

Applied GIS in Environmental Sensitivity Development Based Slope Failure

Ang Kean Hua & Owi Wei Ping

¹ Department of Environmental Sciences, Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor.

² Department of Mathematics, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjung Malim, Perak.

Corresponding Author: angkh23@gmail.com

Abstract

Slope failure become major issues and problem in Selangor State, especially involve with the development in a specific area. This research study conducted using GIS in determined the environmental sensitivity development based slope failure. GIS techniques required several data for analysis, namely elevation data and contour maps, land used map data, original map data, and vegetation map data; which can be received from government department or agencies, height and topographic data maps, data from internet sources, and data from documentation includes publications. The selected area for this research study is Selangor State, which highlighted rapid development of land used for human activities. Accordingly, the first step will be entering all data into database, which involve with the physical and environment components; while the second step will be identification and preparation based on the data layers that required in the research study; and the third step are storing data into database for designed. The storage is referring to non-spatial data elements and geographical data. Results indicate the sensitivity slope with normal sensitive area covers 1.7% and most sensitive area covers 5.7%, which lies in East towards Ulu Selahgor, Gombak, and Ulu Langat. Continuously, the prohibited development area is covering about 7.4% of sensitive area in the 25% to 40% degree of steepness in the area, which represents a critical area

of 603 km² of the 8154 km² area in Selangor State. Build up activities within slope area can be categorized as industrial, institutional and facilities, residential, business and services, and open space and recreational; while the steepness parameter determined 0 % to 15 % is no risk area for slope failure, while 15 % to 25 % are less risk area for slope failure, 25 % to 40 % are moderate risk area for slope failure, and more that 40 % are high risk area for slope failure. Majority residential area is located at Gombak and Hulu Langat with slope sensitivity is between 25 % to 40 % degree of steepness, which is at high risk of slope failure.

Keywords: GIS, sensitivity slope, prohibited development area, build up activities.

Introduction

Malaysia is a developing country, to achieved developed nation. Multiple large projects that had been designed to achieved the developed nation. This results in a lot of areas of land sites, regardless of construction site safety. This includes the hilly terrain and high altitudes. Therefore, the issue of slope failures or landslides often a major issue when there is a problem of loss of life and property. Slope failure is an issue that is very important and should be seriously considered, especially when there is a development in the slope. Slope stability



will affect the level of safety and durability of soil structure, because movement causes the slope of the land has become cracked and can cause debris to happen.

Generally, the problem of slope failure occurred due to certain factors, especially when human beings try to exploit an area for socio-economic purposes. If the people's need and demand for natural resources is increasing such as settlements, agriculture, education, industry and so on, this situation will have forced the people to develop sensitive slopes. There are even worst when irresponsible people are not concerned and less regard for the safety and appropriateness of the site being developed. Analysis hilly terrain or highlands is one of the most important and should be seriously considered in development planning to avoid slope failure happened. Usually, the developers explore the slopes of the hill as the site development primarily as a resort and residential sites. Highland area is an area that is particularly suitable as a site for housing or resort because of its advantages in terms of the landscape surrounding, which are able to attracted many residents and tourists especially from the high incomes. Hence, this may led to many investors and developers to build construction or building on high ground to gain high profits, but fail to concerned the security level.

In ensuring the slopes with potential slope failure, it is unpredictable and absolutely undetermined. Furthermore, the developer usually runs development projects in the slope area without doing a detailed review of the development site. Therefore the application of geographic information system should be implemented for each planning area development projects, especially in hill slope area. Therefore, the

security level of development is more secure. The parties involved in development projects that without knowing the factors of causes slope failure occurred on the slopes of the hill, is a serious problem faced by third-party developers. This is because without understanding and knowing the factors and processes involved in the slopes of the hill on the slope failure, then this becomes a serious problem to the parties responsible for the project development. For example, the recruitment process of early preventive measures either during construction or after construction is completed. Typically, the problem of landslides is caused by third-party developers to carry out development on hilly terrain, which could happen due to without knowing the factors of the natural environment and processes in the slope. In additional, the developer is less emphasis on early prevention measures and the level of safety in construction sites also could cause slope failure to occur.

Planning approach based on information technology is the latest solution in analyzing and identifying problems faced slope failure by humans. Application of Geographic Information System (GIS) is a technology used space-based information, according to Clarke [1] has proposed a common definition for GIS data are as unique spaces that can be connected to a geographical map. In summary, GIS can be regarded as a database and information, which is used in particular to assist the parties in making a decision on a development plan. For example, the develop projects in hilly terrain and high altitudes. GIS applications are also very instrumental in determining whether an area to be developed is appropriate and safe as site development. Application of GIS is also an information technology used to

analyze and identify the hilly terrain, and makes the hill slope failure as one of the important studies. The slope failure was originally natural environmental processes are common. However, when people began to interact with the natural environment, especially on hilly terrain or high altitudes, the problem of slope failure is a major issue and a threat to humans. Therefore, GIS is an information system is essential nowadays to be considered in the planning of national development projects. Therefore, this research study conducted using GIS in determined the environmental sensitivity development based slope failure.

