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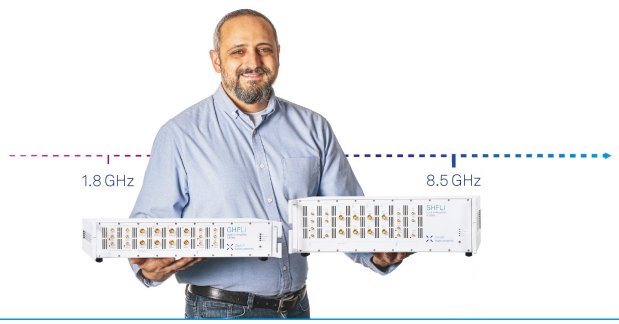

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Vulnerability of Poor Fishermen Household: The Impact of Climate Variability in the Tanggamus District, Lampung Province, Indonesia

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Abstract. Climate change can affect seasonal and annual climate variability in Indonesia. The impact of climate variability, such as rainfall or ocean conditions with high waves or strong winds, is a threat to fishermen in carrying out fishing activities. Therefore, this study was aimed to determine the level of vulnerability and adaptation response caused by climate change to fishing communities. This research was conducted in Kota Agung Subdistrict, Tanggamus Regency, Lampung Province from September to December 2020. This study involved 100 respondents consisting of 70 local fishermen and 30 modern fishermen. The analysis method used in this research was multiple linear regression analysis from the Livelihood Vulnerability Index (LVI). The results of the LVI analysis show that local fishermen are in the most vulnerable category with an LVI value of 0.459, while modern fishermen with an LVI value of 0.440. The LVI value of local fishermen was close to 0.5 indicates the vulnerability of local fishermen compared to modern fishermen. Climate variability causes the vulnerability of local fishermen since it disrupts fishermen livelihoods and encourages fishermen to change their orientation towards fishermen livelihoods. The results of the study indicate that climate variability has an impact on the vulnerability of fishermen households to fishermen life, due to fishermen households are very dependent on fishery products.

INTRODUCTION

Global climate change is marked by the increase of carbon dioxide gases, methane gas, and other gases in recent decades. Climate change certainly results in changes in various aspects, including an increase in global average temperature, an increase in temperature between land and sea, high number of rainfall in the highlands and low in the tropics and subtropics. Furthermore, climate change also causes changes in the distribution of seasonal shifts [1] and high and low rainfall [2]. Thornton et al [3] also added that the existence of climate change can result in fluctuations in climate variability including the frequency, intensity, duration and timing of extreme weather and climate events. Study of Kusumastuti and Weesakul [4] also showed that in Jakarta the highest rainfall ranges from 60 mm and 80 mm per year.

Climate variability is the spatial and temporal fluctuation of climate elements in the short and long term [5]. Climate change can increase the value of climate variability and accelerate the period of the climate variability. In general, seasonal and annual climate variability in Indonesia is influenced by monsoons [6, 7] and ENSO [8, 9, 10]. Climate has an important role in determining characteristics, either directly or indirectly, including growth, development, survival, adaptation and migration of organisms [11, 12] and changes in aquatic ecosystems [13].

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Apart from changes in distribution, climate change also influences biodiversity and aquatic ecosystems. Coastal communities are also affected by climate change which certainly has an influence on social and economic conditions [14]. This is due to the changes in marine aquatic ecosystems as impact of changes in average and climate variability, increased ocean acidification and atmospheric carbon dioxide concentrations [13]. Cinner et al. [15] reported that coastal communities needed adaptive capacity in the coastal area environment regarding flexibility to change strategies and organize collective act in changing respons. This is needed by coastal communities who are very dependent on fish resources and based on natural resources. This phenomenon occurs in coastal communities (fishermen) in Kota Agung Subdistrict, Tanggamus Regency, Lampung. The economic condition of the community depends on the situation and conditions of the nature, namely fishing. Nhuan et al. [16] revealed that ecosystems in coastal areas are classified as high susceptible to various effects of storms, erosion, pollution, and sea level rise. This condition causes threats to the life and livelihood of fishermen to be vulnerable. The vulnerabilities occur can be identified using the Livelihood Vulnerability Index (LVI). Therefore, the aim of this study was to determine the level of vulnerability and adaptation response caused by climate change to fishing communities.

