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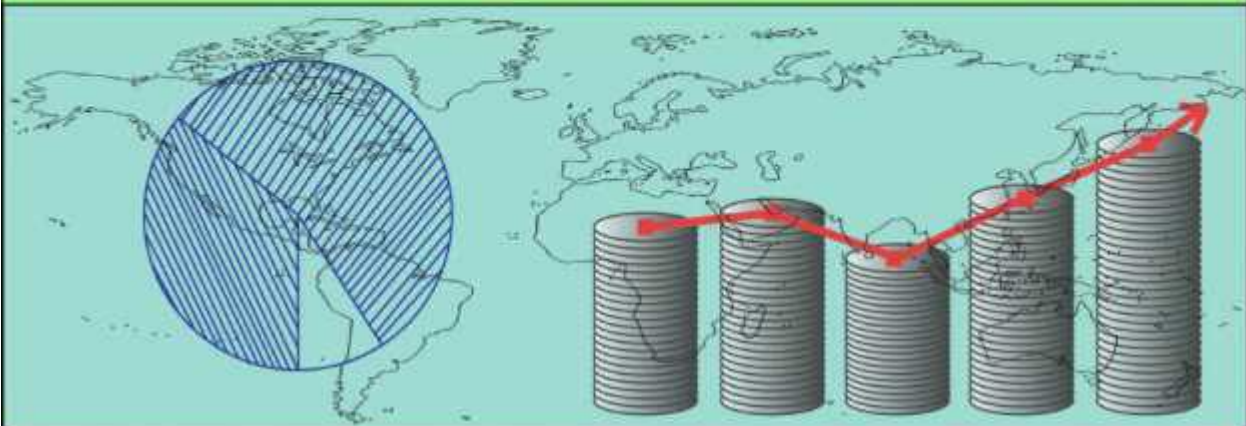
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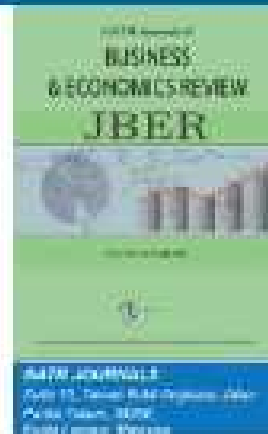
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Vulnerability and Willingness to Pay for Coping with Flood in Klaten Regency, Central Java, Indonesia

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ABSTRACT

Objective – The focus of this research is the analysis of vulnerability and factors that influence willingness to pay (WTP) to cope with flood. Other result of this research is economic valuation of flood impact on paddy field in particular.
Methodology/Technique – This research used the descriptive and quantitative method. Its data were collected through direct interviews with 380 respondents. Its samples were scattered in 11 sub-districts and 94 villages. The representatives of each village were 4 respondents, by adding two respondents from Wedi Sub-district and 2 respondents from Cawas Sub-district. Proportional sampling technique was employed to determine the research samples with criteria: very close (<50 m), close (50-100 m), and far (> 100 m) from the river. Its data were analyzed by using contingent valuation methods (CVM).
Findings – The results of the research are as follows. Many activities have been implemented to mitigate flood in Klaten Regency, but many problems have been encountered due to the limitations of Government Budget (APBD). The variables of income of family/household, water level, distance, and loss have a significant effect on the WTP. In majority, the respondents (72.27%) have the WTP for flood mitigation activities with the average WTP of 15,391 IDR.
Novelty – Economic valuation of flood mitigation programs and activities is required as to further enhance the role of the community, taking into account factors affecting the WTP. The local government should take advantage of the public's WTP to support flood mitigation activities among neighbourhood, village, sub-district and regency.
Type of Paper: Empirical

Keywords: Vulnerability; Flood Mitigation; Contingent Valuation; Willingness to Pay (WTP).
JEL Classification: D12, H84.

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1. Introduction

Klaten regency is one of the areas in Central Java Province with variance of natural hazards, such as volcanic eruptions, earthquakes, tornadoes, droughts, landslides, fires and floods. One of the hazards with a high frequency per year is flood. Losses caused by flood disaster are quite large, almost more than 2 billion IDR annually.

