

Empirical Analysis of Urban Community Social Vulnerability in Hilly Areas of Kajang

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Abstract. The occurrence of landslides in Malaysia have increased significantly by year due to climate and development activities happening in Malaysia. The increasing phenomenon of landslide events in Malaysia especially in the urbanised area has greatly impacted the community living in those affected areas. Therefore, to determine the social vulnerability of the community living in the hilly areas of Kajang, the study assessed the social vulnerability index by using Principal Component Analysis (PCA). Seventeen variables were selected to determine the index including age, health, education, single-parent household, vehicle ownership, housing, income, unemployment, and elevation. Using stratified sampling, 200 respondents from the areas of Kajang Mewah Hilly and Kajang Utama Hilly were selected. Overall, the study shows that the people living in Kajang Mewah Hilly area is more vulnerable compared to Kajang Utama Hilly area if landslides happen here. Therefore, there is a need to increase the resilience of the community to disaster event as well as increase the mitigation efforts by the local authorities.

1 Introduction

The occurrence of disaster events such as landslides has significantly impacted the lives, infrastructure, and property of the affected area [1]. There are a lot of factors that cause landslide event including weather and climate as well as rapid development in urbanised areas and the increasing population [2]. Malaysia is one of the developing countries affected by disasters such as landslides almost every year. The alarming rate of landslide events in Malaysia has increased significantly especially in the urban areas. The landslide in 1993 had caused the Highland Tower, in Ulu Klang, Selangor to collapse due to continuous heavy rain. It caused 48 deaths while another event in the same place caused 4 deaths and 15 injuries in 2008 [3]. A few factors such as heavy rain, natural changes in earth material, plane misalignment, and soil erosion are known to cause landslides [4].

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Besides, over-exploitation of land to give way for urbanisation has also led to landslide event [5]. Urbanisation and its confounding effects such as increasing population have caused such events to happen. The increasing event of landslides in Malaysia thus led to this study to assess the social vulnerability index by using the Principal Component Analysis (PCA) in Kajang area. Besides, Kajang area has experienced few landslides event, Therefore, the geographical location and feature of Kajang increase the vulnerability of the community to disaster. Besides, high daily rainfall intensity can increase the chances of landslide to happen such as the 2017 landslide event happen in Kajang, Selangor caused by continuous rainfalls [6]. Thus, a study regarding social vulnerability index using a Principal Component Analysis is important to determine the level of community vulnerability to disasters. Based on past research, there were few studies that developed (SoVI) Social Vulnerability Index by using Principal Component Analysis (PCA) [7–9]. PCA is an approach to minimize the dimensionality of the index by reducing the variable while maintaining as much information about the data. The result was used to determine the level of Social Vulnerability in two Kajang areas by using the Principal Component Analysis (PCA).

2 Literature Review

Vulnerability refers to the susceptibility of individuals and communities to social, economic, and cultural challenges that impact their ability to cope with harm [10]. According to Cutter et al., social vulnerability is influenced by social inequality, affecting different groups' capacity to respond to adverse situations [11]. Understanding vulnerability is essential for identifying at-risk groups for early intervention. The Intergovernmental Panel on Climate Change (IPCC) defines climate vulnerability as the extent to which systems are susceptible to and unable to cope with the negative effects of climate change [12]. Vulnerability is a widely used concept across various fields [13], including social science, economics, and psychology, but it lacks a universal definition and can be interpreted differently depending on the discipline [10]. Despite the similarities between different locations, vulnerability varies based on the specific challenges faced by each community and the adaptive capacity of its households. Therefore, study regarding social vulnerability is a need to determine the level of vulnerability among the community. 17 variables from 9 themes were used to determine and evaluate the social vulnerability by using principal component analysis. Variables of vulnerability are adapted from several studies [7–9,11,14].

Table 1. The variables used in determining the level of social vulnerability.

