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Landslides Incidents in Federal Territory of Kuala Lumpur, Malaysia

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ABSTRACT

A landslide can be defined as a geohazard incident involving most of the movement of soil surfaces, rock falls or a combination of both movements resulting from gravity attraction. The initial definition of a landslide was recorded by James Dwight Fund in 1862, where landslide is classified into three types, which are now known as flowing debris, land spread, and rock slides. Overgrowing urbanisation has become one of the major contributors to landslides for years. Malaysia is one of the most developed nations that has undergone rapid development since the 1970's, resulting in a higher frequency of landslide activity. When developments and urbanisations continue to overgrow, landslide failures and other effects of soil gesture failures will also rise significantly. Hence, a study is conducted to identify the number of landslides in Kuala Lumpur areas from 2010 to 2020. There were 50 cases of landslide collected across Kuala Lumpur over these ten years. The GIS software was used in this study to generate the distribution map of the landslide incidents.

Key words : *Development, Geohazard, GIS, Landslide, Urbanisation*

Introduction

A landslide or also known as slope failure, can be defined as a geohazard incident involving most of the movement of soil surfaces, rock falls or a combination of both movement as a result of gravity attraction (Batterson *et al*., 1999). Due to gravity, the movement of soil and rock down slopes is called mass wasting whereas the surface movement from the sequel of wind and water is called erosion (Kazmi *et al.,* 2017a). Frankly, landslides have caused thousands of deaths and property damages. The initial definition of a landslide was recorded by James Dwight Fund in 1862, where landslide is classified into three types, which are now known as flowing debris, land spread, and rock slides (Cruden, 2003). Obliquely, landslides can also be defined as a geological phenomenon concerning the displacement of mass rock and debris (Hossain *et al.,* 2015; Sivakumar and Mukesh, 2009).

On the other hand, overgrowing urbanisation has become one of the major contributors to landslides for years. Malaysia is one of the most developed nations that has undergone rapid development since the 1970's, resulting in a higher frequency of landslide activity. To illustrate, the rate of urbanisation in Malaysia reported by the Department of Statistic Malaysia (2020) shows an increasing percentage in 20 years (2000-2020) apart by 14.4%, especially in Kuala Lumpur. Besides, The Public Works Department (JKR) (2006) also stated that Kuala Lumpur has the highest landslide cases recorded compared to other states caused by the rapid urbanisation. Thus, a relationship between urbanisation and landslide can be seen.

The country has also influenced a high pressure

on land-use associated with urbanisation country's growing population from 32,480,000 in the fourth quarter (2018) to 32,680,000 in 2019 (Department of Statistics Malaysia, 2020). More importantly, according to the latest global projections, the urban population will increase from 2.8 billion in 2000 to five billion by 2030 (Muis *et al.,* 2015). Hence, drastic and large-scale changes in land-use to create new land of neighborhoods, infrastructures and cities just to meet the population demands are indeed some of the major contributors to the occurrence of landslides. This unsustainable land enlargement, however, leads to deforestation with the erosion of the covered soil masses, causing a severe threat to slopes. For instance, the process of urbanisation often involves the removal of plants. Plants serve as canopies that protect the surface of the soil from being eroded. As stated by Moore (2020), deforestation is a major cause of soil erosion, which could eventually lead to a landslide. Trees and their roots provide an anchor for the soil from the wind and rain. If the plants are cleared out for urbanisation, the land will become vulnerable to landslides.

Malaysia's Landslide History

The National Slope Master Survey 2009-2023 stated that 440 cases of landslides were recorded from 1973 to 2007, and 31 cases resulted in approximately 600 deaths since 1973 (Public Works Department, 2009). Besides, there are more than 1,000 cases of a minor landslide that are not reported. Abdul Rahman and Mapjabil (2017) also pointed out, throughout the country, there were a total of 21,000 landslides, of which 16,000 cases were reported in Peninsular Malaysia, roughly 3,000 in Sabah and 2,000 in Sarawak. These statistics show that landslides have become a frequent disaster here in Malaysia.

