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The Analysis of Flood Disaster Risk at Wonoasri Village, Tempurejo Sub-district, Jember District

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ABSTRACT

A disaster is an event which causes an interference in a life and and livelihoods in a society. The flood disaster potential happened at Wonoasri village was caused by geographical location from Wonoasri village which is in the form of lowland and many formed lands that are concave. Thus almost each year, those places are experiencing flood. The flood is caused by the overflowing river at Sananrejo, Curahnongko and Mayang River which result in the occurrence of clogging due to sedimentation in some watersheds (referred as DAS in Indonesia). The aimed of this studied was to analyse the flood disaster risk at Wonoasri Village, Tempurejo Sub-District, Jember District. To did that, this studied used quantitative method and descriptive-analysis. The analysis of disaster risk was gained through weighing and disaster risk analysis matrix as well as interview and observations. Samples used in this present studied were 110 respondents. They were Wonoasri people consisting of Curahlele and Kraton area. The leveled of flood disaster risk at Wonoasri Village, Tempurejo Sub-District, Jember District was in the yellow zone meaning that it was placed in the moderate risk leveled with a scale of 2 so the hypothesis statement of flood disaster risk leveled at Wonoasri Village, Tempurejo Sub-District, Jember District. To collected the data, this studied used questionnaire which measured the average score of overall respondents. Disaster risk could be overcome by decreasing the leveled of vulnerability and by increasing community capacity through educating them about disaster handling done through the socialization held periodically for the society and all organizations related to the disaster risk countermeasure.

Keywords: Disaster risk analysis, Flood

INTRODUCTION

High level of risk experience caused by a disaster is the main reason why it is necessary to do risk analysis towards the disaster. This analysis is arranged by using an available standard method in a certain area of each government level. Wonoasri village experiences flood disaster almost every year. This village is located in a downstream area being the end point of the whole rivers encounter and this area also has many forests and plantation land used as agricultural land by local people. Wonoasri village is also a concave lowland, so when the heavy rain comes, the place will be inundated and this condition causes flood.

A study showed that the countermeasure done by BPBD still focuses on the emergency situations only and still refers to the priority scale in a disaster countermeasure(1). The researcher completed the study done previously by analyzing the risk towards the flood disaster happened at Wonoasri village, Tempurejo District. From the study, it can be known how big the threat level, vulnerability, and capacity which affect the high level of flood disaster risk.

Method used in this study was from weighing analysis which refers to the chief regulation of BNPB No. 2 in 2012 about Disaster Risk Assessment, from questionnaire-formed interview, and from direct interview. Risk level of flood disaster at Wonoasri village, Tempurejo District is known in the yellow zone meaning that this is placed in the moderate risk level with a scale of 2. Reducing the level of vulnerability of community and increasing the capacity of society was done by educating the people about disaster countermeasure by giving the information through socialization done periodically for the society and all the village organizations related to the disaster countermeasure. Based on the questionnaire result in the field, Wonoasri village belonged to the category of village which has primary level of disaster with an average of 28.00. The disaster countermeasure at Wonoasri village had been well-done yet there were no standard operating procedures of valid countermeasure that can be used as guidelines for disaster countermeasure

METHODS

This study used quantitative method and descriptive-analysis. The analysis of disaster risk was gained from the weighing and risk analysis matrix as well as interview and observation. Samples used in this study were 110 respondents. They were Wonoasri Village consisting of Curahlele and Kraton area. The total of population in this study was 9667 people. Sample collection technique in this study was Consecutive Sampling with the criteria of inclusive and exclusive determined by the researcher. Research sample was gained through calculation of Slovin[2] formula.(2)

$$n = \frac{N}{Nd^2+1} n = \frac{9667}{9667x(0,1)^2+1} = 98 \text{ respondents}$$

Information:
n = sample measurement
N= population measurement
d = fetch tolerance limits (10%)