RESEARCH METHODS

Research time and location

This research was conducted in Kota Agung Subdistrict, Tanggamus Regency, Lampung Province from September to December 2020. The location selection was carried out purposively with the consideration that Kota Agung District is located in the east coast of Sumatra, the majority population of local fishermen, there is the East Coast Sumatra Fishing Port. and Fish Auction Place (TPI), tides and floods frequently occur in this location.

Sampling

A non-probability sampling approach through purposive sampling method was used as sampling method, namely deliberately selecting an individual to be sampled with certain criteria. The criteria based on the age (20-50 years old) of fishermen and modern fishermen. The indicators consist of adaptive sapacity (socio demographics: education level, household strategy; number of working familiy, social networking: receiving government assistance in the last year), Sensitivity (food, water, health), and exposure (natural disaster and climate variability). The population size refers to the data on the number of local fishermen and modern fishermen obtained from KUD Mina Mandiri Kota Agung with a total of 793 people. Based on the fishermen's data entered into the Slovin formula, the number of samples of 91,59 was obtained. To facilitate calculation, the number of samples taken was rounded to 100 people.

Data Analysis

This study compared two types of fishermen, namely local and modern fishermen landing their catch at the TPI of Kota Agung District, Tanggamus Regency, Lampung. IPCC [17] assessed the vulnerability of communities' capacities to respond to livelihood security. The vulnerability of fishermen's households to climate variability is identified using the Livelihood Vulnerability Index (LVI) method. Hahn et al. [18] conducted an average sub-component approach that made the same contribution to the overall index even though each major component had different sub-components.

The study components consist of adaptive capacity, sensitivity and exposure. LVI in this study uses a simple approach in which the same weight is applied to all major components and sub-components. These components are the socio-demographic profile, livelihood strategies for social networks, food, water, health and natural disasters and their impacts.

The LVI analysis model used refers to the modification of the medium [18]. This approach uses a number of sub-component indicators that are combined for each of the main components. A systematic combination of indicators is used to assess the level of vulnerability. A set of independent indexes with values between 0 (low) and 1 (high) was used to compare household access to various capital. This index is calculated using a value adapted from the standardization of all indicators consisting of the human development index developed by UNDP [19].

$$LVI_d = \frac{\sum_{i=1}^{n} wmi \cdot Md_i}{\sum_{i=1}^{n} wmi} \quad (1)$$

Description:

LVI_d = LVI for fishermen groups (Local and Modern),
Wmi = weight of the sub-components,
Mdi = Value of components for groups of fishermen (Local and Modern)

RESULT AND DISCUSSION

Vulnerability of fishermen households

Table 1 shows the index values of the LVI sub-components for the various main components and sub-components. The adaptive capacity factors used are socio-demographic conditions, livelihood strategies, social networks, food, water, health and natural disasters and their impacts. Overall, the result research illustrates the adaptive capacity factor including the socio-demographic index of local and modern fishermen of 0.487 and 0.493, the household strategy index of 0.457 and 0.511, the social network index of 0.520 and 0.528. The adaptive capacity with a socio-demographic component that has an influence on the vulnerability value of both local and modern fishermen is the number of school members of 0.448 and 0.365, respectively. The high index of adaptive capacity is caused by the average number of family members, the average number of family members attending school, the percentage of fishermen as the main job and the percentage of receiving assistance from the government. The average number of family members of local fishermen is 4.33, the average family member attending school is 1.87. Local fishermen need a large income due to their large number of families and family members attending school certainly requires high expenditure.

