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ASSESSING THE CAPACITY OF FLOOD PRONE HOUSEHOLDS IN WEST PASAMAN TO REDUCE FLOOD RISK

Nia Puspita Sari[1], Widyastutik[2], *Pini Wijayanti [3]

[1]Regional Development Management – IPB University, Indonesia
[2]Department of Economics - IPB University, Indonesia
[3]Department of Resources and Environmental Economics – IPB University, Indonesia
Email: piniwijayanti@gmail.com

*Corresponding Author, Received: May 10, 2024. Revised: May 27, 2024. Accepted: June 28, 2024

ABSTRACT: West Pasaman is a regency in Indonesia that has a high risk of flooding. Flood risk reduction through enhancing household capacity must be pursued because individuals or households are the first to be directly affected by floods. This research aims to determine the household capacity level in flood risk reduction and the associated factors. Data about household knowledge, emergency preparedness, access information, mitigation measures, livelihood diversification, and social networks is collected by a survey of the households in Nagari Aia Gadang Barat. The result shows that the capacity of households in Nagari Aia Gadang varied to low, medium, and high levels, with the most significant proportion being the medium level, namely 65%. Household capacity is positively associated with the head household's education level and total income.

Keywords: *Disaster Risk, Flood, Household, Mitigation Measures*

1. INTRODUCTION

Development is a sustainable process of managing available resources to achieve community welfare through a multidimensional process involving major changes in social structures, popular attitudes, and national institutions [1]. Development is a systematics process where planning process is one of main component[2]. Process development from planning, implementation, and monitoring needs to pay attention to the impact of development on the environment. Process development without consideration of environmental issues can cause a disaster that can destroy development gain.

Disasters are a severe problem and a threat to sustainable development goals [3]. It can affect the gain of some goals in SDGs, such as ending poverty in all it forms, ending hunger, archive food security and improved nutrition, ensuring healthy live, ensuring inclusive and equitable quality education, ensuring availability and sustainable management of water and sanitation, sustainable economics grow, sustainable city and community [4]

The frequency of natural disasters has increased over the last twenty years [5]. The number of disaster events between 2000 and 2019 increased by 74% compared to the last period due to a rise in climate-related disasters. Floods dominated this event with a total of 3.254 events or around 44% of total disasters, and it has increased by around 134% compared to flood events in 1980 -1999 [6]. Flood events are predicted to increase in the future due to climate change, population growth, and land conversion [7].

Climate change occurs worldwide, but the impact will be different in one and another country or community [8]. Developing countries are more vulnerable due to economic conditions, which result in the inability to implement adaptation strategies to reduce climate change impacts [9]. Indonesia is one of the developing countries with the highest risk of disaster worldwide [10] due to geography position, climate conditions [11], and environmental degradation [12]. From 2000 – 2019, disaster events in Indonesia were dominated by hydrology disasters, such as floods and landslides [6].

West Pasaman is one regency in Indonesia with high risk of flood [13] due to topography, climatology, and land conversion characteristics. There are 147 rivers in this regency, and some of them have the potential to cause floods, such as the Batahan River, Pasaman River, and many others.

Flood in the Pasaman River can be categized as fluvial flood, where this type of flood is defined as a high-water level in the river channel exceeding the height of the bank river and causing dyke breach [14]. Floods at this location often occur around the confluence of Kanaikan River and Pasaman River. Excessive rain near the Pasaman River and upstream caused a gradual increase of water, which

bottlenecked around the bridge and caused a flood that inundated the villages around the river [15].

Floods are complex disasters involving natural hazards, humans, and the environment [16] that have severe impact on human lives and cause material damage that exceeds the community's capacity to cope without the support of external parties [17]. Floods and the damage to the economy and infrastructure often threaten households in riverbank areas.

High impact disasters like earthquakes and tsunamis causes huge economic losses and can destroy long-term development gains in a short time. Annual floods that happened nearly every year also cause significant losses, but unlike earthquake and tsunami, the impact of annual flood are often invisible like corps failure of loss of income due to family member cannot go to work [18].

The impact caused by disasters is not determined by the magnitude of the disaster only but is also influenced by socioeconomic factors [19]. A disaster might be a natural event, but the impacts depend on the household's or community's condition that arises from various micro and macro policies [20]. In the context of flood at the household level, the flood risk households face is influenced by their vulnerability and capacity (Baan dan Klijn 2004). Household with high adaptive capacity, effective preparedness and resilience infrastructure will experience less economic losses [22].

Disaster risk reduction is an important thing to do as an effort to decrease disaster impact. Disasters cannot be avoided, but the impact can be reduced by managing risk factors. Risk approach used by Indonesia National Disaster Management Authority (BNPB) indicated that flood risk closely related to three factors namely threat, vulnerability, and capacity. Enhancing capacity is more possible and realistic to do because threats and vulnerability are difficult to change in relation to budget dan socioeconomic factors [23]. Disaster risk reduction through enhancing household's capacity need to be done because communities as individuals or household are the first one whom directly affected by disaster. This paper aims to analyze households' capacity for flood risk reduction and its relationship to socio-economic characteristics of households.

