu Tuhan, Ranau) telah dipilih sebagai kajian kes. Inventori yang telah dilaksanakan menunjukkan sifat-sifat aliran puing seperti yang berikut: Halaju aliran puing adalah bersamaan dengan 0.1 sehingga 2.0 kali isipadu mendapan, manakala jarak pergerakan adalah kira-kira tiga kali ganda daripada perbezaan ketinggian; aliran puing adalah jenis berbutir yang mempunyai tenaga kinetik dan halaju yang tinggi, serta jarak pengangkutan bahan yang pendek dan sedimentasi yang tinggi ke arah kawasan pengendapan; penghasilan aliran puing adalah melibatkan proses pencecairan tanah yang dikawal oleh indeks keplastikan yang rendah dan kandungan kelembapan tanah yang tinggi, dan; nilai ambang keamatan-tempoh hujan yang rendah adalah dalam julat 2.97 mm/jam dan 8.02 mm/jam yang diberikan oleh persamaan $I=9.9D^{-0.52}$.

Sementara itu pula, analisis kemudahrentanan aliran puing dalam skala lembangan menunjukkan bahawa kebanyakan kawasan lembangan kajian diliputi oleh mudahrentan aliran puing yang rendah, yang dikawal oleh faktor utama melibatkan jarak ke linemen negatif, indeks tumbuhaan bezaan ternormal, dan jarak ke alur air. Akhir sekali, strategi mitigasi dicadangkan dengan menggabungkan pendekatan aktif dan pasif.

Kata kunci: penilaian, Banjaran Crocker, aliran puing, inventori, kemudahrentanan.

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