HOUSEHOLD PREPAREDNESS FOR NATURAL HAZARD EVENTS IN CENTRAL JAVA, INDONESIA: A REVIEW FROM THE SOCIOECONOMIC ASPECT

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ABSTRACT: Socioeconomic aspects related to how households' access to their basic needs. The ability of each household to vary affects how they respond to disasters. There have been many studies on how the effects of natural hazards on socio-economic aspects. Therefore, this research will use a different way by looking at the comparison between one indicator with another. How big is the ratio of households with good socioeconomic conditions with those who are not good at responding to natural hazard events? Descriptive analysis will describe how much the percentage of household preparedness in Central Java. While inferential analysis with binary logistic regression will explain socioeconomic variables that have a significant effect on household preparedness, and a comparison for each variable. This study find the relationship between social economic variables and household preparedness. Disaster preparedness from the poor households is different with that are not poor, as well as between those living in the urban or rural.

Keywords: Preparedness, Disaster, Natural Hazard, Household, Central Java

1. INTRODUCTION

Indonesia is one of the most vulnerable countries for natural hazards [1-4]. The presence among the three major plates of the world: Eurasian plate, Pacific plate, and Indo-Australian plate, makes Indonesia vulnerable to earthquakes and tsunamis [4]. Also, the existence at the meeting of three mountain systems (Alpine Sunda, Circum Pacific, and Circum Australia), makes this country has more than 500 volcanoes where 128 of them are still active [5-6]. This threat is spread across almost the entire region, stretching from the tip of Sumatra to Papua, from small to large scale [1-4].

Indonesia's National Disaster Management Agency (named: BNPB) reported that natural hazards that occurred in Indonesia during 2008-2017 were quite high. Total natural hazards that occurred reached 18,010 events. This natural disaster caused enormous damage, both physical and material. The death toll reached 23.75 million people, where 5,661 people died, 122,987 injured, and 23.6 million suffer. Besides the physical, natural hazards also have a significant material loss. From 2008-2017, the number of houses and facilities damaged by natural hazards reached 4.93 million units [4-5]

Java Island, in general, has a high-level risk of exposure for several types of natural hazards such as floods, earthquakes, landslides, droughts, and volcanoes [4-6]. Data on the number of natural hazards that occurred during 2008-2017 placed three provinces in Java (Central Java, West Java, and East Java) in the highest position, where Central Java was the highest with 4,292 incidents [Fig. 1] [5]

The area of Central Java does have a high level of vulnerability to natural hazards. The level of disaster vulnerability in Central Java can be seen from the Indonesian disaster risk index (IRBI), where 22 districts/cities in Central Java province are categorized as high disaster risk areas, while 13 districts/cities are in medium disaster risk [5-7]. The population of Central Java, which reaches 35 million people, has caused a large number of potential casualties. As explained by [8] that population density is one source of disaster vulnerability. Therefore, disaster management must be done appropriately. Communities, families/households, and individuals must know the steps in dealing with natural hazards [9].

Responsive management is not effective in reducing disaster risk. Many people don't know what to do and how to save themselves. This situation has repeatedly occurred, as indicated by a large number of victims in various regions in Indonesia. Therefore, the paradigm needs to be changed from response to [10-11]. People need to know how to respond to potential dangers.

Preapared and knowledge of what must be done when a disaster occurs can minimize the negative impacts caused [12]. Unfortunately in developing countries, preparedness is usually not given priority, until the threat of disaster is considered higher [13].

With a high level of vulnerability and a high number of natural hazards, the average percentage of preparedness in Central Java is still below 20%. Statistics Indonesia [2] noted that only around 17.48% of households knew how to save themselves from disasters. Likewise, the percentage of households that know the signs of danger is only 11.62%. In addition, the involvement of households in training and simulation is also still low. Only 1.12% of households whose household members have participated in disaster training and simulation.

Disaster risk reduction efforts cannot be separated from socio-demographic factors. The different social and demographic conditions of each country make disaster management efforts also different. Risk reduction must be adapted to certain circumstances. Every country has different political, socio-economic, cultural, environmental, and hazard situations. Measures that work to reduce risk in one country may not necessarily work in another [14-17]. We need to improve our understanding of the factors that affect household preparedness. The aim is to find ways to reach vulnerable people. They must be able to protect themselves and respond efficiently [18-19]. What factors have an effect on the level of preparedness ? Therefore, this study was conducted to obtain an overview of the status of household preparedness for natural hazards and the variables that affect it.

