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Abstract. When photographed from a disaster map, Indonesia is the ring of fire. Almost the entire Indonesian archipelago is prone to disasters. This portrait should not be worried if an inherent and coherent disaster management effort can be carried out. This paper wants to provide empirical calculations (the economic value) on the role of disaster mitigation on the quality of life. Disaster mitigation is one form of amenities offered by the local governments. In addition, disaster mitigation is one of the components forming the quality of life. This paper involves some capital cities in Indonesia. The study shows that people have willingness to receive compensation between Rp 0.981 million per year and Rp. 1.009 million per year for disaster mitigation factors, or we can say that the willingness to receive compensation between Rp. 81 thousand per month and Rp. 84 thousand per month for disaster mitigation factors.

1 Introduction

Indonesia is a very interesting area, because it have an extensive continental exposure areas (Sunda Exposure and Sahul Exposure), it also has the highest folds of mountains in the eternal and snowy regions (Central Papua Mountains). Besides that, the only one in the world is a very deep inter-island sea, the Banda Sea (more than 5,000 meters), and a very deep sea between two arches, namely the Weber trough (more than 7,000 meters). Two of the world's major volcanic lines also meet in Indonesia and several mountain folds in the world meet each other in Indonesia [1]. This condition was a part of the result of the meeting process of three large tectonic plates, namely the Indo-Australian, Eurasian and Pacific plates. The meeting zone between the Indo Australian plate and the Eurasian plate off the west coast of Sumatra, south of Java and Central Java, while the Pacific plate in the northern part of the island of Papua and Halmahera [1,2]. Nowadays, the Indonesian archipelago has a history of formation that is quite long and complicated in terms of its geological aspects. Indonesia which is located between two Asian continents in the north and Australia in the south has very complex and very unstable geological or geodynamic elements [1,3].

Based on the Concept of Tectonic Plate (known as Konsep Tektonik Lempeng), in the territory of the Indonesian Maritime State, there are many terrestrial disasters. For example, it can be stated that during 1970-2008, 20% of all earthquakes on Earth, it is occurred in Indonesia. Meanwhile, since 2004–2008, there have been six major earthquakes that have damaged a number of areas in Indonesia, especially in the front arc region of Sumatra Island and the southern part of Java which have caused huge losses [1]. In addition, throughout the period 2004 - 2014, the risk of natural disasters included geological factors (earthquakes, tsunamis and volcanic eruptions), disasters caused by hydrometeorological factors (floods, landslides, droughts, hurricanes), disasters caused by biological factors (epidemics humans, plant / livestock diseases, plant pests), caused by technological failures

(industrial accidents, transportation accidents, nuclear radiation, chemical pollution), and environmental damage [4].

As a result, the impact caused by a catastrophic event is very large, both when viewed from the physical, spatial, social, economic, and cultural aspects. One of them, is related to quality of life. The quality of life can be measured by three indicators, namely self-happiness, health status, and life satisfaction [5]. Previous studies in various countries showed that natural disasters tend to worsen people's quality of life [6,7]. In addition, there are other risk factors that are often associated with deteriorating quality of life for disaster survivors, because they are not limited to women, old age, living alone, low socio-economic status, ethnic minorities, and also the death of loved ones during treatment [8]. Meanwhile, social capital can be considered as a form of disaster mitigation because it is a representation of social support, as a trauma healing factor while also preventing negative impacts that often hit disaster survivors [9].

In connection with the above, it is necessary to have integrated disaster mitigation efforts between various elements both the public, the private sector and the government. This effort is expected to minimize the impact of losses caused. So based on the description above, this paper aims to provide little contribution through calculating the economic value of disaster mitigation toward the quality of life in Indonesia.

2 Disaster Mitigation as a Part Quality of Life

The quality of life of a region can be measured by calculating the willingness to pay households for an amenities. This value is a proxy for the estimation of the implicit price of quality of life. Approach by observing and using information from the market related to quality of life. The general framework for measuring the quality of life of a region is the hedonic approach. This method allows us to estimate the price of non-market goods. This can be done by observing and using data from the market related to environmental quality / amenities. Here, the implicit price proxies for comfort can be seen from the labor market and housing market [10, 11, 12].

The housing market is reflected in the hedonic housing rental model while the labor market is reflected in the hedonic wage model. Rental and wage variables reflect the quality of life of the region because individuals are assumed to enjoy the amenities in an area by buying or renting a house in the area using wages obtained from the labor market. However, this model results some variations in the amenities because the factor of travel costs.