Sample calculation using *Slovin* formula resulted in 98 respondents. To avoid the absence of responses towards respondents in this study, then the researcher added 10% respondent from the total 98 sample, so at the end, the sample used was 110 respondents in total. Data collection methods carried out in this study was interview techniques conducted to the citizens of Wonoasri community and several related informants, field observations and documentation studies obtained from agencies related to the flood disaster that occurred in Wonoasri Village, Tempurejo Sub-District, Jember District. The threat index was derived from two components, namely the possibility of a disaster occurring and the magnitude of the impact recorded on a disaster. The level of flood threat was obtained based on direct interviews related to the likelihood / probability of a flood occurrence and various impact factors that occurred due to flooding in the Wonoasri village, Tempurejo Sub-District, Jember District. The data that has been obtained is then divided into 3 levels, namely low, medium, and high threats with a weighting scale of 1 to 5, so that the level of threat of flood disasters that occur in Wonoasri Village, Tempurejo Sub-District, Jember District.

The vulnerability index is derived from the incorporation of physical, economic, social and environmental vulnerabilities that are included in the formula equation which refers to BNPB Regulation Number 2 on 2012 concerning guidelines for determining disaster assessment. Determining the flood vulnerability index is obtained through the following formula:

$$\text{IKB} = (\text{IKS X}0.4) + (\text{IKF X } 0.25) + (\text{IKE X } 0.25) + (\text{IKL X O. } 1)$$

Information :
IKB = *Indeks Kerentanan Banjir* / Flood Risk Vulnerability
IKS = *Indeks Kerentanan Sosial* / Social Risk Vulnerability
IKF = *Indeks Kerentanan Fisik* / Physical Risk Vulnerability
IKE = *Indeks Kerentanan Ekonomi* / Economic Risk Vulnerability
IKL = *Indeks Kerentanan Lingkungan* / Environmental Risk Vulnerability

The results of the flood vulnerability values are then included in the disaster risk assessment matrix which is seen based on the color and scale zones referring to the laws that have been determined. The level of capacity is obtained based on the combination of threat level and capacity index. The capacity index was obtained from observations made by researchers in the field which were adjusted to the regional capacity assessment material based to Sendai Framework for Action. Parameters assessed in the capacity index: rules and institutions for disaster management, early warning and disaster risk assessment, disaster education, reduction of basic risk factors and development of preparedness on all lines that have been carried out related to flood disasters that occurred in Wonoasri Village, Tempurejo Sub-District, Jember District.

Determination of the level of disaster risk is obtained based on the disaster risk assessment matrix through a color zone and a certain scale that illustrates the magnitude of the risk level of the flood disaster in Wonoasri Village, Tempurejo Sub-District, Jember District. Furthermore, the determination of disaster risk is also complemented by data derived from direct interviews by the Wonoasri village community to identify the criteria for the resilient village of flood disaster in the village of Wonoasri, Tempurejo sub-district.

Risk assessment of flood disasters in terms of Curahnongko Public Health Center work area was obtained based on direct interviews with the prevention infectious diseases section of Curahnongko Public Health Center and was obtained from observations related to the related documents contained in Curahnongko Public Health Center o. Then the results of secondary data were assessed through structural and non-structural mitigation efforts of the flood disaster that occurred in Wonoasri Village, Tempurejo Sub-District, Jember District.

Control assessments due to disasters are obtained based on direct observations in the field which consist of control before a disaster, when a disaster occurs, and control carried out after a flood disaster in the village of Wonoasri. In addition, observations were also carried out to find out the distribution of diseases and

countermeasures that had been carried out to overcome the disease that occurred after the flood disaster in Wonoasri Village, Tempurejo Sub-District, Jember District.

Before the study conducted, the researcher tested the questionnaire validity to 50 respondents from people of Tempurejo who had same characteristics as Wonosari people in overcoming the flood disaster. As known in the analysis done, r calculation of each question was > r table (0.098) with coefficient $\alpha = 0.05$, so it could be said that all items in the instrument were valid and could be used in the study. Reliability test was done to compare the score of *Cronbach Alpha* with the minimal score of 0.6[(6)]. Reliability test result done by using SPSS showed that the score of *Cronbach Alpha* is 0.735 > 0.6, so it could be stated that the instrument was reliable and could be used in this study.