The study of preparedness factors is important to provide information and references to policymakers in responding and determining appropriate interventions for those who are vulnerable. This study can be used as a reference for determining group priorities with low levels of preparedness. Effectiveness in pre-disaster management will contribute to the reduction of post-disaster impacts.

2. CONCEPTUAL FRAMEWORK

Disasters mean something that causes trouble and loss or sufferers. Disaster is the impact of an event that cannot be overcome with local resources. The process starts with the existence of a hazard which becomes an event. Events whose impacts can be reduced by local resources are considered as accidents. Conversely, if it cannot overcome, then it is called disaster [20-21]. Natural hazards are defined as events that are caused by nature and can threaten safety [22-24].

Natural hazards can be classified into three categories: hydrometeorology (floods, typhoons, etc.), geophysics (earthquake, tsunami, etc.), and biological (exposure to pathogens of microorganisms, poisons, etc.) [25].

Natural hazards can occur suddenly or through a slow process. They are usually inevitable, always giving a shock effect and causing a lot of losses, both soul and material. This shock effect is caused by a lack of vigilance and preparedness in facing the threat of danger [2]. Although by definition disasters cannot be predicted, the cycle can be anticipated through planning that focuses on risk reduction efforts. The better prepared and planning is carried out, the better risk-reduction steps can be taken [26].

Disaster preparedness is steps taken previously to ensure an effective response to the impact of hazards through a timely and effective early warning system, as well as the temporary evacuation of property and assets from threatened locations [27]. Preparedness also refers to actions taken to reduce the impact of disasters such as predicting (if possible), preventing, and mitigating vulnerable groups [28]. Disaster preparedness can be done by anyone, either by the government, communities, households or individuals.

The stakeholders of preparedness are grouped into three main groups: individuals & households, government, and school community. In this case, the household plays an important role as one of the spearheads in preparedness [28]. This research will focus on measuring disaster preparedness at the household level. We need to measure this to examine what factors affect preparedness in natural hazards.

Some researchers try to develop a natural disaster preparedness framework. [28-30] used 5 parameters to measure the level preparedness of households in dealing with disasters: Knowledge and attitudes, policies and guidelines, emergency response plans, early warning systems, and resource mobilization. [31-32] in their research also compiled three critical factors to measure disaster preparedness. The three critical factors are knowledge, disaster emergency plans, and information-communication.

Previous studies found a significant relationship between household characteristics and preparedness. Factors such as demography and socioeconomic, have an affecting on household / individual preparedness for disasters [33-39].

These factors are influential because the socioeconomic status of the community can be affecting their decision making, and the same logic can be applied to decision making about evacuation in emergencies caused by natural hazards [31-34].

Some demographic and socioeconomic variables such as gender and poverty are also directly related to natural disaster vulnerability factors. Poor, women, limited education, disability groups, children, and the elderly are groups with high levels of vulnerability and have a greater risk of exposure to disasters [28]. Some studies have also found a relationship between the experience in facing disasters and physical/geographic factors in preparedness [31-34]. People with past disaster experiences tend to learn from experience and have better prepared when disasters occur again [29-31]. While physical/geographic factors refer to the tendency of location and environment. Physical/geographic vulnerability is determined by aspects such as population density, the remoteness of a settlement and the location [1-2]. Several previous studies also found how social capital factors affecting household preparedness [6-8]. Social capital offers an approach that can see in

more detail the relationship between social relations and household preparedness. The relationship between social capital and disaster preparedness is tied to certain groups where people living in the same community can become discussion partners because they have the potential to be exposed to the same threats [6].

This research will use the framework approach as previously compiled. We try to measure household preparedness using 2 parameters related to the level of household knowledge and how households mobilize their resources to deal with natural hazards. We will use several indicators to describe the parameters above. Indicators that will be used are how to rescue from disaster, early warning system, and disaster training/simulation.