Geographically, Malaysia is located in the tropical climate of South East Asia and characterized by heavy rain almost all year round, particularly from October to February; landslides happen rather frequently in Malaysia (Abd Majid *et al.,* 2017; 2018; 2019). On account of heavy and prolonged rainfall, US National Aeronautics Space Administration (NASA) stated that Malaysia had 171 number of cases recorded between 2007 and 2016 and indirectly making the country as the 10th highest in the frequency of landslides (Leoi *et al.*, 2018).

Ulu Klang region in Malaysia has become very vulnerable to landslides due to the significant urban development. Consequently, Malaysia has recorded the appalling landslide in 1993, involving 48 deaths due to the collapse of Highland Towers (Figure 1). The overall length of the landslide and the rupture surface width were 120 meters (Gul *et al.,* 2017). Kazmi *et al.* (2017b) stated that the failure of retaining walls under heavy rains after several days was a contributing factor resulted in a landslide, which led to the building's collapse. In the same manner, cutting and fill slopes around the building was also one of the factors responsible for this landslide (Jaapar, 2006).

Fig. 1. The collapse of Highland Towers
Source: Google Image

Indeed, there were several fatal landslides recorded after the first catastrophe incident. However, Bukit Antarabangsa (Figure 2) held a record as the second horrific landslides in the region in 2008 at only 1.4 km from Highland Tower. The landslide in results had entirely blocked the main road access for some 5,000 residents living in the area. On top of that, there were 14 bungalow houses destroyed, five

Fig. 2. Bukit Antarabangsa
Source: Google Image

fatalities and 14 people had been confirmed injured (Low *et al.*, 2012). Low *et al*. (2012) and Al-Karni (2011) also stated that this failure is caused by high pore water pressure within the slope.

Landslide Incidents in Kuala Lumpur from 2010 to 2020

Kuala Lumpur is the capital city of Malaysia, which is located at 3.1390 °N, 101.6869 °E. According to The World Population Review (2020), this city is divided into a number of districts spanning nearly eight million population and is predicted to increase by nine million in another decade. Besides, the Department of Statistics Malaysia (2020) also stated that Kuala Lumpur is the largest city in Malaysia, covering of 243 km^2 areas. Over the past years, Kuala Lumpur is considered as the city of gold for all job seekers, hence become one of the active areas for migration. To this day, internal migration can be seen as a problem that should be given attention to. This can contribute to the increasing population, resulting in uncontrolled urban growth (Rashid, 2018). In short, to accommodate enough space for the residents, unsustainable developments are more likely to happen and lead to rising incidents of landslides. From few literatures, there were 50 landslide cases managed to be collected around Kuala Lumpur areas from 2010 to 2020, as shown in Table 1 below.

Table 1 shows a total of 50 cases collected through literature reviews. In this study, landslide incidents that took place in 2010 recorded as the highest cases occurred in a year. There were 17 cases out of 50 that were reported, whereas 0 cases in 2015. In addition, each of these landslides is likely to be attributed to different factors. In this regard, urban areas, such as those in Kuala Lumpur often involve the removal of plants in the highlands for the purpose of development activities. To have a better visual of the landslide distribution, a map was generated using ArcGIS software (Figure 3). The red dots in the map indicate to the landslide cases took place in Kuala Lumpur from2010 to 2020.

