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Settlement preferences in the disaster-prone areas of Brantas River

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Abstract. Kota Lama is one of the urban villages in Malang city that has settlements along the Brantas River. Kota Lama experienced three landslides and flooding in 2015 and one in 2016. Those disasters caused the community to take action of post-disaster recovery, yet the people still choose to remain living in Kota Lama. Therefore, the study aims at determining the preferences of the citizens living in disaster-prone areas in Brantas River. The research used a factor analysis of 12 variables: 1) neighbourhood situation, 2) air condition, 3) relations between neighbours, 4) security, 5) location, 6) customs, 7) ethnic diversity, 8) the presence of social groups, 9) the community's customs and habits, 10) proximity to the economic facilities, 11) adequate educational facilities, and 12) adequate medical/health facilities. The results show that two factors have been formed, namely Factor 1 (access) comprising variables of neighbourhood situation, air condition, relations between neighbours, location, ethnic diversity, the presence of a social group, supporting positive habits at home, close to the economic facilities, educational facilities, as well as medical facilities, and Factor 2 (assurance) consisting of customs and security.
Keywords*:* analysis factor, disaster-prone area, settlement preferences

1. Introduction

Settlement preference is the environmental quality reflecting the quality of human life, in this case, comprising of: 1) situational variables of distance to service centres, climate, and topography; 2) physical variables of space organization, clean air, and calm ambience; 3) psychological variables of population density and luxury; as well as 4) socioeconomic variables of tribe, social status, crime rate, and education [1]. The choice of living is influenced by the attractiveness of settlements and conditions that are considered ideal [2]. Preference is an attitude of choice to a thing influenced by internal and external factors. It can be based on several circumstances including social scope (such as occupation, income, number of family members, dependents, and children education), housing (condition, type, and price of the house), community aspect, location scope, as well as physical aspect [3]. Assessing the housing location of one individual and another is not the same because the background of the level of needs and interests are different [4]. Kota Lama is one of the areas prone to floods and landslides in Malang City. Data of disaster occurrence from BPBD Malang has recorded three landslide events in 2015 and one in 2016 taking place in this village [5, 6]. As a result of the flood disaster, residents had to perform post-flood recovery actions. Although they are facing the risks of flood and landslides, they still choose to stay in Kota Lama. The tendency of the people who remain to live in this location is a big question to be studied.

2. Research Method

The study took place in a neighborhood (RT) in Kota Lama. The basic consideration is the previous research that all RWs in Kota Lama fall into a high category of hazard and vulnerability levels, except for those located very far from Brantas River [7]. This statement is supported further by the actual condition of the existing study area (results of interview surveys in 2016) showing that only houses nearby or directly adjacent to Brantas River were impacted by the flood disaster at Kota Lama in 2003, 2005, 2009, 2013. Similarly, those areas were struck by landslides, three times in 2015 and once in June 2016 [6]. This research used a sampling size technique of proportionate stratified random sampling where all individuals or elements in the population have the same opportunity to be a respondent [8]. The total sample size was 279 households.

Factor analysis is a statistical method used to describe variability among observed, correlated variables regarding the potentially lower number of unobserved variables called factors. The observed variables were modelled as a linear combination of the potential factors, plus 'error' terms. Factor analysis aims at finding independent latent variables. Followers of factor analytic methods believe that the information gained concerning the interdependencies between observed variables can be used later to reduce the set of variables in the dataset [9]. There are 12 variables analyzed in this research as shown in Table 1.

Table 1. Variables used in this study.

	Variable
Conditions in the neighbourhood (neighbourhood situation)	X_1
Healthy air in the area (air condition)	X_2
Good relations between neighbours (relations between neighbours)	X_3
Adequate security (security)	X_4
Strategic location to stay (location)	X_5
Positive behaviour and habits of the community (customs)	X_6
People diversity is not an issue in the area (ethnic diversity)	X_7
The presence of a social groups	X_8
The community's customs and habits	X_9
Progressive economic development in the area (close to the economic facilities)	X_{10}
Adequate educational facilities	X_{11}
Adequate medical/health facilities	X_{12}

The factor analysis in this study employed data taken through questionnaires using the Likert scale regarding people's preferences of the residential environment. Table 2 lists the Likert scale used in the survey.

Table 2. Likert scale.

Measurement Scales	Descriptions
5	Strongly agree
4	Agree
3	Simply agree
2	Disagree
1	Strongly disagree

The order of factor analysis in this study is as followed in Figure 1.