Based on the explanation, the framework of this study is to learn how the variables of household characteristics affecting the level of household preparedness against natural hazards (Fig.1).
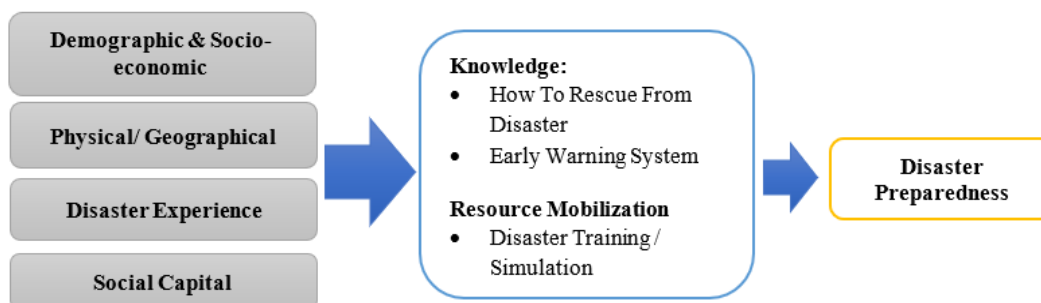

Fig. 1 Conceptual Framework

3. METHODS

3.1 Data

This study uses raw data from 1.557 households that live in areas prone to natural hazards in Central Java. The data was obtained from the March 2017 National Socio-Economic Survey (NSES) conducted by BPS (BPS, 2017a). The samples were selected by the method of two stages one phase stratified sampling from 180,000 "census blocks". The "Census Block" is the smallest statistical working area that is commonly used as a framework in social surveys at BPS,

especially for household research units.

3.2 Dependent Variable

As shown in Table 1, each variable is given a score 1 for "yes" and 0 for "no". Preparedness status is obtained from the sum of the scores of each variable, where the lowest score is 0 and the highest is 3. The total score will be used to determine the status of household natural disaster preparedness. Households with score 2 or 3 will be categorized as "ready", and a score 0 or 1 for "not ready".

Table 1. The Indicator of dependent variable and preparedness status category

Indicator	Answer	Preparedness Status
(1)	(2)	(3)
Know how to save yourself from natural hazard		
Knowing signs or warnings to deal with natural hazard emergency events in the neighborhood (such as the gathering area, evacuation route instructions, sirens signaling the tsunami).	1 = yes 0 = no	1 = ready 0 = not ready
Household members have attended training / simulations about disasters.		

Source : Identified from NSES questionnaire

The first indicator aims to determine whether the household knows how to save themselves from natural hazards. Respondents were given examples of natural hazards such as earthquakes, tsunamis, etc., then asked about their knowledge of saving themselves from these hazards. Meanwhile, the second indicator is used to identify whether the respondent is aware of warning signs such as tsunami sirens, as well as knowing directions for evacuation routes and gathering areas. This question is also intended to determine whether the respondent's neighborhood has disaster management infrastructure or not. In addition, the third indicator is used to determine household members who have attended training/simulations on natural hazards.

3.3 Independent Variable

Independent variable (X) used in this study is a variable of household characteristics of several factors (Table 2).

Table 2 Independent Variable

Demographic and Socio-Economic	
Education (X_1)	1= high, 0 = low
Living with children under five years old (X_2)	1= yes, 0= no
Gender (X_3)	1= male, 0= female
Poverty Status (X_4)	1 = not poor , 0= poor
Information access (X_5)	1= high, 0= not good
Physical/Geography	
Residential area (X_6)	1= urban, 0= rural
Experience	
Experienced against natural hazards (X_7)	1= yes, 0= no
Social Capital	
Participation in community activities (X_8)	2= always, 1= often, 0=rare / never

The education (X_1) and gender (X_3) variables were measured based on the status of the head of the household, who is considered the person in charge of the unit. Heads of households with an education level above high school are categorized as "high" while those below are "low". Meanwhile, the unit of measurement of the other six variables is the household as a whole.

