

UNIVERSITI TEKNOLOGI MARA

**GEOGRAPHICAL INFORMATION
SYSTEM (GIS) BASED MULTI-
CRITERIA DECISION MAKING
(MCDM) FOR LANDSLIDE HAZARD
ZONATION: A CASE STUDY OF
AMPANG JAYA MUNICIPAL
COUNCIL**

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Architecture, Planning and Surveying

May 2014

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Malaysia has undergone rapid development in many sectors. As the impact of fast economic growth, there will be an increase in land demand for sectors such as industries and housing area. The limitation of flat ground areas especially in urban areas such as Kuala Lumpur and Selangor has increased the demand for other alternatives such as in hilly areas. Landslides have caused large numbers of damages and losses especially in hilly development areas. Major landslide incidence that took place in Highland Tower, Ampang in 1993 was definitely an eye opener for the federal government and local authorities to properly manage hillslope development especially in high risk areas. Although there are various methods and criteria used to determine landslide hazard zones, it is not clear which criteria and models are appropriate to be used in the Malaysian environment. The aim of this study is to explore the potential integration between Geographical Information System (GIS) and Multi-criteria Decision Making (MCDM) to model landslide hazard zonation. The objectives are: i) to identify the different techniques, models and criteria used to map landslide hazard zones, ii) to propose the best criteria to predict landslides hazard zones, iii) to develop/propose new models to predict landslides hazard zones, iv) to evaluate the accuracy of the developed models, and v) to generate landslide hazard zonation maps of the study areas. This study covers areas under the administration of Ampang Jaya Municipal Council (MPAJ) and Hulu Langat. Although there are various other methods such as deterministic, heuristic and statistical methods to map a landslide hazard zone, only heuristic method was considered in this study. Six (6) techniques in MCDM were considered to determine the weights for each of the criteria used. Twelve (12) criteria namely slope, elevation, aspect, drainage density, proximity to river, proximity to the road, lithology, geomorphology, soil type, land use, rainfall and flow accumulation were used in this research. Expert opinions from different agencies were gained to determine the criteria and score for each of the proposed criteria. Finally, nine (9) models were developed based on different criteria and techniques. Accuracies of different models were obtained by comparing the predicted results with the landslide historical data using two (2) methods. Different results were obtained when different methods and different models were used. Using Method 1, result for Model 1 (rank sum), Model 2 (rank reciprocal), Model 4 (rating) and Model 7 (pairwise comparison) were identified to have higher accuracies (i.e. 66.7%, 60.6%, 66.7% and 60% respectively). The accuracies of other developed models which are Model 3 (rank exponential), Model 5 (Analytical Hierarchical Process), Model 6 (pairwise comparison), Model 8 (Analytical Hierarchical Process) and Model 9 (Analytical Hierarchical Process) are 57.6%, 22.9%, 37.1%, 22.9% and 8.6% respectively. Using Method 2, accuracy for Model 1 is 97.1% and Model 2, Model 3 and Model 4 shows the same accuracies (i.e. 94.2%). The accuracies of Model 5, Model 6, Model 8, Model 9 and SINMAP are 94.2%, 80%, 97.1 %, 80%, 57.1% and 42.8% respectively. Relationship between criteria have indicated that there are four (4) important criteria namely slope, lithology, soil properties and geomorphology that need to be considered in mapping landslide hazard zones. Three (3) models (i.e. Models 1, 4 and 7) are used to generate the landslide hazard zones maps of Hulu Langat and the results have shown that the hazard zones match with the landslide scars of the study area. As a conclusion, integration of GIS and MCDM can be an important technique to predict and map landslide hazard zones.

ACKNOWLEDGEMENTS

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the name of ALLAH, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to ALLAH for the strengths and His blessing in completing this thesis. First of all, a special appreciation goes to my supervisor, Associate Professor Dr. Wan Mohd. Naim bin Wan Mohd. for his continues support, enthusiasm, criticism and his moral support during my studies. His facilitation of opportunities to gather and expand knowledge is unique and has been of great value to me. Equally important, Dr. Noraini binti Surip, my second supervisor from Agensi Remote Sensing Malaysia (ARSM) who not only encouraged me in my undertaking but who also gave me strong moral and intellectual support, which kept me going through the many difficult moments during the PhD studies; I am very much indebted.

Special thanks to the Universiti Teknologi MARA for the scholarship and financial support to complete the study. I also wish to thank all staffs from the Centre of Studies for Surveying Science and Geomatics for their support during my candidature. Not to forget, Mr. Fadli Baba from Institut Kerja Raya Malaysia (IKRAM) for his ideas, valuable information related to landslides and hill slope development in Malaysia. I wish to acknowledge the contributions of Ir. Zafrul Fazrey from the Ampang Jaya Local Authority (Majlis Perbandaran Ampang Jaya, MPAJ), Mr. Shafie from the Institute for Infrastructure Engineering and Sustainable Management (IIESM), Universiti Teknologi MARA (UiTM), Shah Alam and Ir. Dr. Anuar b. Othman from the Department of Irrigation and Drainage (Jabatan Pengairan dan Saliran, JPS) Wilayah Persekutuan.

Last but not least, I would like to express my gratitude to my family especially to my parents, Hj. Othman Yusoff and for the prayers and encouragement towards my studies. Deep gratitude goes to my husband En. Akhbaaruddin b. Abd Hamid and my loving childrens, Ain Khadeeja, Arina Khairina, Arini Khairani and Ahmad Al-Khawarizmi for their love, care and support. Thank you very much and may Allah bless all of us.

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