Climate variability results in decreased fishermen's income, thus fisherman households are vulnerable to their livelihoods. It is due to the live survival of fishermen still depends on the main source of income, namely fish catches. Therefore, fishing households are vulnerable to their livelihoods. Although the results of the income analysis show that local fishermen have the highest income compared to modern fishermen, the income of local fishermen's family still depends on the result of fishing. This can be seen from the statement given by 100 percent of respondents who stated that fishing is their main job. In addition, local fishermen have an average number of working family members of 1.33. This is due to the main source of income of fishermen household is fish catches. If the catch decreases, the family's economy will be weaker. Pauly [20] suggested that fishing communities should have other profitable activities and create other sources of employment to anticipate the collapse of fisheries and global climate changes.

The high level of education will support and provide self-development such as knowledge and skills. Noviyanti et al. [21] reported that people with higher education level has the ability to adapt better and has the capability to access a wider range of fields. Higher education will lead to mental and ethical growth in education for community fishermen that can change the way of reasoning and thinking to take considerations and decisions. Riantini et al [22] also added that the factors causing the vulnerability of fishermen households are the number of household members, production, capital, fishing income, and the use of technology.

The social network component experiences vulnerability both on modern and local fishermen including making loans to other fishermen household, providing loans to other fishermen household, receiving assistance from the government in the last year. Ayers and Huq [23] also revealed that the existence of a large budget is insufficient to face and overcome the enormous costs of adaptation to climate change in the process of allocating funds for adaptation. Maya Riantini et al. [24] also suggested that institutional roles are quite important in overcoming the vulnerability of fishermen households, for example the Joint Business Group (KUBE).

TABLE 1. The index value of the LVI sub-components.

Category	Main Component	Sub component	Group of Fihermen	
			Local	Modern
Adaptive Capacity	Socio demographics	Percentage of Household Completing Elementary School Education	0.486	0.667
		Average Number of Family Members	0.528	0.400
		Average Number of Educated Family Members	0.448	0.365
	Household Strategy	Average Number of Working Family Members	0.220	0.200
		Average Number of Family Members not working as Fishermen	0.240	0.200
		Percentage of Fishermen as the Main Occupation	0.910	1.000
	Social Networking	Average of fishermen household making loans to other fishermen household	0.440	0.400
		Average of fishermen household providing loans to other fishermen household	0.440	0.487
		Percentage of fishermen household receiving government assistance in the last year	0.200	0.200
Sensitivity	Food	Percentage of fishermen household receiving famine assistance	1.000	1.000
		Percentage of fishermen household depend on the catch	0.910	1.000
		Average period of family income from the catching product	0.080	0.234
	Water	Percentage of fishermen household having nature clean water sources	0.857	1.000
		Percentage of fishermen household experienced water availability problems	0.257	0.533
		Percentage of fishermen household owning water reservoirs	0.171	0.267
	Health	Percentage of fishermen household members with health problems	0.589	0.267
		Average of sick fishermen household members	0.300	0.600
		Percentage of chronically ill fishermen household members	0	0
		Percentage of fishermen household member not working or attending shool due to illness	0.289	0
		Average number of health facilities in Fishermen Residence	0.385	0.600
		Average required time to arrive at health facilities	0.486	0.200
		Percentage of fishermen household receiving government health services	0.600	0.400
		Percentage of fishermen households with Toilets	0.714	1.000
Exposure	Natural disaster and climate variability	Average of fishermen household experienced floods in the last 5 years	0.390	0
		Average rainy months during the last 5 years	0.247	0.423
		Percentage of fishermen household receiving flood warnings	0.740	0

Table 1 also shows the condition of the sensitivity factor including the food component for local fishermen (0.08) and modern fishermen (0.23), the water index for fishermen households owning water reservoirs for local fishermen (0.17) and modern fishermen (0.267). The health index shows good value for local fishermen (0.48) and modern fishermen (0.20). The sensitivity factor of the food component experiences a level of vulnerability for both local and modern fishermen. The health component shows vulnerability to climate change in modern fishermen regarding the mental disorders. This is related to their lifestyle, which tends to buy unhealthy goods or food from the sale of uncertain catches causing high levels of stress. 100 percent of local fishermen depends on the catch to fulfil their needs and can meet their daily needs with an average of 2.47 months from the catch. In addition, the water needs of local fishermen is fulfilled by natural water sources such as wells. Therefore, the average percentage of local fishermen experiencing water availability problems is 53.33 percent.