The poverty status variable (X_4) is measured based on the level of household expenditure adjusted to the poverty line. The Central Java poverty line set by BPS in March 2017 was Rp. 333.224 / capita. So that households with per capita expenditure below that figure will be categorized as poor. The variable information access (X_5) is measured from the use of smartphones and the internet. Households that use smartphones and the internet are categorized as having good access to information. The categorization of residential areas (X_6) is based on the classification criteria set by BPS. The urban-rural classification is measured based on three indicators: population density, agricultural households, and urban facilities (schools, markets, hospitals, hotels, etc). Participation in community activities (X_8) is measured based on the intensity of household members in participating in community activities such as community service in the neighborhood, etc.

3.4 Analytical Method

This study uses two analytical methods: descriptive and inferencing. Descriptive analysis using graphs will be used to see a general picture

of household preparedness. Whereas, inferencing analysis with binary logistic regression was used to test variables that significantly affected household preparedness.

According to Hosmer and Lemeshow (Hosmer & Lemeshow, 2000), binary logistic regression is a method used to describe the relationship between the response variable (the dependent variable) with one or more independent variables. The response variable, in this case, is assumed to be discrete in a category with two possible values, "succeed" or "fail". "Success" is usually denoted by Y = 1 while "failed" with Y = 0. The regression model used is [mod. 1] :

$$\pi(x) = \frac{exp(\beta_0+\beta_1 x_1+\cdots+\beta_p x_p)}{1+exp\ (\beta_0+\beta_1 x_1+\cdots+B_p X_p)} \quad [1]$$

where β_j is the parameter value j = 0.1, ... p, and p is the number of variables observed.

[21] explain that the function π (x) is a non-linear function, therefore logit transformation is needed to get a linear function. The linear function will be used to see the relationship between response variables and explanatory variables. From the logit transformation results, the model obtained is [mod. 2]:

$$g(x) = \beta_0 +\beta_1 x_1 +\cdots+\sum_{l=1}^{kj-1}\beta_{jl}\,D_{jl}+...+\beta_p x_p \quad [2]$$

The parameters in logistic regression are estimated using the Maximum Likelihood Estimator (MLE). In general, the MLE method produces parameter values by maximizing the likelihood function of the probability values in the group of observed data. Furthermore, the Bj parameter is tested whether it has an affecting on the dependent variable or not [21].

4. RESULT AND DISSCUSSION

Table 3. Characteristics of the unit of observation

Variable	N	%
Education (X_1)		
Low	1.267	81,4
High	290	18,6
Living with children under 5 years old (X_2)		
No	1167	75
Yes	390	25
Gender (X_3)		
Female	229	14,7
Male	1.328	85,3
Poverty Status (X_4)		
Poor	178	11,4
Not Poor	1.379	88,6
Information access (X_5)		
Poor	752	48,3
Good	805	51,7
Residential area (X_6)		
Rural	856	55
Urban	701	45
Experienced against natural hazards (X_7)		
No	860	55,2
Yes	697	44,8
Participation in community activities (X_8)		
Never/Rare	554	35,6
Often	455	29,2
Always	548	35,2

Based on Table 2 Variables with a percentage difference above 50% are "education level", "living with children under five years", "gender", and "Poverty status". While the rest have almost the same percentage difference. From Table 2, We can see that the heads of households in natural hazards-prone areas on average are male and have low education. Most of them also do not have family members under 5 years. Most households live in rural areas, and the average household actually has expenditure above the poverty line,

which indicates that most of them are not poor. This might explain why they have good access to information. Besides that, most households also have good social capital, which can be seen from the participation of social activities that have a high percentage.
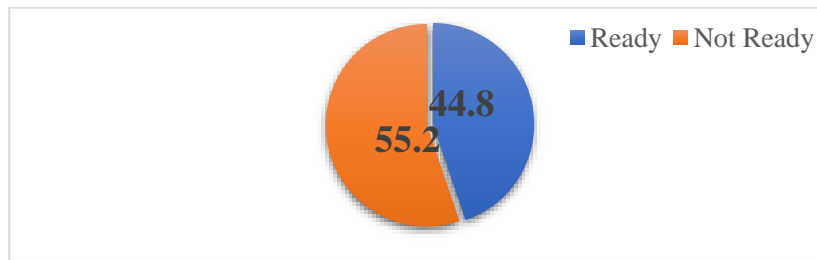

Fig. 2. Percentage of household preparedness status for natural hazards in Central Java

Based on Figure 2, we can see that the percentage of households that have preparedness in Central Java is only 44.8%. A simple explanation of this result is that only about 45 out of 100 households are truly prepared for natural hazards.