This paper adopts studies that have been carried out by previous researchers in the context of measuring the implicit price of regional quality of life [10, 11, 12]. This model develops with the aim that it can be applied to measure the implicit price of each region in Indonesia. The form of the development of the model is as follows, first optimizing the characteristics of individuals and households in wage hedonic models and hedonic housing rental models. This is related to efforts to improve the ability of the model to explain variations in wages and rent of houses. Second, developing the definition of amenities in the context of accessibility of transportation, tourism facilities, environmental conditions, disaster mitigation, and public facilities. In this paper, we used education, health, and disaster mitigation.

3 Data, Model Specification, and Measuring Quality of Life

3.1 Data

The data used in this study are individual and household National Socio-Economic Survey (Susenas) data and Village Potential (Podes) data. Data on public facilities, transportation accessibility, and disaster mitigation are obtained from data on Village Potential (Podes). Disaster mitigation information includes the tsunami early warning system by the local government, safety equipment by the regional government, and safety counseling (disaster simulation) by the local government. Data on education, health, employment, housing data, and consumption or household and socio-economic information is obtained from data from the National Socio-Economic Survey (Susenas). The data are some of the information used in this study, namely age, gender, employment status according to business field, main employment status, regional characteristics, and the last level of education completed. In this study using

susenas and podes in 2011, taking into account Podes and Susenas data were published simultaneously in the same years.

3.2 Model Specification

This paper adopts the model that has been done by the previous authors [10,11]. They built a general framework for measuring quality of life known as the hedonic approach. The approach with this method provides an alternative for estimating the price of goods marketed is often not available. This approach seeks to make observations with data obtained from the market based on environmental quality and the amenities information. The markets represented in this method are divided into two categories, namely the labor market and the housing market. The labor market is a representation of the wage model, while the housing market is a representation of the rental model [13]. Both model can be written as follows:

$$LWage_i = f(A, W_i) \quad (1)$$

$$LRent_i = f(A, W_i) \quad (2)$$

Where, $LRent_i$ is rent in logarithms; $LWage_i$ is wages in logarithms; A is an amenities provided by the city such as public facilities (health and education) and disaster mitigation; W are the social demographic characteristics of the household; and i are the households. The two models will be estimated by the OLS method through multiple regression [14,15]. The variables description as follows

Table 1. Description of Variable

Variable	Description
maritalstat	1 = married and 0 = others
age	age from head of household
gender	1 = male and 0 = female
mainjobstat	1 = paid workers and 0 = others
educelementary	1 = elementary school attained and 0 = others
educjunior	1 = junior high school attained and 0 = others
educsenior	1 = senior high school attained and 0 = others
educuniversity	1 = university school attained and 0 = others
numofhh	number of household member
hhworkprimary	1 = if head of household works in primary sector and 0 = others
hhworksecondary	1 = if head of household works in secondary sector and 0 = others
hhworktertiary	1 = if head of household works in primary sector and 0 = others
numprimaryschool	number of the existing primary school in cities
numjuniorschool	number of the existing junior high school in cities
numseniorschool	number of the existing senior high school in cities
numuniversity	number of the existing university in cities
numhospital	number of the existing hospital in cities
numbirthhospital	number of the existing birth hospital in cities
numcenterhealthsoc	number of the existing center health society in cities
dumdisastermtgt	1 = disaster mitigation from the cities government and 0 = none

3.3 Measuring Quality of Life

The measurement of quality of life in this paper adopts the Berger-Blomquist-Hoehn model, where some adjustments are needed to be calculated with available data. Some of these adjustments in terms of formulating and choosing the amenities variables. In this paper, several government facilities / services are used such as education, health, and disaster mitigation [11,16]. In this paper, the annual implicit price is calculated first by summarizing annual household compensation to the labor market and housing market.

Next, we calculate the quality of life in the form of rupiah to compare the quality of life, for example between regions or cities. The calculation results in giving positive or negative values because they represent the quality of life index relative to other regions. In other words, the difference in value can be used as a base approach, for example reference and can be applied to cities with the lowest rank so that the value of the quality of the base city is relative to other cities. The quality of city life is measured by estimating compensation to be paid or that can be paid to households to stay or not in the city [13].

4 Result And Discussion

Table 2 and Table 3 describe the regression results on wage models and rental models by including comfort variables (education, health, and disaster mitigation). Each table presents three models, where the first model includes attributes for disaster education and mitigation; the second model includes attributes for health and disaster mitigation; and the third model includes all three attributes.