The flood disaster has caused losses in the agricultural sector, health problems and economic activities of the community, impairment of education and other public servants, and infrastructure damages (Tietenberg,

1998). Moreover, it also causes the loss of property, public facilities, and environmental damages. The damages caused by the flood include broken dikes, broken bridges, and submerged residents and public facilities such as schools, markets, and other buildings.

Benson and Clay (2004) classify the impact of natural disaster into three. The first is direct impact. Meanwhile Coppola (2007) stated direct impact includes financial loss from economic asset damages (e.g. building damages such as housing and business premises, infrastructure, and farmland). In economic terms, the value of this loss is categorized as stock value. The direct impact also includes physical damages, or physical environment changes.

The second is indirect impact. Indirect impact includes cessation of production processes and loss of outputs and sources of revenue. In economic terms, the value of this loss is categorized as a flow value. The indirect impact also related to the socio-economic impact of natural disaster.

The last one is secondary impact or byproduct impact. The examples of secondary impact may manifest inhibition of economic growth, disruption of planned development plans, rising balance of payments deficits, rising public debt, and rising poverty rates (Fuks, 2008; Hagos et al., 2012; Landry et al., 2011).

Demographically, the number of population of Klaten Regency potentially exposed to flood is 11,013 from 94 villages of 11 sub-districts, namely: Cawas, Bayat, Ceper, Gantiwarno, Prambanan, Karangdowo, Juwiring, Wonosari, Pedan, Trucuk, and Wedi.

In majority, the population of Klaten Regency has a high dependency on agriculture. Most of them are farmers, and they live in the areas with a high frequency of flood. As farmers, they have difficulty in financing the next planting period under such circumstance. Therefore, an effective mitigation action is required to manage the potential risks, especially if they cause shocks to all development sectors.

Given that the areas are prone to flood disaster, it is necessary to investigate and to understand what actions must be implemented to cope with the flood. Besides, it is also important to investigate what kind of community's participation must exist to reduce the negative impact of flood.

2. Literature Review

Socioeconomic variables, physical characteristics, estimation of losses, and local wisdom in many previous researches had a significant effect on the WTP (Amiga, 2002; Adenike & Titus, 2009; Awunyo et al., 2013). Lizinski et al. (2015) showed similarities in their research. Income variable and education variable have a positive effect on the increase of the WTP. As a characteristic of residents in developing countries, income rate is relatively low, and most residents spend their income on necessary needs. Osberghaus (2014) conducted research in Germany, meanwhile, Shang (2012) conducted in Shanghai, their result were relatively different especially in socioeconomic variable. Awareness is required to avoid disaster risk because they understand and predict that disaster risk will be more suffered.

The investigation on vulnerability and preparedness in Cawas District showed that the residents of Cawas are relatively economically and environmentally vulnerable, meaning that if the disaster happened in Cawas, its residents would be vulnerable to income decrease.

3. Research Methodology

This research was conducted in Klaten Regency, Central Java Province. This research was devoted to flood-prone areas in Klaten Regency covering 11 sub-districts: Cawas, Bayat, Ceper, Gantiwarno, Prambanan, Karangdowo, Juwiring, Wonosari, Pedan, Trucuk, and Wedi.

3.1 The Scope of the Research

This research was focused on the flood problem in Klaten Regency, especially flood mitigation and community participation in flood mitigation in Klaten Regency, especially in downstream watershed areas, which are prone to flood around the downstream river flow covering 11 sub-districts according to Local

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Legislation of Klaten Regency Number: 11 of 2011 regarding Spatial Planning for Klaten Regency Years 2011 - 2031 (Figure 1 in the appendix).

3.2 Types and Data Sources

The data of the research consisted of secondary and primary ones. The former were collected from the Central Bureau of Statistics (BPS), the Local Board of Disaster Management (BPBD) in Klaten Regency. The data needed for estimation of the WTP were collected through direct interview with the respondents. The respondents were determined according to the classification of flood-prone areas in Klaten Regency, namely: Cawas, Cawas, Bayat, Ceper, Gantiwarno, Prambanan, Karangdowo, Juwiring, Wonosari, Pedan, Trucuk, and Wedi sub-districts.

3.3 Population and Samples

The number of population for this research was 11,013. 380 respondents were determined as the samples of the research through the purposive sampling method in which the respondents were those who live in flood-prone areas. 94 villages were identified as the areas with high frequency of flood. The areas were then classified into three flood hazard groups based on their distance from the river: Group 1 included the villages located less than 50 meters from the river; Group 2 included the villages located between 50-100 meters from the river; and Group 3 were the villages located more than 100 meters from the river.