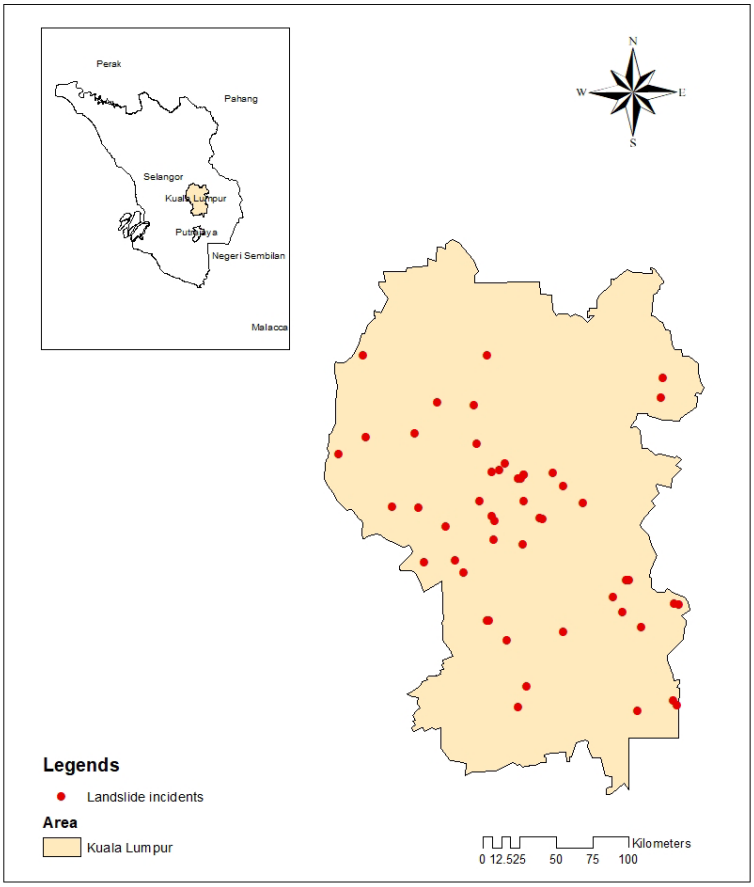

Fig. 3. Distribution Map of Landslide Incidents
Source: Hazard Map with Landslide Historical Sites (2020) and fieldwork (2020)

Table 1. Landslide Incidents in Kuala Lumpur from 2010 to 2020.

No.	Year	Area	
1	**2010**	January	Jalan Ipoh, Kuala Lumpur
2		March	Loji Rawatan Air Langat 2 &Pengagihan Air di Selangor & WPKL, Kuala Lumpur
3		March	Sam Mansion, Jalan Kampung Attap, Kuala Lumpur
4		April	Jalan Bukit Maluri 12, Kuala Lumpur
5		April	Limbang Route 1-85, Kuala Lumpur
6		April	JabatanPerkhidmatanVeterinar, Cheras, Kuala Lumpur
7		May	Blok C (Lama), IPJKR, Kuala Lumpur
8		May	Kampung CherasBaru, Kuala Lumpur
9		June	Jalan Persekutuan, Kuala Lumpur
10		June	Taman Salak Jaya, Cheras, Kuala Lumpur
11		July	KompleksPejabat Kerajaan Bukit Perdana, Kuala Lumpur
12		July	Blok E (Parlimen Lama) IPJKR, Kuala Lumpur
13		July	SK Bandar Baru Sri Petaling 2, Kuala Lumpur
14		July	SM(P) Methodist, Kuala Lumpur
15		November	Taman Persekutuan Bukit Kiara (CerunRuntuh), Kuala Lumpur
16		November	Jalan Selangor, Bukit Persekutuan, Kuala Lumpur
17		December	Jalan Perkasa, Taman Salak Selatan, Kuala Lumpur
18	**2011**	April	KompleksPejabat Kerajaan Bukit Perdana, Jalan Dato Onn, Kuala Lumpur
19		April	Kampung Pindah, Kampung Baru
20		May	Galeria Sri Perdana, Jalan Damansara
21		July	Jalan Kuchai Lama
22	**2012**	February	IPG KampusIlmu Khas, Cheras, Kuala Lumpur
23		February	JabatanPertanian Malaysia, Taman Duta, Kuala Lumpur
24		March	Jalan Belfield Off Jalan Maharajalela, Kuala Lumpur
25		October	Kampung CherasBaru, Kuala Lumpur
26		December	INTAN, Bukit Kiara, Kuala Lumpur
27		December	JabatanPerhutananSemenanjung Malaysia, Jalan Sultan Salahhudin, Kuala Lumpur
28		December	Bukit Setiawangsa, Taman Setiawangsa, Kuala Lumpur
29		Deccember	Bukit Wangsamas, Kuala Lumpur
30	**2013**	March	Persiaran Tuanku Syed Sirajuddin, Bukit Tunku, Kuala Lumpur
31		May	IPG KampusAntarabangsa, Lembah Pantai, Kuala Lumpur
32		May	Jalan Ampang, City Centre, Kuala Lumpur
33		May	Bukit Nanas Forest Reserve, Jalan Ampang
34		May	Taman Shanghai, Jalan Klang Lama
35	**2014**	January	Wisma Tani, Jalan Salahuddin
36		July	Simpang 4 Jalan Imbi
37		October	Sri Putra Mas Condominium, Jalan Duta Mas
38		December	Taman Damai Rasa
39	**2016**	August	Jalan SegambutDalam, Lebuhraya Utara Selatan
40		November	Vista Hamoni Apartment, Taman Bukit Cheras
41	**2017**	July	Midah Ria Flats in Taman Midah, Cheras
42		November	Taman Billion, Cheras
43		November	Jalan MedangTanduk, Bukit Bandaraya
44	**2018**	April	Taman DesaSegambut Tengah
45		September	Lorong Pisang 1, Taman Shanghai, Jalan Klang Lama
46	**2019**	June	Taman Bukit Cheras
47		October	Azalea Apartment, Kampung Sri Penchala
48		October	Kemas Training Institute in Jalan Syed Putra
49		November	Jalan Abdullah, Bangsar
50	**2020**	July	Kampung Palimbayan, Sungai Penchala