Table 2 and Table 3 also describe the regression results on wage models and rental models by including comfort variables (education, health, and disaster mitigation). Each table presents three models, where the first model includes attributes for disaster education and mitigation; the second model includes attributes for health and disaster mitigation; and the third model includes all three attributes. Table 2 shows the magnitude of changes in wages as a consequence of the impact of changes in amenities, while table 3 shows the magnitude of changes in rent as a result of changes in amenities. The regression results are processed using the Ordinary Least Square (OLS) method. The number of amenities variables analyzed in both tables are statistically significant at degrees 1%, 5%, & 10%.

Table 2. Estimation Results for Wage Eq.

Dependent Lwage	Model 1			Model 2			Model 3		
Independent	Coef.	Std.Err	Sign	Coef.	Std.Err	Sign	Coef.	Std.Err	Sign
maritalstat	-0.669	0.132	***	-0.673	0.132	***	-0.679	0.131	***
age	0.112	0.002	***	0.110	0.002	***	0.110	0.002	***
gender	1.578	0.153	***	1.587	0.153	***	1.574	0.152	***
mainjobstat	0.710	0.060	***	0.724	0.059	***	0.710	0.059	***
educelementary	3.010	0.143	***	2.941	0.142	***	2.928	0.141	***
educjunior	3.364	0.141	***	3.281	0.140	***	3.266	0.140	***
educsenior	3.551	0.135	***	3.465	0.133	***	3.447	0.133	***
educuniversity	3.598	0.141	***	3.522	0.141	***	3.509	0.141	***
numofhh	0.044	0.018	**	0.039	0.018	**	0.039	0.018	**
hhworkprimary	2.833	0.206	***	2.945	0.212	***	2.956	0.210	***
hhworksecondary	3.123	0.112	***	3.066	0.111	***	3.067	0.110	***
hhworktertiary	3.073	0.097	***	3.012	0.097	***	3.013	0.096	***
numprimaryschool	0.064	0.032	**				0.007	0.032	
numjuniorschool	0.048	0.006	***				0.025	0.006	***
numseniorschool	0.020	0.034					0.014	0.033	
numuniversity	0.223	0.072	***				0.233	0.074	***
numhospital				0.197	0.060	***	0.163	0.060	***
numbirthhospital				0.459	0.054	***	0.386	0.056	***
numcenterhealthsoc				0.546	0.055	***	0.427	0.061	***
dumdisastermtgt	0.389	0.052	***	0.378	0.052	***	0.350	0.052	***
Num of Obs		4655			4655			4655	
F - Stat		19855.730			21396.510			17204.700	
Prob F - Stat		0.000			0.000			0.000	
R - Squared		0.982			0.982			0.982	

*** : sign. 1%; ** : sign 5%; * : sign. 1%

The estimation results show that the t statistic value as a proxy for individual testing on the hedonic model of wages and rent shows that not all amenities variables partially significantly affect wages or rent. In the wage equation, the variable number of elementary schools and the number of secondary schools does not show a significant effect. Then, the number of elementary schools did not show a significant influence on the rent equation model. Here shows that households in each city have different preferences for amenities, so that the representation of household behavior is not always the same [11]. However, the study findings show that all the independent variables in the equation for wages and rent are jointly significant. This is indicated by the probability value of F statistics that are smaller than alpha values 5 percent or 1 percent. This result is quite satisfactory considering that the amenities measured in this study are not partially contributed by each variable but the amenities produced together in several cities in Indonesia

Table 3. Estimation Results for Rent Eq.