3.4 Research design

This research employed the contingent valuation method (CVM). CVM is an alternative method to investigate monetary value, and it has some advantages to investigate the value of goods or services that are not available in the market (Tietenberg, 2002). This research used survey by providing the list of questions or questionnaire guide for respondents. The questionnaire was designed to be answered by head of households. However, it was possible for some cases of non-head of household respondents to answer the questionnaire with special conditions of households.

The vulnerability by livelihood vulnerability index (LVI) was measured in this research area. LVI was developed by Hahn et al. (2009), which consists of seven main components, namely: Social-Demographic Profile (SDP); Livelihood Strategy (LS); Health (H); Food (F); Water (W); Social Network (SN); Natural Disaster (ND); and Climate Variability.

4. Result

4.1 Physiographic Research Areas.

Most of the research areas are lowlands with the altitudes of 100 - 200 meters from sea surface (mdpl), except in Cawas, Bayat and Gantiwarno Sub-districts with some limestone hills. The southern parts of the study sites are directly adjacent to Pegunungan Seribu, the area of Gunung Kidul Regency, Yogyakarta Special Region. Klaten Regency due to adjacency to the southern parts of Pegunungan Seribu could be classified as the research area with rain water runoff from the mountain areas. The areas that are mostly lowland and covered by regosol and grumosol which are loose, easy to absorb water, and easily eroded, make this area susceptible to flood, especially in December - February in which the rainfall can reach 495 mm (BPS, 2015).

4.2 Demographic and Socio-Economic Conditions of Respondents.

Demographically, 312 of the respondents (82.11%) were males; 174 of the respondents (45.79%) were aged more than 50 years old; 154 of the respondents (40.53%) held the latest education of senior secondary school; and 94 of the respondents (24.74%) were farmers. Thus, most of the respondents were old and low-income

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farmers, and the number of respondents without education background and with the latest of education junior secondary school was 157 (41.32%). Economically, 110 of the respondents (28.95%) had the income of 1.000.000-2.000.000 IDR.

4.3 The Impact of Flood on Residents.

138 of respondents (36.32%) lived in areas with the distance of less than <50 m from the river; 302 of the respondents (79.47%) stated that their homes or paddy fields were affected by floods; 163 of the respondents (42.89%) stated that the flood frequency was less than 5 times; 138 of the respondents (36.32%) claimed that the average flood height they experienced ranged from 50 to 100 cm, 138; 107 of the respondents (28.16%) stated that the average loss they suffered was less than 500.000 IDR. Generally, the respondents who experienced flood at the residential areas stated that the length of flood and the height of inundation were relatively not too high, but the flood usually rapidly receded. In addition, the respondents claimed that the farming areas suffered higher loss from the flood than the residential areas.

4.4 Flood Mitigation Analysis

This analysis was used to investigate the significance of independent variables namely: age, education level, number of family members, family income, height level of inundation, distance, and loss which influenced the willingness to pay disaster mitigation as dependent variable. The model used in this study was the multinomial logistic model to determine willingness to pay of respondents, with a dichotomous choice format, which was to offer the respondents a certain amount of money and to ask whether the respondents were willing to pay or not the amount of money for flood disaster mitigation activities. The model was formulated as follows:

$$Log\ (PrWTP) = \alpha + \beta 1 X1 + \beta 2 X2 + \beta 3 X3 + \beta 4 X4 + \beta 5 X5 + \beta 6 X6 + \beta 7 X7 + e$$

Where Pr is probability and WTP is willingness to pay flood mitigation, X1 is the respondent's age, X2 is the highest level of education of respondents, X3 is the number of family member of respondent, X4 is the respondent's family income, X5 is the flood puddle in respondent's nature, X6 is the distance of the respondent's house / Nearest), X7 is the total loss experienced by the flood, α is a constant, β1-β7 is the regression coefficient, e is the standard error.

Logistic regression results show the effect of age, education level, number of family members, family income, height level of inundation, distance and loss on the WTP for flood mitigation (Table 1).