RESULTS

Level of Flood Risk Threat

Level of Flood Risk Threat that could be seen based on the indicator of probability was risk scale of 5 (there was possibility of flooding of 80-99%) and the impact of flood was risk scale of 4 (severe with a description of 60%-80% of the area destroyed). The flood disaster threat potential at Wonoasri village, Tempurejo Sub-District, Jember District could be seen as follows:

Table 1. Matrix of Flood Disaster Threat level at Wonoasri village

Probability		**Impact**				
		1	2	3	4	5
	1					
	2					
	3					
	4					
	5				Flooding	

Information:

	High threat of scale 3
	Moderate threat of scale 2
	Low threat of scale 1

As seen in the Table 1, the flood threat level at Wonoasri village was located in yellow zone which is in the dangerous/moderate threat with scale of 2 so the hypothesis stating that the level of threat of flood disaster at Wonoasri village, Tempurejo Sub-District, Jember District is high was rejected.

Level of Flood Risk Vulnerability

The level of flood vulnerability is obtained based on the summation of the social vulnerability index, physical vulnerability index, the economic vulnerability index and the environmental vulnerability index. The calculation of flood vulnerability level that occurs in Wonoasri Village can be known through the calculation as follows:

$$IKB = (IKS\ X0.4) + (IKF\ X\ 0.25) + (IKE\ X\ 0.25) + (IKL\ X\ O.\ 1) = 2 + 1.25 + 1 + 0.3 = 4.55$$

Information:

IKB = *Indeks Kerentanan Banjir* / Flood Risk Vulnerability
IKS = *Indeks Kerentanan Sosial* / Social Risk Vulnerability
IKF = *Indeks Kerentanan Fisik* / Physical Risk Vulnerability
IKE = *Indeks Kerentanan Ekonomi* / Economic Risk Vulnerability
IKL = *Indeks Kerentanan Lingkungan* / Environmental Risk Vulnerability

Tabel 2. Matrix of flood vulnerability level in Wonoasri Village

Level of threat		**Vulnerability Index**				
		1	2	3	4	5
	1					
	2				Flood	
	3					
	4					
	5					

Information:

	High vulnerability of scale 3
	Moderate vulnerability of scale 2
	Low vulnerability of scale 1

The degree of vulnerability is obtained by merging the threat level with the vulnerability index into an assessment matrix. The color existed in the assessment matrix is an indicator of the degree of vulnerability that occurs in the region due to a disaster. Matrix of vulnerability level is shown in Table.

Based on the color in the vulnerability assessment matrix in Table 2 it is known that the vulnerability level of Wonoasri village is classified as 3 namely the vulnerability level included in high category and vulnerable to flood disaster so that the hypothesis statement that states the vulnerability level of flood in Wonoasri Village, Tempurejo Sub-District, Jember District is high to be accepted.

Level of Flood Risk Capacity

Based on Table 4, it is known that based on the result of weighing of level of flood disaster capacity in Wonoasri village by 2 with moderate value. Based on the level stages of flood disaster capacity in Wonoasri village is at level 2, in which Wonoasri village has taken action and efforts to reduce disaster risk with all achievements but have not maximum because of the absence of institutional commitment or systematic policies that are well-established and well-documented[(5)]. The assessment matrix of capacity level based on the color zone is shown in Table 4.

Tabel 4. Assessment matrix of Regional Capacity level related to Flood disaster in Wonoasri village

		Capacity Index				
		1	2	3	4	5
Threat level	1					
	2		Flood			
	3					
	4					
	5					

Information:

	High capacity of scale 3
	Moderate capacity of scale 2
	Low capacity of scale 1

Table 4 shows that the capacity level of Wonoasri village related to flood disaster is in yellow zone with scale 2 that have moderate capacity of the region to the capability in facing flood disaster that happened, so the statement of hypothesis affirm that capacity level at flood disaster area in Wonoasri Village, Tempurejo Sub-District, Jember District is low to be rejected.

Flood Risk Level

The level of disaster risk is determined by combining the degree of vulnerability with the capacity level. The color contained in the assessment matrix of disaster risk describes the huge of risk level of flood disaster in Wonoasri Village Tempurejo Sub-District Jember District. Assessment matrix of disaster risk level is shown in Table 5.