Source: Hazard Map with Landslide Historical Sites (2020) and fieldwork (2020).

Since the 1990s, GIS has been used in processing room data. Simultaneously, insufficient land to accommodate the needs of communities in urban areas encourages hillside development. To prevent catastrophic events from continuing to occur, especially in urban areas, GIS was also used in local plan studies. Shukla *et al.* (2016) also use a GIS application to generate maps that serve to provide information on areas that are vulnerable to landslides. This could be useful for the authorities to practice more sustainable development planning in the future.

Normally, a single factor does not trigger a landslide; in fact, involving the combination of several factors, such as rainfall, lack of drainage system, steep slopes and hillside development. Hillside development activities, which consist of the building of new houses and facilities on highlands, also changes the flow of water from highland to the ground. In this study, however, it is discovered that the major contributor to landslide incidents in Kuala Lumpur is overgrown hillside development. As mentioned before, migration is one of the reasons that contributes to the increasing population, resulting in uncontrolled urban growth. Due to depleting flat land, the construction of residental buildings on hillside has increased significantly (Gue and Tan, 2003). Thus, the urban development has expanded to the hilly areas. Hillside development continues to rise not only for tourism, but as a result of pressure from population growth and other economics activities (Too *et al.*, 2011). Moreover, a higher inclination of the slope can contribute to a higher gravity force in pulling materials down the slope, thereby increasing the risk of landslides. Ismail and Wan Yaacob (2018) also stressed that there is a high possibility of a catastrophic landslide to happen if the slopes structures lose their holding capacity.At the end, it is found that the architects and government policies have taken less measures to learn from the errors (Abu Samah, 2006). Hence, landslides could be happened more frequently in the future if hilly areas development continues to overgrown.

Conclusion

This study presents the distribution of landslide incidents from 2010 to 2020. There were 50 cases reported between 10 years in Kuala Lumpur. Landslides are more likely to occur in the future, but assessing the occurrence of slides in one area is considered a more difficult challenge. The Sustainable Development Goal (15) stated that forests are the key to global sustainable development. Thus, soil erosion can be decreased if forests are managed sustainably. There are in fact few causing landslide incidents for instance, rainfall, slope cutting and hillside development. Thus, it is found that hillside development gives a significant effect stability of slopes which will eventually cause landslides. At any rate, landslides are true cannot be prevented, but it is possible to reduce the fatalities caused by landslides.

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