Variables	Description	Unit	Source
Age	Household with child younger than 15 years old	%	[7,9,11]
	Household with elderly over 65 years old or older	%	[7,9,11]
Health	Head of household with illness	%	Authors
	Member of household with illness	%	[14]
	Distance from nearby clinic or hospital	Km	Authors

Education	Highest education attainment	%	[7–9,11]
Single parent household	Household with single parent	%	[9]
Vehicle ownership	Number of vehicles	Num.	[9]
Housing	House ownership	%	[9]
	Housing with more than 10-unit structure (e.g., apartment)	%	Authors
	Total occupied housing unit	%	Authors
Income	Household with low-income standard	%	[9]
	Household with income below 60% of the national median	%	[9]
	Household with income 200% over the national median	%	[9]
Unemployment	Head of household unemployed longer than 6 months	%	[7,9]
	Members of household unemployed longer than 6 months	%	Authors
Elevation	Average elevation from above the sea level	m	Authors

Sources: [7–9,11,14].

3 Methodology

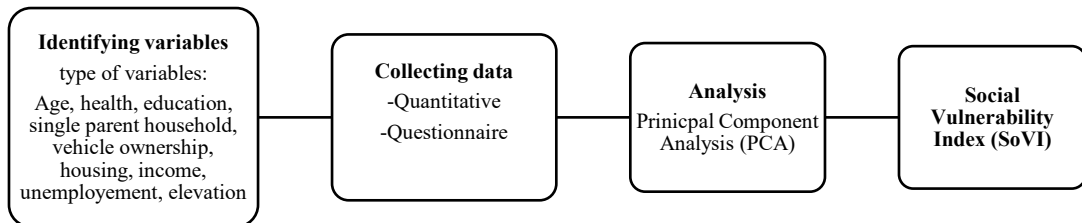


Fig.1. Process of developing SoVI.

Quantitative research method was used in this study to analyse the data. Survey was used as an instrument to collect data regarding the socioeconomic vulnerabilities of the community. Figure 1 is the process of developing Social Vulnerability Index (SoVI); the first process is identifying variables, second collecting the data, third analysis; descriptive analysis and Principal Component Analysis (PCA), and lastly is Social Vulnerability Index (SoVI). First, variables were identified using past literatures and the suitability of the study area. After a thorough process, 17 variables were chosen as the variables in this study including age, health, education, single parent household, vehicle ownership, housing, income, unemployment, and elevation.

Second is the process of collecting the data. The process of data collection included face-to-face interview and survey by using questionnaires. The questionnaires comprised demography, ownership, wealth, resources, health status, social involvement, knowledge and experience of disaster, disaster preparedness, and infrastructure and vulnerability to disaster. The study area for this study was in the hilly areas of Kajang town, Selangor, Malaysia. Besides, land use and urbanisation that happened can increase the possibility of hazardous event including landslide [15], therefore there is a possibility that Kajang area is susceptible to landslide event. Therefore, the study of Social Vulnerability Index was conducted in hilly area residential such as Kajang Mewah and Kajang Utama (Refer to Figure 2 and 3). Kajang Mewah Hilly and Kajang Utama Hilly were selected as the study site as the area of Langat River Basin is a low-terrestrial, and mountainous area [16,17]. The experience of landslide events in Kajang with the characteristic of the area and the possibility of changes can increase the possibility of landslide happening in Kajang. Thus, choosing Kajang Utama Hilly and Kajang Mewah Hilly will help to analyse the social vulnerability of one community. A number of 200 respondents from both of the areas were selected by using stratified sampling method and the activity of data collection was done by trained enumerators. The data collection was conducted from January until March 2022.



Fig. 2. Map of Kajang Utama Hilly.



Fig. 3. Map of Kajang Mewah Hilly.

Analysis of the study was made using SPSS (Statistical Package for the Social Science) version 25.0. There were two types of analysis in this study including descriptive analysis and Principal Component Analysis (PCA). Descriptive analysis was carried out to determine the descriptive data of demography profiling of the respondents in both Kajang Mewah Hilly and Kajang Utama Hilly. Next is the Principal Component Analysis (PCA). After the data collection process, the data collected had to go through the process of standardisation and normalisation.