2. METHODS

2.1 Household Capacity in Flood Risk Reduction

Study focused on households near the Pasaman River. The study area covers one *Nagari* (term for village in Sumatera Barat), namely *Nagari Aia Gadang Barat (see Fig. 1).* The reason for choosing this village is that it experiences annual floods nearly every year with different scales. The flood in 2018 was the largest in the last 10 years. This flood inundated around 800 households, with the flood height reaching 200 cm.

Fig 1 Study Area

This study uses socioeconomics quantitative descriptive analysis to analyze household capacity in flood risk reduction and its association with socioeconomic characteristics. The data used in this study are primary data and secondary data. Primary data was collected from a questionnaire survey to 40 households in Nagari Aia Gadang Barat. Meanwhile, secondary data was collected from institution reports, regulations, books, journals, and other information sources related to the research topic. Respondents are selected by purposive sampling with criteria that they live close to

Pasaman River and experience the direct impact of flood. In addition, primary data was also collected from interviews to expert informant from village office and Pasaman Barat Regional Disaster Management Authority (BPBD Kabupaten Pasaman Barat) to get more detail information about flood in Nagari Aia Gadang Barat

Level of household disaster capacity is determined by giving a score to questionnaire about household's knowledge, emergency preparedness, access to information, mitigation measures, livelihood diversification, and social network [17]. The result of questionnaire is made into index according to preparedness index by LIPI-UNESCO/ISDR 2006, and then categorized into low, medium and high according to Regulation of BNPB No. 02 of 2012.

2.2 Capacity Level and its Association with Socio-economic characteristics

Somers'd correlation analysis is used to test the association between households capacity, the education level of the head household and the household's total income. The hypothesis tested in this study is as follow:

1. Household capacity (Y) has a positive correlation with the education level of the head of household (X_1). Education level of head household affect their ability to save themselves as well as the ability to adapt and recover from impact of disaster [24]. People with higher education level have higher knowledge regarding disaster prevention [25]. People or communities with lower education are likely to have lower access to post-disaster recovery programs.
2. Household capacity (Y) have positive correlation with total income of household (X_2). Households with high income will be able to choose to not live in flood prone area or can also adapt to flood risk by building their house with good structure and material [25].

Detail data type of each variable are available in Table 1.

Table 1. Detail Data Type

Variable Name	Scale	Explanation
Household capacity level (Y)	Ordinal	1 = low 2 = medium 3 = high
Education level of head household (X_1)	Ordinal	1 = not finished elementary school 2 = Elementary school 3 = Junior high school 4 = Senor high school 5 = University
Total income of household (X_4)	Ordinal	1= ≤1.000.000 2 = 1.000.001 – 2.000.000 3 = 2.000.001 – 3.000.000 4 = 4.000.001 – 5.000.000 5 = ≥ Rp 5.000.000

3. RESULTS AND DISCUSSION

3.1 Household Capacity in Flood Risk Reduction

Household capacity for flood risk reduction can be seen from their knowledge, emergency preparedness, access information, mitigation measures, livelihood diversification, and social network [17]. This aspect describes their capacity during disaster, pre-disaster, and after disaster.

Household knowledge can be seen from their understanding of threat and risk reduction. Knowledge of risk reduction can be seen from their participation in disaster training. Obtaining disaster training is one of the community's rights, according to Law Number 24 of 2007. Disaster training disaster needs to must be carried out to increase community knowledge and awareness of potential disasters in their residence. The shows that only nine out of 40 respondents have interest in taking part in disaster education results show that only nine out of 40 respondents have an interest in taking part in disaster education, while the rest were not interested due to work or household chores.

Household emergency preparedness can be seen from their effort to prepare themselves for flooding, such as preparing food, emergency equipment, and emergency plans. The results show that respondents were aware of flood potency in their area and already knew what it caused and signs before it happened due to their experience.

Household informational access can be seen from their access to flood information and access to early warning. Flood early warning system (FEWS) has an important role in reducing flood risk. [26]. Early warnings for disasters can be obtained from multiple sources such as TV, cellphones, or FEWS. FEWS can be modern or traditional, like *kentongan* or other tools. Efforts to provide FEWS have been provided by the Ministry

of Village, Development and Disadvantage Region, and Transmigration in 2018. However, this tool did not function properly at the time the flood in 2023 was happening, so people had to check the water level themselves after the rain lasted for several hours.

Mitigation measures can be structural or nonstructural mitigation measures. Around 57.5% respondents have done at least one mitigation measure to adapt with flood risk as seen in Table 1. Respondents whose buildings age are less than ten years tend to adapt by raising their floor by 100 to 150 cm from the ground. The type of respondent mitigation measures can be seen in Table 2. Another mitigation measure done by households who change their house structure is by building a simple stilt house to store their assets to avoid flood inundation.