Table 1. Result of Analysis

Variables	Definitions	B	Wald	P-Value.	Result
X1	Age	-.019	1.809	.179	Not significance
X2	Level of education	-.019	.024	.877	Not significance
X3	Member of family	.124	.807	.369	Not significance
X4	Family Income	.474	7.898	.005	significance
X5	Height of inundation	.467	4.138	.042	significance
X6	Distance	-.375	5.780	.016	significance
X7	Total loss	.225	3.914	.048	significance
α	Constanta	.311	.071	.789	

Source: Primary data processing

WTP is a monetary value to be paid by respondents based on several questions to reduce the impact of flood as shown in Table 2. Of 380 respondents, 275 respondents stated that they had willingness to spend their own cost to do flood mitigation (WTP). Most respondents, 112 respondents (29.47%), stated that their highest WTP

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ranged from 5.000 IDR to 10.000 IDR per month per household. Meanwhile, the average WTP was calculated as much as 15,391 IDR.

Meanwhile, respondents who did not have willingness to pay the contribution of flood mitigation are presented in Table 3. The number of respondents who stated that they did not the WTP was 105 respondents (27.63%). The respondents had some reasons not willing to participate in the mitigation. 39 respondents (10.26%) assumed that the mitigation program is the responsibility of the government; 28 respondents (7.37%) were willing to help physically; and 22 respondents (5.79%) claimed that they had no extra money or even they still lacked money to fulfill their daily needs.

Table 2. The WTP of respondents to reduce flooding risk

No	Amount of WTP (IDR)	Number of Respondents	Percentage (%)
1	< 5.000	103	27.11%
2	5.000 – 10.000	112	29.47%
3	10.000 – 20.000	33	8.68%
4	20.000 – 100.000	19	5.00%
5	100.000 - 200.000	6	1.58%
6	200.000 – 400.000	2	0.53%
7	400.000b – 1.000.000	0	0.00%
8	> 1.000.000	0	0.00%
9	Not willing	105	27.63%
	Total	380	100.00%

Source: Primary data processing

The answers of respondents are as follows based on a further investigation toward the respondents who did not have the WTP:

Table 3. Respondents who did not have the WTP

No	Reasons	Number of respondents	Percentage
1	No extra money	22	5.79%
2	Want to be involved as voluntary	28	7.37%
3	Other kinds of supports	5	1.32%
4	Not priority	4	1.05%
5	Responsibility of government	39	10.26%
6	Still need to seek for more information	3	0.79%
7	Low level trust to institution	4	1.05%
8	No comments	275	72.37%
	Total	380	100.00%

Source: primary data processing

4.5 Vulnerability Index

The vulnerability of farmers to climate changes in Klaten Regency LVI and LVI-IPCC is classified as moderate, with the index figures of 0.344 and 0.038. Many respondents stated that their life has a high

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dependency on the agriculture. When their paddy fields are inundated by flood (failed to harvest), they have to borrow money from their neighbors or from banks.

5. Conclusion

Economic valuation method is needed to investigate monetary value of disaster impact. Moreover, this method also figures out the description of socioeconomic characteristic. Based on result and analyses of the data, we summarized that:

- Flood mitigation programs and activities carried out in Klaten Regency are quite a lot. Their implementation is also quite good but is not yet able to reach all the flood-prone areas due to the limited local government budget. Therefore, supporting funds from the central government and from the community are required.
- Most of the research respondents, 275 respondents (72.37%), have willingness to spend their own cost to do flood mitigation (WTP), and most respondents (27.89%) have willingness to pay the WTP in the amount of 5 thousand rupiahs to 10 thousand rupiahs per month per household. The average WTP in flood mitigation activities is still relatively low, namely: 15.391 IDR / household / month.
- The variables of income of household, height of inundation, distance, and loss have a significant effect on the WTP. Meanwhile, those of age, education, and family members do not have a significant effect on the WTP.

Suggestion

- Evaluation of flood mitigation programs and activities should be undertaken to further enhance community participation by taking into account the factors which affect the WTP.
- It is necessary to enliven the flood mitigation activities by utilizing the non-governmental funding potentials at RT, RW, village, sub-district and even regency level by, for example, holding regular dues of residents for financing mutual help activities such as cleaning up the river and fixing the embankment.
- The farmers' participation in the Rice Farmers Insurance (AUTP) program, especially for farmers in flood-prone areas, needs to be improved to reduce harvest losses caused by the floods.

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