Standardisation and normalisation of the data were done to ensure that the data were standardised before the data proceeded to Principal Component Analysis (PCA) to calculate the index of Social Vulnerability. Principal Component Analysis is a method for reducing the dimensionality of a large dataset by converting the original set of variables into a smaller dataset while maintaining the same information [18]. The validity of the Principal Component Analysis was further tested using Kaiser-Meyer-Olkin (KMO) criterion and Barlett's test. The KMO's test is significant in testing the sampling adequacy of each variable used in this study [7] while Barlett's test is significant to test the null hypothesis. The Social

Vulnerability Index (SoVI) scores were divided into four categories using standard deviation from the mean, with a mean of 0 and deviation of 1 [8]. The numerical ranging from 0 to 1 was then grouped into four vulnerability categories which will determine the score of Social Vulnerability Index (SoVI) (Table 2).

Table 2. Vulnerability classification.

Category	Score
Highly vulnerable	0.7501 – 1.0000
Moderately vulnerable	0.5001 – 0.7500
Low vulnerable	0.2501 – 0.5000
Not vulnerable	0.0000 – 0.2500

4 Result & Discussion

Table 3 is the result of demography profiling for both Kajang Mewah Hilly and Kajang Utama Hilly, in Kajang, Selangor. Majority of the respondents were in the category of age between 19 to 29 years old for both Kajang Mewah Hilly (50.9%) and Kajang Mewah Utama (46.4%), while 26.7 percent of Kajang Mewah Hilly and 20.2 percent of Kajang Utama Hilly, the respondents were between the age of 30 to 39 years old. For the age group between 50 to 59 years old, most of them were from Kajang Utama Hilly (19.0%), and Kajang Mewah Hilly (16.4%), while the lowest was from the age group of 60 to 69 years old. Next for gender distribution, majority of the respondents from Kajang Mewah Hilly area, females (51.7%) were more than males (48.3%), compared to Kajang Utama Hilly area in which the majority of the respondents were male (57.1%) compared to female (42.9%).

For the citizenship of the respondents, majority of Kajang Utama Hilly residents were Malaysians while for Kajang Mewah Hilly, 95.7 percent of the respondents were Malaysians while others were non-citizens. Next, for the ethnicity of the respondents, majority of the respondents both from Kajang Mewah Hilly (74.1%) and Kajang Utama Hilly (78.6%) were Malays, while 14.7 percent (Kajang Mewah Hilly) and 9.5 percent (Kajang Utama Hilly) were Chinese. 8.6 percent of Kajang Mewah Hilly and 11.9 percent of Kajang Utama Hilly were Indians, while 2.6 percent of respondents in Kajang Mewah Hilly were categorised as others.

Next, for the marital status of the respondents, majority of the respondents from both areas were married with 57.8 percent (Kajang Mewah Hilly) and 59.5 percent (Kajang Utama Hilly), followed by single with 41.4 percent (Kajang Mewah Hilly) and 59.5 percent (Kajang Utama Hilly), and only Kajang Mewah Hilly recorded divorce status (0.9%). As for the education level, majority of the respondents completed high school with 38.7 percent (Kajang Mewah Hilly) and 41.6% (Kajang Utama Hilly). 16.4 percent of Kajang Mewah Hilly and 22.6 percent of Kajang Utama Hilly obtained their degree certificates and 28.4 percent of Kajang Mewah Hilly and 26.2 percent of of Kajang Utama Hilly had diploma or finished their STPM certification. While most of the respondents finished their school and obtained their higher education certificate, minority of the respondents in Kajang only finished primary school.

Table 3. Demography profiling for respondents in Kajang Mewah Hilly and Kajang Utama Hilly.