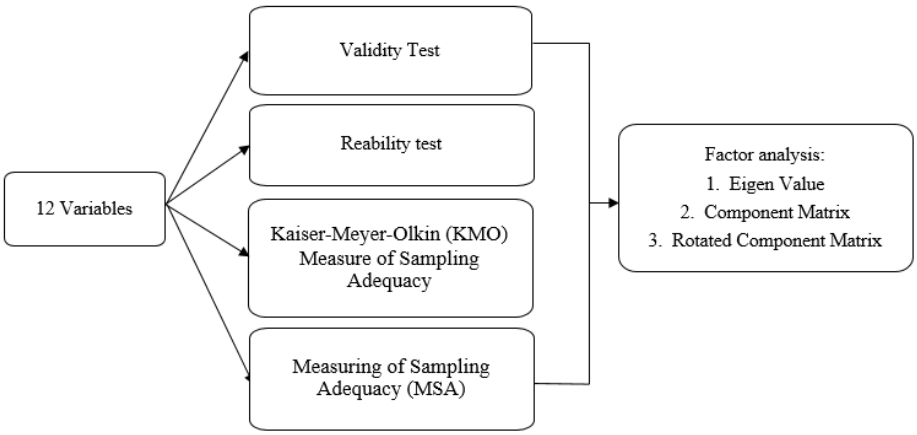

Figure 1. Procedural scheme of the methods applied in this study.

3. Results and Discussion

3.1. Feasibility testing of variables

The feasibility testing of variables was carried out through validity and reliability tests. There were 279 samples (n) in this research, then the degree of freedom (df) = n – 2 = 277. Using a significance level of 5%, r table value was obtained of 0.1175. The next step was to conduct a 12 variables test by: 1) validity test, 2) reliability test, 3) Kaiser-Meyer-Olkin (KMO) and Bartlett's Test, as well as 4) Measures of Sampling Adequacy (MSA). The results of those tests showed that the 12 variables were suitable for further processing which was the factor analysis.

3.2. Factor formation

Once the variables were determined, selected, and their correlation calculations have met the requirements for further analysis, the next step was to establish the factors to find the underlying structure of the relationship between initial variables. The method used in the factor formation was the principal component analysis. The two primary measures in the factor formation were the determination of the number of factors and the formed rotation of the factors.

Determination of the number of factors

The number of factors was determined by combining several criteria to obtain the most appropriate number of factors for the research data (Table 3).

Table 3. Total variance explained.

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.852	48.766	48.766	5.852	48.766	48.766
2	1.179	9.826	58.593	1.179	9.826	58.593
3	0.865	7.205	65.798			
4	0.853	7.108	72.906			
5	0.695	5.793	78.699			
6	0.591	4.927	83.626			
7	0.507	4.226	87.852			
8	0.439	3.658	91.510	.		
9	0.346	2.880	94.391			
10	0.331	2.758	97.148			
11	0.227	1.894	99.043			
12	0.115	0.957	100.000			

The first criterion used was the eigenvalues. Factors having more than one eigenvalue would be maintained, and factors with less than one eigenvalue would not be included in the model. As seen in the table above, eigenvalues greater than one were obtained on one factor and two factors. Thus, the number of factors was two factors. The second criterion was the determination based on the percentage value of the total variance that could be explained by the number of factors to be formed. From the table above, interpretations could be made related to the total cumulative variance of the sample. If those variables were summarized into several factors, then the total value of the explanatory variance was as follows:

- If the eight variables were extracted into one factor, the total unexplained variance would be 5.852 / 12 x 100% = 48.766%.
- If the eight variables were extracted into two factors, the total explained variance would be 1.179 / 12 x 100% = 9.826%, and the cumulative total variance for two factors would be 48.766% + 9.826% = 58.593%.

By extracting the initial parameters into two factors, a considerable cumulative total variance of 58.593% was generated, implying that the two factors formed can already represent the 12 parameters of urban residency preference in Kota Lama. Hence, the extraction of two factors has met the second criterion. The third criterion was the determination based on the scree plot which is a plot of eigenvalues against the number of extracted factors. The point at which the scree begins to occur shows the number of appropriate factors. This point occurs when the scree starts to look flat. As seen in Figure 2, the scree plot starts horizontally on the extraction of the initial variables into two factors.

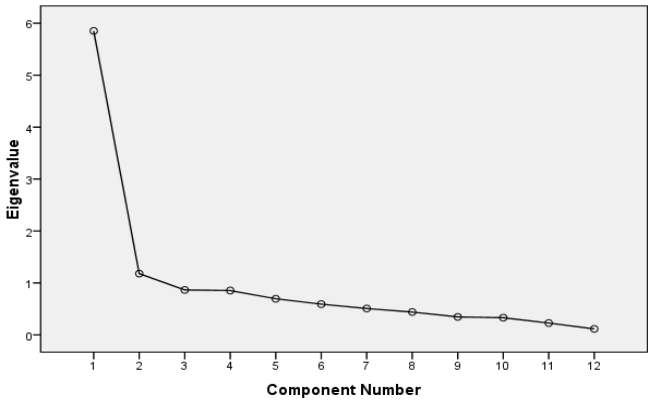

Figure 2. Scree plot.