Methodology

GIS technology has capability to determined slope failure, which needed several data for analysis purposes like elevation data and contour maps, land used map data, original map data, and vegetation map data [2-4]. These data can be received from government department or agencies, height and topographic data maps, data from internet sources, and data from documentation includes publications. The selected area for this research study is Selangor State, which highlighted rapid development of land used for human activities. Accordingly, the first step will be entering all data into database, which involve with the physical and environment components; while the second step will be identification and preparation based on the data layers that required in the research study; and the third step are storing data into database for designed. The storage is referring to non-spatial data elements and geographical data.

Results and Discussions

The results indicate the sensitivity slope (Figure 1), prohibited development area (Figure 2), and build up activities within the slope area (Figure 3). In sensitivity slope, the sensitive area covers 1.7% and most sensitive covers 5.7%. According to the Figure 1, most of the location is lies in the East, which is more towards Ulu Selahgor, Gombak, and Ulu Langat. Continuously, prohibited development area is covering about 7.4% of sensitive area in the 25% to 40% degree of steepness in the area. 7.4% of this area represents a critical area of 603 km² of the 8154 km² area in Selangor State. Lastly, build up activities within slope area can be categorized as industrial, institutional and facilities, residential, business and services, and open space and recreational. The steepness parameter determined 0 % to 15 % is no risk area for slope failure, while 15 % to 25 % are less risk area for slope failure, 25 % to 40 % are moderate risk area for slope failure, and more that 40 % are high risk area for slope failure. Generally, the potential for slope failure risk areas are Ulu Selangor, Gombak and Ulu Langat because the area is located at high ground area. Meanwhile, the area with potential less occurrence of slope failure is Sepang Districts, Klang, Petaling, Kuala Selangor and Sabak Bernam. Continuously, majority residential area is located at Gombak and Hulu Langat with slope sensitivity is between 25 % to 40 % degree of steepness. Thus, residential area is at high risk of slope failure.

Figure 1: Sensitivity Slope Area

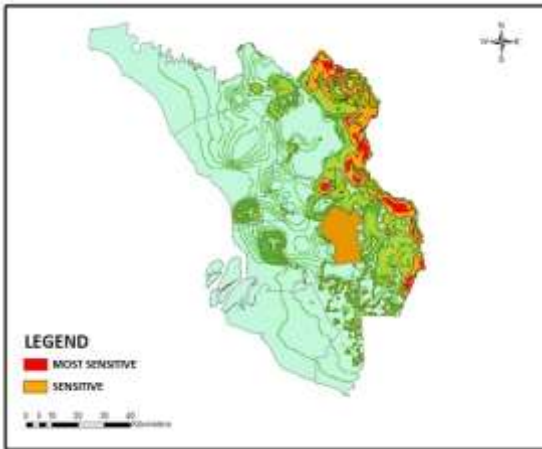


Figure 2: Prohibited Development Area

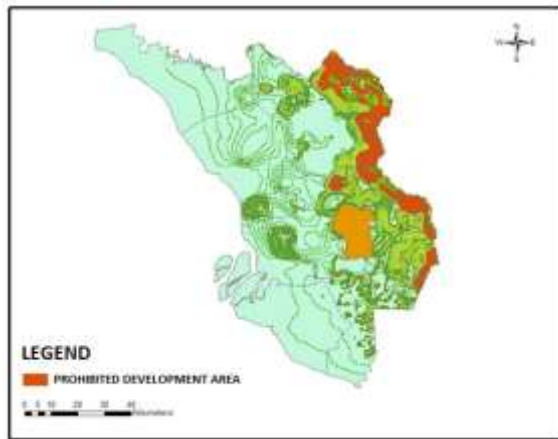
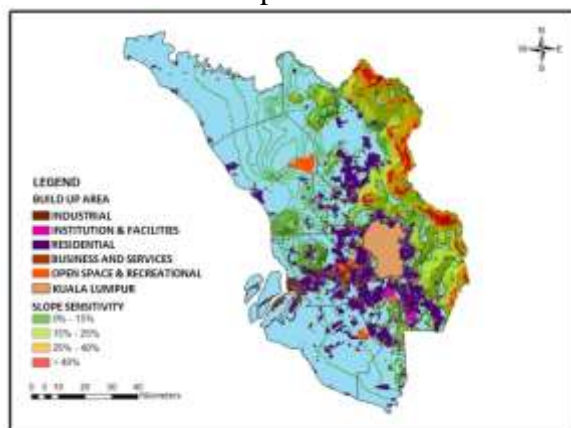


Figure 3: Build Up Activities within the Slope Area



Conclusion

As conclusion, the sensitivity slope with normal sensitive area covers 1.7% and most sensitive area covers 5.7%, which lies in East towards Ulu Selahgor, Gombak, and Ulu Langat. Continuously, the prohibited development area is covering about 7.4% of sensitive area in the 25% to 40% degree of steepness in the area, which represents a critical area of 603 km² of the 8154 km² area in Selangor State. Build up activities within slope area can be categorized as industrial, institutional and facilities, residential, business and services, and open space and recreational; while the steepness parameter determined 0 % to 15 % is no risk area for slope failure, while 15 % to 25 % are less risk area for slope failure, 25 % to 40 % are moderate risk area for slope failure, and more that 40 % are high risk area for slope failure. Majority residential area is located at Gombak and Hulu Langat with slope sensitivity is between 25 % to 40 % degree of steepness, which is at high risk of slope failure.

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