Demography Profiling	Kajang Mewah Hilly	Kajang Utama Hilly
Age		
19 – 29 years old	50.9%	46.4%
30 – 39 years old	26.7%	20.2%
40 – 49 years old	16.4%	19.0%
50 – 59 years old	4.3%	9.5%
60 – 69 years old	1.7%	4.8%
Gender		
Male	48.3%	57.1%
Female	51.7%	42.9%
Citizenship		
Malaysian	95.7%	100.0%
Non-Malaysian	4.3%	0.0%
Ethnicity		
Malay	74.1%	78.6%
Chinese	14.7%	9.5%
Indian	8.6%	11.9%
Others	2.6%	0.0%
Religion		
Islam	74.1%	78.6%
Buddha	17.2%	9.5%
Hindu	6.0%	3.6%
Christian	2.6%	8.3%
Marital Status		
Single	41.4%	40.5%
Married	57.8%	59.5%
Divorcee	0.9%	0.0%
Education Level		

Does not go to school	2.6%	1.2%
Primary school	2.6%	2.4%
High school	38.7%	41.6%
STPM/Diploma	28.4%	26.2%
Degree	16.4%	22.6%
Skill certificate	11.2%	6.0%

After demography profiling, Principal Component Analysis was analysed but to ensure the validation of the result, a KMO statistical test was carried out during the Principal Component Analysis (PCA) in which the KMO held a function to assess the sample adequacy and both full and partial correlations of the variables. KMO value ranges from 0 to 1, which should be greater than or equal to 0.6 to ensure the adequacy of analysis [19]. The KMO measure of sampling adequacy from the test was 0.661. From the result of adequacy test, the KMO test showed a sampling adequacy of more than 0.5 in which the variables used in the study were relevant and proportionate to result and above the minimum requirement. While the Bartlett’s test of sphericity showed a significant value of p , in which the value of $p < 0.05$. As for the result, total variance explained by the 17 selected variables in this study showed that the total cumulative value of the total variance was 71.83 percent in which six components were extracted out of 17 variables from this study. Overall, from the study, Kajang Mewah Hilly and Kajang Utama Hilly is equally vulnerable to landslide event. Hence, this is the composite SoVI score for Kajang Mewah Hilly (0.5400) compared to Kajang Utama Hilly area (0.53612).

Table 4. The scores of Social Vulnerability Index for Kajang Mewah Hilly and Kajang Utama Hilly areas.

Vulnerability Factor	Kajang Mewah Hilly	Kajang Utama Hilly
Factor 1	0.01753	0.30235
Factor 2	0.28076	0.01459
Factor 3	0.07071	0.01859
Factor 4	0.05653	0.03318
Factor 5	0.07935	0.03282
Factor 6	0.03512	0.13459
Overall score	0.54000	0.53612

The Social Vulnerability Index (SoVI) scores show that both areas, the population in Kajang Mewah Hilly and Kajang Utama Hilly are moderately vulnerable to the landslide hazard. Therefore, there is a need for disaster management in which it will help the community in both areas before, during, and after the disaster event. Quantifying the social vulnerability of the community susceptible and vulnerable to landslide event will not only contribute to landslide study in Malaysia but also can help the community and responsible party in disaster management. During the mitigation and preparedness phase, SoVI can be utilised as a proactive tool to organise community-based disaster mitigation efforts that aid more susceptible communities, ultimately strengthening community resilience [7]. Besides, increasing community resilience towards disaster event can decrease the exposure of a community to

this disaster event with the help of their capacity for adaptation. Nonetheless, studies that use Principal Component Analysis (PCA) to determine the social vulnerability of a community can assist policy maker at the national level in prioritizing area that needs development and aids interventions [7,9]. Even though this study contributes to determining the level of vulnerability of a community, the limit of this study is in terms of identifying the factors that influence the vulnerability of the community. Therefore, there is a need for other study that not only identifies the level of vulnerability but also identifies the factor that influences the vulnerability of the community.

5 Conclusion

In conclusion, this study was made to determine the social vulnerability of the community in hilly Kajang area in which the study assessed Social Vulnerability Index using Principal Component Analysis. Seventeen themes were used to determine the Social Vulnerability Index and overall result from the study shows that Kajang Mewah Hilly and Kajang Utama Hilly is equally vulnerable to landslide event. Therefore, there is a need to increase the resilience of the community to disaster event as well as increase the mitigation efforts by the local authorities. In the future study, there is a need for a study that needs to determine not only the level of vulnerability of a community but also the factors that contribute to vulnerability. This is important in disaster mitigation activities as well as disaster management by the local stakeholders.

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