Table 2. Household Mitigation Measures

Mitigation measures	number	Percentage (%)
Have not done any mitigation measures	17	42,5
Raising their first floor	10	25
Constructing the 2nd Floor	9	22,5
Elevating the 1st floor and constricting the 2nd floor	4	10
Total	40	100

Household social networks can be determined from how many years they stay, their relationship with the community, and their participation in certain organizations. The result shows that their social network is relatively high since most of the respondents were born and raised in research locations and have a good relationship with their neighbors. Most respondents will evacuate themselves to their neighbors or their relatives' houses.

Household level capacity ranged from 20.83 to 70.83, with a mean of 47.03 and a standard deviation of 13.17. This index is then categorized into three levels: low, medium, and high. The result showed 22 % of respondent were in low category, 65% were in the medium category, and 13 % were in the high category, as seen in Fig 2.

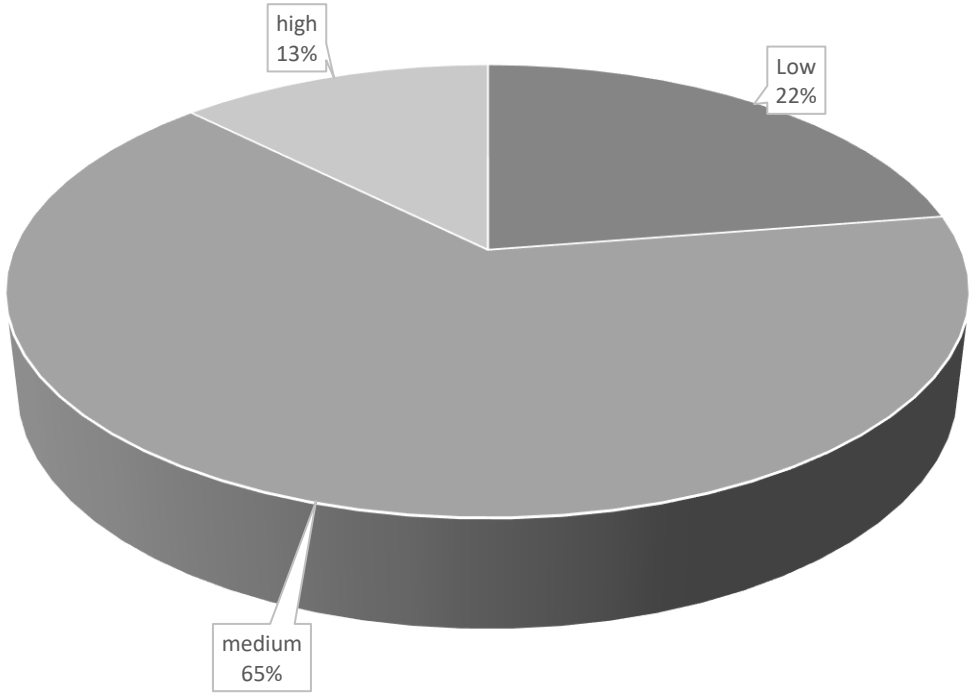

Fig 2. Percentage of Respondents Based on Capacity.

3.2 Capacity Level and its Association with Socio-economic characteristics

Household capacity (Y) is expected to be associated with the household head's education level (X1) and the total income of households (X_2). Somers'd correlation analysis was performed to analyze it. Table 2 shows the results.

Household capacity has a positive correlation with household head's education level. Households with higher household head's education levels tend to have higher capacity levels. This is because the level of education can directly influence cognitive abilities, problem solving ability, perception of risk and indirectly influence poverty, access to information and social capital [27]. A correlation value of 0.261 shown that the positive association between capacity level and education level in this study is not that strong. A P-value smaller than α = 10% indicates that the relationship between the two variables is significant. This conclusion is similar to Shah et al [25].

Household capacity level and total income have a positive association, meaning that higher-income households will have higher capacity. The positive relation between these two variables might be happened because the household with higher income have more ability to build their building or to change the structure of their building with a better material [25].

positive correlation between household capacity and education level and income needs to be considered when formulating flood risk reduction policies. Enhancing capacity by providing information about flood risk, its impact, and how to cope with it is a necessary thing to do, but intervention in education and income also needs to be taken into consideration. Stakeholders can consider providing entrepreneurship training or urge the household to carry out mitigation measures by planting the riverbank with plants that have economic value and can reduce erosion in the riverbank.

4. CONCLUSION

Household capacity in flood risk reduction varies to low, medium, and high levels with percentages respectively 22%, 65%, and 13%. This result indicates that enhancing capacity still needs to be done to make households more resilient to future floods.

Household capacity has a positive correlation with the education level of the head household and the total income of the disaster. This result indicates that this variable need to take into consideration when formulate flood risk reduction in Nagari Aia Gadang.

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