Dependent Lrent	Model 1			Model 2			Model 3		
Independent	Coef.	Std.Err	Sign	Coef.	Std.Err	Sign	Coef.	Std.Err	Sign
maritalstat	-0.527	0.122	***	-0.526	0.122	***	-0.541	0.121	***
age	0.107	0.002	***	0.105	0.002	***	0.104	0.002	***
gender	1.328	0.139	***	1.334	0.138	***	1.327	0.138	***
mainjobstat	0.279	0.054	***	0.298	0.054	***	0.280	0.054	***
educelementary	2.545	0.124	***	2.474	0.123	***	2.460	0.123	***
educjunior	3.025	0.124	***	2.944	0.123	***	2.927	0.123	***
educsenior	3.259	0.118	***	3.177	0.117	***	3.157	0.116	***
educuniversity	3.404	0.124	***	3.336	0.124	***	3.318	0.123	***
numofhh	0.212	0.016	***	0.207	0.016	***	0.206	0.016	***
hhworkprimary	1.762	0.198	***	1.884	0.203	***	1.889	0.199	***
hhworksecondary	2.481	0.100	***	2.413	0.099	***	2.418	0.098	***
hhworktertiary	2.465	0.085	***	2.396	0.085	***	2.402	0.084	***
numprimaryschool	0.091	0.029	***				0.028	0.029	
numjuniorschool	0.054	0.006	***				0.029	0.006	***
numseniorschool	0.076	0.029	***				0.070	0.029	**
numuniversity	0.199	0.064	***				0.215	0.067	***
numhospital				0.158	0.053	***	0.108	0.054	**
numbirthhospital				0.475	0.049	***	0.373	0.051	***
numcenterhealthsoc				0.697	0.051	***	0.512	0.055	***
dumdisastermtgt	0.373	0.048	***	0.363	0.047	***	0.322	0.048	***
Num of Obs		4655			4655			4655	
F - Stat		20191.440			21865.210			17818.780	
Prob F – Stat		0.000			0.000			0.000	
R – Squared		0.983			0.984			0.984	
*** : sign. 1%; ** : sign 5%; * : sign. 1%									

Based on the regression results above, we can calculate the value of compensation by adjusting the coefficient (drk / dAk and dwk / dAk) in the value (rupiah) per year. Each of these values is multiplied by 12 months and the average house rent in one year for the rental model, and multiplied by 12 months and the average annual wage for the wage model. Based on the table above, the implicit price for disaster mitigation is Rp. 981,882 This value is the implicit price calculated for each variable of amenities. The quality of life index value is obtained by summing all the total variable amenities of each implicit price obtained [11,13]. Total value can be positive or negative. The total positive value indicates that in order to enjoy amenities in a given year, each household is willing to pay compensation in the amount of the implicit value. Conversely, negative total values indicate that to enjoy comfort in a given year, each

household is willing to receive compensation equal to that value. Researchers can eliminate negative values by choosing a base first, usually with the lowest rating as a base. The quality value that is the basis will be a value relative to the other. Each amenities will be assessed from the estimated compensation to be paid by the household or given to the household [11,12].

Table 4. Implicit Price for Disaster Mitigation & Quality of Life

Model	Implicit Price		Quality of Life	
	Rp / Year	Rp / Month	Rp / Year	Rp / Month
I	(1,009,159)	(84,097)	(1,495,748)	(124,646)
II	(973,392)	(81,116)	(3,125,536)	(260,461)
III	(981,882)	(81,824)	(3,524,740)	(293,728)

From Table 4, we show that the implicit price for disaster mitigation and the total value for quality of life for all models are negative. In model 3, the value is Rp. 0.981 million and total amenities as a representation of quality of life are Rp. 3.524 million. Here are interesting findings, when the two indicators are negative, it indicate that each household tends to be willing to accept compensation for disaster mitigation. On the other hand, by looking at the value of quality of life, regional governments can attract the entry of migrants, by providing a minimum subsidy of Rp. 3.524 million per household per year or equivalent to Rp. 0.293 million per month per household. One factor that causes high amenities is the high preference and assessment of households in the health sector. In the health sector, estimates of household assessments are relatively high with regard to accessibility of hospitals, maternity hospitals, and community health centers.

5 Conclusion

The findings of this paper that households in Indonesia tend to receive compensation for disaster mitigation. In other words, households tend to prefer government assistance or subsidies related to disaster mitigation efforts. The value of compensation that the government can give to households between Rp. 0.981 million per year and Rp. 1.009 million per year. The value of this compensation per household is equivalent to Rp. 81 thousand per month until Rp. 84 thousand per month. Suggestions, local governments begin to give priority to disaster mitigation efforts so that they are expected to improve the quality of life for the people who live there.

From this findings, we can describe that the quality of life in the context of accessibility of transportation, tourism facilities, environmental conditions, disaster mitigation, and the availability of public facilities produced jointly by the public sector and the private sector. This refers to the ability of local governments to provide minimum service standards as a whole and the ability of the community to enjoy basic public facilities such as education, health, infrastructure, tourism facilities, security, and others [11]. Both the existence of public facilities and services for transportation accessibility such as roads tend to be influenced by government policies [13]. If the quality of life is low, the government can immediately take corrective measures in the short and long term. Third, in Indonesia development is always biased urban (city) and public services such as household access to educational facilities, health, infrastructure, tourism facilities, security, and others are always better in urban areas. This is an attraction in making decisions to stay in the city because it provides better comfort [11,13].

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