Table 5. Assessment matrix of disaster risk level in Wonoasri village

		Capacity index				
		1	2	3	4	5
Vulnerability level	1					
	2					
	3		Flood			
	4					
	5					

Information:

	High capacity of scale 3
	Moderate capacity of scale 2
	Low capacity of scale 1

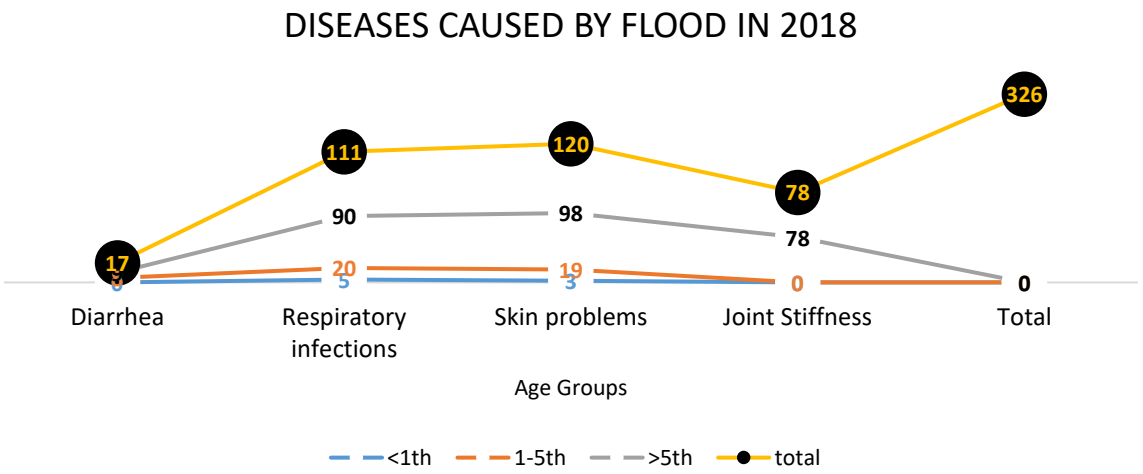
Table 5 shows that the level of flood disaster risk in Wonoasri Village, Tempurejo District is known to be in the yellow color zone which is at moderate level of risk with scale 2 so that the hypothesis statement of flood disaster risk in Wonoasri Village Tempurejo Sub-District Jember District is declared highly rejected. Determination of risk level of flood disaster was also obtained through interview with questionnaires conducted to the Wonoasri Village Tempurejo Sub-District Jember District consisting of villagers of Kraton and and Curahlele as many as 110 people to know the readiness and criteria of the flood resilient village in the society of Wonoasri village. The analysis results of the village flood resilient village based on the questionnaire are listed in Table 6.

Table 6. Analysis Result of Questionnaire of Flood Resilient Village

	n	Minimum	Maximum	Mean	Std. Deviation
Age	110	14	70	37.85	14.478
Score	110	2	57	28.00	13.842
Valid N (listwise)	110				

Based on the result of data collection using questionnaires, it is noted that the average score of the overall score of respondents who have been interviewed is 28.00. The average score of 28.00 is then put into the categorization of the flood resilient village, then it is known that the Wonoasri village is included in the category of primary flood resilient village[4].

Controlling of Disease of Post-Flood Disaster



Source: Data of diseases caused by flood from Curahnongko Public Health Center in 2018

Figure 1. Graph of disease recapitulation as flood disaster effect of Wonoasri village in 2018

Based on Figure 1 above, skin diseases was the number one disease which infected people in Wonosari village following the flood with 120 children >5 years old infected (36.4%). It is followed by respiratory infections with 111 child patients aged >5 years old (33.7%). The next post-disaster disease was joint stiffness which was experienced mostly by elders (24.7%). Meanwhile, only 17 people had diarrhea after the flood which happened to children between 1 to 5 years old and to children aged > 5 years old. It means, 5.2% children and toddlers had diarrhea. Related to the diseases, Curahnongko Public Health Center gave medicines to cure the post-flood diseases experienced by Wonoasri Villagers. Further, water chlorination was also done to purify the contaminated water in wells in the residence.