Table 1 also shows the exposure category, modern fishermen have the highest vulnerability index compared to local fishermen. Flood disasters in the last 5 years and rain during the year multiplied the results in vulnerability. Climate variability also resulted in tidal flooding in Kota Agung. Kota Agung Subdistrict is an area that is vulnerable to climate variability. The vulnerability index of fishermen in Kota Agung Subdistrict is higher than the vulnerability index of modern fishermen. The high vulnerability index is caused by the frequent floods happened in Kota Agung Subdistrict. Putra and Handayani [25] suggested means in overcoming and reducing the level of vulnerability in coastal communities in adapting to climate change, such as reduce the construction of buildings and house floors, repair and elevation of roads, cultivate and plant mangroves, and build embankments.

The vulnerability of fishing households to climate variability can be seen from several factors such as adaptive capacity, sensitivity and exposure (Figure 1). The condition of local fishermen is vulnerable to the sensitivity of modern fishermen. The results of the vulnerability analysis of respondent fishermen households show that local fishermen are vulnerable to adaptive capacity compared to modern fishermen. In terms of sensitivity factors, modern fishermen are more vulnerable to sensitivity than local fishermen. Meanwhile, local fishermen are prone to exposure compared to modern fishermen. The high sensitivity index is caused by the percentage of fishermen households depend on the fish catches, the average period of family income from the catching product and the percentage of nature water ownership.

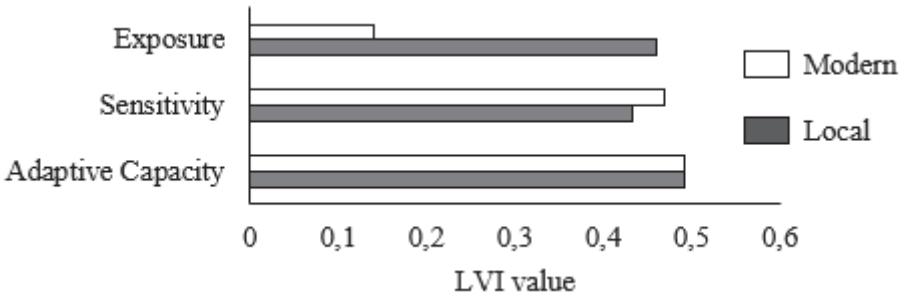

FIGURE 1. LVI contribution factor index

Climate change can elevate the possibility of great tsunami wave to occur in Lampung, resulting in a high level of vulnerability. Riantini et al. [26] reported that the tsunami disaster also had an impact on decreasing availability of clean water, damaged village infrastructure, poor environmental sanitation, damaged fishing settlements, and damaged supporting facilities for fishing activities.

CONCLUSION

The results of the LVI analysis show that the LVI values of local fishermen and modern fishermen are 0.459 and 0.440. It means that the LVI value of local fishermen has the highest vulnerability value compared to modern fishermen, namely the LVI scale is 0 (less vulnerable) to 0.5 (very vulnerable). Overall, the LVI value of local fishermen has the highest vulnerability value compared to modern fishermen. The vulnerability of fisherman is to prove that the vulnerability relates to the climate change. Climate variability is marked by tidal flooding in the Kota Agung area, Kota Agung District and the vulnerability index level of fishermen has a higher influence than the vulnerability index of modern fishermen.

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