From the combination of the three criteria, it could be concluded that the most appropriate factor extraction was two factors.

Component matrix

The component matrix shows the distribution of the 12 parameters on two factors formed, while the figures in the table are factor loadings indicating the correlation between a parameter with Factor 1 and Factor 2. The process of determining which parameters would be entered into which factor is done by a comprehensive comparison of the correlation of each row. More details could be seen in the following Table 4.

Table 4. Component matrix.

Variable	Factor	
	1	2
X_6	0.833	-0.172
X_8	0.828	0.152
X_3	0.822	-0.219
X_1	0.785	-0.149

Variable	Factor	
	1	2
X_5	0.784	-0.169
X_{11}	0.737	0.164
X_7	0.717	-0.275
X_{12}	0.664	0.106
X_{10}	0.622	0.099
X_2	0.582	-0.039
X_4	0.545	0.366
X_9	0.241	0.877

Rotation

The rotation in this study aims to obtain factors with loading values that are clear enough for interpretation. Rotated component matrix is a correlation matrix that shows a more distinct and apparent distribution of variables compared with the component matrix. More details is seen in the following Table 5.

Table 5. Rotated component matrix.

Variabel	Factor	
	1	2
X_3	0.846	0.093
X_6	0.839	0.140
X_5	0.792	0.125
X_1	0.786	0.144
X_7	0.758	-0.002
X_8	0.718	0.440
X_{11}	0.629	0.419
X_{12}	0.581	0.338
X_2	0.557	0.173
X_{10}	0.545	0.316
X_9	-0.091	0.905
X_4	0.377	0.538

The results indicate that the loading values of the variables for the two factors have been sufficiently differentiated and are ready for interpretation. All variables have a high loading on one factor and a small loading for the other factor.

From the results of factor analysis, two primary factors affecting the settlement preference of the residents in disaster-prone areas of Kota Lama, Kedung Kandang district, Malang City, have been obtained. The factor grouping is shown in Table 6.

Table 6. Results of classifying variables into factors.

Factor	Component Variables
Factor 1(access)	X_3, X_6, X_5, X_1, X_7, X_8, X_{11}, X_{12}, X_2, X_{10}
Factor 2 (security)	X_9, X_4

Factor 1, the biggest variation contributor, has close relationships with ten component variables. Factor 1 consists of relationships between neighbors X_3 (0.846), behavior and habits of the society X_6 (0.839), suitable location for residence X_5 (0.792), and neighborhood conditions X_1 (0.786), healthy air X_2 (0.758), community diversity X_7(0.718), the presence of a social group X_8 (0.629), adequate educational facilities X_{11} (0,581), adequate health facilities X_{12} (0.557), and progressive economic development X_{10} (0.545).

Factor 2, the second largest contributor, has close relations with two component variables, i.e., positive customs and habits X_9 (0.905) and adequate security X_4 (0.538). The factors' names were then determined based on the characteristics of their members by examining the variables constituting

Factor 1 and 2. Giving a new name for each factor is subjective; it could also be derived from the variable having the highest factor loading value [10]. The interpretation of factors that have been formed in particular gives a name that is considered to represent the variables of the factors members [11]. Considering both theories, by looking at the variables making up the factors, Factor 1 could be determined as Access Factor and Factor 2 could be named as Security Factor.

The two factors formed are in line with the statement of [1], [2], [3], [4]. Settlement preference is the need for access to resources, especially economic resources that imply the social needs as well as the convenience to reach the workplace to obtain a source of income. Settlements must also provide security guarantee, in the sense of ensuring family circumstances. Both factors have proven that the accounts related to the community preferences to remain living in Kota Lama were houses or shelters providing access to resources and security guarantee.

4. Conclusion

Based on the factor analysis, it can be concluded that two primary factors are affecting the settlement preferences in disaster-prone areas of Kota Lama, Malang City, namely access and security aspects. Access Factor is the new label obtained from the interpretation of factor analysis, considered as representative for the variables constituting Factor 1, i.e., relationships between neighbors, behavior and customs of the community, residential location, environmental condition, community diversity, the presence of social groups, educational facilities, health facilities, healthy air, and economic development. The second factor, named 'security', represents the variables of customs and habits of the community as well as the adequate security.

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