DISCUSSION

The possibility of flood risk is affected by the condition of the destroyed riverbank, the unavailability or destruction of green space as a part of drainage system, the violation of spatial system, the increase of violations of law, the lack of systematic spatial planning, and the peoples' lack of discipline. According to the assessment of flood risk in Wonoasri Village in Tempurejo Sub-District of Jember District, the flood risk in Wonoasri Village was in the yellow zone which is in the flood zone 2 (moderate probability of flood). This makes the hypothesis stating the flood risk of Wonoasri Village in Tempurejo Sub-District of Jember District is high was rejected. This moderate probability of flood condition needs to be reduced to flood level 1 (low probability) using all possible measures, so the flooding effects can be minimized.

Based on the color in flood vulnerability index in result, the flood vulnerability index of Wonoasri Village was in scale 3 which means the area has high vulnerability to flood. Thus, the hypothesis stated that the flood vulnerability index in Wonoasri Village in Tempurejo Sub-District of Jember District is high was accepted. The higher the vulnerability in Wonoasri Village, the higher the risk of disaster to occur[3]. This high vulnerability of Wonoasri Village will affect the possible upcoming flood risk. Therefore, the high flood vulnerability index must be decreased through maximum efforts in minimizing and controlling the flood risk in Wonoasri Village.

Table 4 shows that Wonoasri Village flood capacity was in yellow zone (level 2) with moderate flood capacity which makes the hypothesis stated that the flood capacity of Wonoasri Village in Tempurejo Sub-District

of Jember District is low was rejected. This moderate flood capacity should be improved into level 4 or 5 with high disaster capacity index to minimize the disaster risk. Increasing the flood capacity can be done by developing across sectors cooperation which is related to the disaster countermeasure management. This includes increasing the peoples' ability and skill to manage actions during and post disaster through integrated disaster management simulations which involves other sectors such as village administrators, *DESTANA* organization, Curahnongko Public Health Center, *BPBD* of Jember District, Public Works Department, and other related institutions.

Table 5 illustrates that the scale of flood risk in Wonoasri Village in Tempurejo District was in yellow zone (level 2) with moderate risk. So, the hypothesis which mentioned that the scale of flood risk in Wonoasri Village is high was rejected. The moderate scale of flood risk is affected by the moderate disaster threat and the high flood vulnerability in Wonoasri Village in Tempurejo District.

Determining the risk of flood had also been done through questionnaire which was distributed to villagers of Wonoasri in Tempurejo District which involved people living in Kraton and Curahlele areas with 110 people in total. The questionnaire was used to identify the flood readiness and the criteria of flood resilient village in Wonoasri. The questionnaire results showed that Wonoasri was included as flood resilient village with 28 mean score. The villagers had disaster resilience in a point to maintain the available infrastructure and village functions when disaster happens.

Various diseases infecting the villagers after the flooding were caused by the water contamination in villagers' wells. The water was contaminated with harmful bacteria and virus brought by the flood. The post-flood disease control had been conducted by Curahnongko Public Health Center by giving the needed medicines to reduce the disease effects experienced by people in Wonoasri Village. Besides, Curahnongko Public Health Center also did water chlorination to all contaminated water wells through fast-response team from Communicable Disease Control Unit of Curahnongko Public Health Center. Other fast response actions had also been done including providing clean water and voluntary cleaning actions to clean houses, yards, fields, and roads. These actions were done by the villagers themselves together with *DESTANA* organization, village administrators, and all related institutions. Those made the post-disaster recovery can be done faster.

CONCLUSION

The flood risk level in Wonoasri Village in Tempurejo District was identified in the yellow zone with moderate risk (level 2). This makes the hypothesis which mentioned that the scale of flood risk in Wonoasri Village is high was rejected. Further, the data from questionnaire results indicated that the average score of total respondents was 28.00 which made Wonoasri Village was included as level one flood resilient village. Related to those facts, the researchers' suggestions were to decrease the disaster vulnerability and to increase the peoples' capacity to control flood through periodical disaster socialization or campaign for the villagers and for all village organizations that will be involved in the disaster control and management. Furthermore, it is also important to complete the disaster control using standard operational procedure of disaster control which is well-written and well-documented.

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