Table 4. Percentage of household preparedness status according to independent variables

Variable	Category	Preparedness Status		Total
		Not Ready	Ready	
(1)	(2)	(3)	(4)	(5)
Education (X₁)	Low	58,6	41,4	100
	High	40,3	59,7	100
Living with children under 5 years old (X₂)	No	56,56	43,44	100
	Yes	51,03	48,97	100
Gender (X₃)	Female	51,09	48,91	100
	Male	55,87	44,13	100
Poverty Status (X₄)	Poor	66,85	33,15	100
	Not Poor	53,66	46,34	100
Information access (X₅)	Poor	61.,0	38,30	100
	Good	49,07	50,93	100
Residential area (X₆)	Rural	60,16	39,84	100
	Urban	49,07	50,93	100
Experienced against natural hazards (X₇)	No	60,80	39,20	100
	Yes	48,20	51,80	100
Participation in community activities (X₈)	Never/rare	58,30	41,70	100
	Often	60,22	39,78	100
	Always	47,81	52,19	100

Source: Calculated from SUSENAS raw data

Table 3. Descriptively can be explained that households with better levels of education, living with children under five years old, female head of household, not poor, having better information access, living in urban areas, have experience of natural hazards, and always participate in community activities, tend to have higher preparedness.

Based on the results of the analysis, the model formed can be written as follows:

$$g(x) = -0,944 + 0,551X_1 + 0,223X_2 - 0,336X_3 + 0,349X_4 + 0,288X_5 + 0,170X_6 + 0,424X_7 - 0,015X_{8A} + 0,451X_{8B} \quad [3]$$

The model 3 explains that there are two variables, namely gender (X_3) and participation in community activities (X_{8A}) which have a negative relationship with household preparedness. while the remaining variables are positive. The negative sign indicates that the reference variable category (coded = 0) has the probability to have better preparedness. For example, consider the gender variable where the female head of the household is

coded "0" and "1" for the male. Therefore, from the model, it can be explained that female household heads tend to be more prepared for natural hazards than male. Furthermore, partial test results can be seen in table 4.

Table 5. Statistical Value of Partial Test

Dependent Variable	β	Std. Eror	z- value	Pr(>|z|
(1)	(2)	(3)	(4)	(5)
Education (X_1)***	0,551	0,142	15,136	0,000
Living with children under 5 years old (X_2)*	0,223	0,124	3,264	0,071
Gender (X_3)**	-0,366	0,153	5,739	0,017
Poverty Status (X_4)**	0,349	0,177	3,893	0,048
Information access (X_5)**	0,288	0,112	6,613	0,010
Residential area (X_6)	0,170	0,114	2,228	0,136
Experienced against natural hazards (X_7)***	0,424	0,109	15,142	0,000
Participation in community activities (X_8)	-	-	16,298	0,000
Participation in community activities (often) ($X8_A$)	0,015	0,135	0,012	0,914
Participation in community activities (always) ($X8_B$)***	0,451	0,128	12,461	0,000
Constant	0,944	0,217	18,993	0,000

Source : The output of binary logistic regression
Noted = * p < 0,1; ** p<0,05; *** p<0,001

Seven variables statistically have a significant relationship with household preparedness. Education, experience against natural hazards, participation in community activities, and information access are significant at the 1% level. Meanwhile, poverty status, gender, and living with children under five are significant at the 5% and 10% levels respectively. Table 5. explained that the probability of the error rate of the model estimate for the seven variables is less than 10%. In addition, for the residential area variable, there is not enough evidence to conclude that this variable has a significant relationship with household preparedness.

From Table 5. We can be explained the trends of each variable that affect the status of household preparedness using the odds ratio. Odds ratio estimates how much more likely the effect of observations with $X_j = 1$, versus observations with $X_j = 0$, or a comparison between two events, the incidence of "success" versus "failure". The odds ratio is the value of exp (β), the higher β value indicates that the tendency of the ratio of the independent variable to the preparedness status is also getting higher.

Table 6. Interpretation of Odds Ratio

Variable	Odds Ratio	Interpretation
(1)	(2)	(3)
Education (X_1)	1,735	Head of household with higher education, 1,740 times more prepared against natural hazards than those with low education.
Living with children under 5 years old (X_2)	1,250	Households who have children under five years old are 1,250 times more prepared than those who do not.
Gender (X_3)	0,694	Female heads of households are $\frac{1}{0,694}$ or 1,440 times more prepared than male.
Poverty Status (X_4)	1,417	Households with expenditure levels above the poverty line (not poor) are 1,417 times more prepared than those below the poverty line (poor).
Information access (X_5)	1,334	Households with good access to information are 1,334 times more prepared than than those with poor.
Experienced against natural hazards (X_7)	1,529	Households that have experienced against natural hazards are 1,565 times more prepared than those who have never experienced natural hazards.
Participation in community activities (always) ($X8_B$)	1,570	Households that always participate in community activities are 1.525 times more prepared than those who have low participation in community activities.

Source : The output of binary logistic regression

The partial test results [Table 5.] explain that three factors have a significant relationship with household preparedness against natural hazards in Central Java. These three factors are demography

and socioeconomic, experience, and social capital. The level of education and participation in community activities is the most influential variable on preparedness status with the odds ratio of 1.7 and 1.6 respectively.

Whereas for geographic factors, there is not enough evidence to conclude that this factor affects the status of household preparedness for natural hazards in Central Java. As explained by [31-34] that residential areas have no affecting on the level of household preparedness. In the case of Central Java, this study suspects that this happened because differences in community access to facilities were not too different between urban and rural areas. Most villages in Central Java have developed quite rapidly. This can be seen from the village development index (VDI) data, where Central Java is included in the five provinces with the highest VDI [3-4].

This work also found that five demographic and socioeconomic factors are also statistically significant in explaining household preparedness: education, having children under five years old, gender, poverty status and access to information. The analysis found that female heads of households tend to have better preparedness. These results are similar to some previous studies [21-24]. A plausible explanation is because, at the grassroots level, women are often in a position to handle risk. This is due to the role of women as environmental resource users and managers, economic providers, administrators, and community workers [35-36].

Apart from gender, another interesting thing to discuss is the relationship between poverty and household preparedness. Poor households are those who have expenditures below the poverty line. This work reveals that poor households are indeed more vulnerable to a greater risk of disaster. The result makes sense because poor people tend not to be prepared to face danger, have more potential to die, be injured, or suffer, and have many obstacles during the response phase. Also, poor households often only depend on the agricultural sector to make a living. They also tend to have limited education which makes them more vulnerable to the hazards.

We also found a relationship between access to information and preparedness. Information is indeed an important element of preparedness because it is directly related to the early warning system and the emergency response plan. As examined [7-8], people tend to access information about storms through information media. Some of them made preparations such as ensuring the emergency equipment was available and canceled the trip. They also access information about emergency services during a disaster.

The experience against natural hazards is also one of the factors that have a significant effect on household preparedness. Losses and damage resulting from previous disasters can increase disaster preparedness [19-20]. Experience makes people more responsive when facing dangers [18-20].

Social capital factors also show a significant influence on household preparedness. Households who always participate in community activities tend to be better prepared to face natural hazards than those who have never participated. This result was not generally applicable. There is no significant influence from households that "often" participate in community activities on the household's preparedness. In theory, it is true that not all groups can take the same benefits from social capital. This study shows that only households with a high level of community participation were able to take benefits.

5. CONCLUSION

Based on the results and discussion previously explained, the conclusions from this work are: There are still many households in Central Java who are not ready to face natural hazards. The percentage of household preparedness in Central Java is still below 50%, where only 45 out of 100 households are ready. In addition, level of education, living with children under five years old, gender, household expenditure (poverty), information access, having experienced natural hazards, and participation in community activities, significant in explaining household preparedness.

We hope that the study will be useful in providing a reference to policy interventions on disaster management. In addition, this study is also expected to provide an understanding of household behavior in preparing themselves for natural hazards, as well as being a reference for further disaster researches in Indonesia.

6. ACKNOWLEDGEMENTS

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