

Community Vulnerability to Lake Drought in Muara Enggelam Village

Yaskinul Anwar *

Geography Education, Mulawarman University, Samarinda, 75119, Indonesia

yaskinul.anwar@fkip.unmul.ac.id

*Corresponding author

Irmawati Muhammad

Geography Education, Mulawarman University, Samarinda, 75119, Indonesia

irmawati.m@gmail.com

Aulia Nurlita


Geography Education, Mulawarman University, Samarinda, 75119, Indonesia

nurlita.aulia@gmail.com

Mislan

Physics, Mulawarman University, Samarinda, 75119

airmasadepan@yahoo.co.id

 Submitted: 2024-05-18; Revised: 2024-05-29; Accepted: 2024-05-29; Published: 2024-06-19

Abstract— Drought vulnerability epitomizes a community's capacity to cope with drought-related calamities. In Muara Enggelam Village, the susceptibility to lake drought stems from diminished rainfall and lake water levels plummeting below 4.5 meters, as documented by the Mahakam River observation station in Kota Bangun. Consequently, the study focuses on the manifestation of lake drought vulnerability within Muara Enggelam Village. The research methodology encompasses a multifaceted approach involving observation, documentation, interviews, and questionnaires to gauge vulnerability levels. These assessments were based on key indicators of exposure, sensitivity, and adaptive capacity. Employing a cluster random sampling technique, 75 respondents were selected to represent the village population. Data analysis entailed the application of scoring and weighting methodologies. The outcomes of the study reveal that Muara Enggelam Village falls within Zone D, denoting high sensitivity as the primary component of vulnerability. Specifically, the indicators yield values of 0.41 for Exposure Intensity (EI), 0.81 for sensitivity intensity (SI), and 0.49 for adaptive Capacity Intensity (CI). The highest sensitivity observed in the village can be attributed to factors such as low-income levels and a significant proportion of the population engaged in fishing activities. In conclusion, this research sheds light on the intricate dynamics of drought vulnerability in Muara Enggelam Village, emphasizing the urgent need for targeted interventions to bolster the community's resilience against future drought events.

Keywords— Vulnerability, Drought, Floodplain Lake, Melintang Lake, Muara Enggelam.

I. INTRODUCTION

Mahakam Cascade Lake is a shallow lake located in East Kalimantan. This lake refers more to a collection of lakes located in the middle of the Mahakam watershed which consists of 20 lakes, with the main constituents

being 3 large lakes, namely Lake Jempang, Lake Semayang, and Lake Melintang. In the dry season, the lake water dries up so that parts of the lake generally become dry land, leaving only small channels that also function as transportation routes. When dry, lake water will collect in river channels or lake channels and form surrounding plains and swamps (Directorate of Land Water Damage Control, 2019). Analysis of monthly rainfall data shows that the lowest rainfall fluctuation occurred in March (49.80 mm/month) which occurred in 2021 (Directorate of Land Water Damage Control, 2019).

Long droughts that occurred in the Mahakam Cascade Lake area were recorded in 1997 (192 days), 2006 (67 days), and 2019 (65 days) (Directorate of Dams and Lakes, 2021). Droughts occur in lakes when there is no incoming water supply. Drought data for the Mahakam Cascade Lake refers to the height of the lake's water level, which is said to be dry when the lake's water level is below 4.5 meters from the Mahakam River observation station at the Bangun City pier (Directorate of Dams and Lakes, 2021). The drought that occurred in the Mahakam Cascade Lake area is not like the generally known drought, where there is no more water, but there is still water in the lake, but there is no incoming water supply. The drought makes it difficult for people to cross the lake, due to the low water level of the lake. This has an impact on hampering the distribution of goods for traders, and loss of livelihood as fishermen, especially for people who depend on their work as fishermen alone. (Yoenus, 2015).

The impact of the drought is felt by the people in the villages on the Mahakam Cascade Lake. One of those most affected by the drought disaster is Muara Enggelam Village. This village is located above Lake Melintang. During a drought, Muara Enggelam Village will experience a shortage of clean water because it is located near or even on peatland. Water conditions when normal lake water has an average pH below 6 (Directorate of Dams and Lakes, 2021). So, during extreme low tide or drought, it is estimated that the pH of the water in the lake channels will be even more acidic.

Apart from that, many people who work in the fisheries sector will experience a loss of livelihood due to the loss of water in the lake. This loss of livelihood is both from the fishing sector and from cultivating fish in cages. This is like research on the Ayamuru Lake drought in Maybrat Regency, West Papua where people lost income from their livelihoods and there was no access to transportation because the lake water receded (Smur et al., 2021). The longer and more extreme the lake water recedes, the more vulnerable the community will be to facing drought disasters. This condition is caused because the lake is a source of life that is needed by the local community (Dhuhita, 2022).

Vulnerability is when a community cannot face or overcome the effects of a drought disaster that occurs in their village (Ayantunde et al., 2015). There are three aspects of vulnerability; exposure, sensitivity, and adaptive capacity (Jayanti et al., 2018; Engström et al., 2020). These three aspects (exposure, sensitivity, and adaptive capacity) will be used as indicators in determining the level of vulnerability of the community in Muara Enggelam Village in facing drought in the form of adjusted scoring and weighting results.

The vulnerability of a community in Muara Enggelam Village is a factor that influences how easily a community is affected by a lake drought which can be seen from three aspects of vulnerability. The resulting drought is expected to increase knowledge about community vulnerabilities and help plan and implement adaptation for the future, which can reduce the risk of drought (Thao et al., 2019). The purpose of this research is to provide information regarding the vulnerability of the community in Muara Enggelam Village to lake drought so that it can be a means of managing capacity to overcome drought in the future.

II. METHOD

This research employs the Cluster Random Sampling technique, whereby the researcher selects multiple informants from each village in a random manner. The sampling process is divided into two segments, taking into account factors such as road accessibility and housing type (refer to Figure 1). Determination of community vulnerability levels in this study is achieved through the identification of exposure, sensitivity, and adaptive capacity indicators (refer to Table 1). Data analysis utilizes scoring and weighting techniques. Weighting analysis is employed to assess the degree of influence each indicator has on vulnerability. Following the calculation of relative indices for each indicator, a point of intersection is determined, resulting in a relative index placement on the drought vulnerability index triangle diagram (refer to Figure 2). The vulnerability zone categories, derived from the triangular diagram structure, are presented in Table 2.

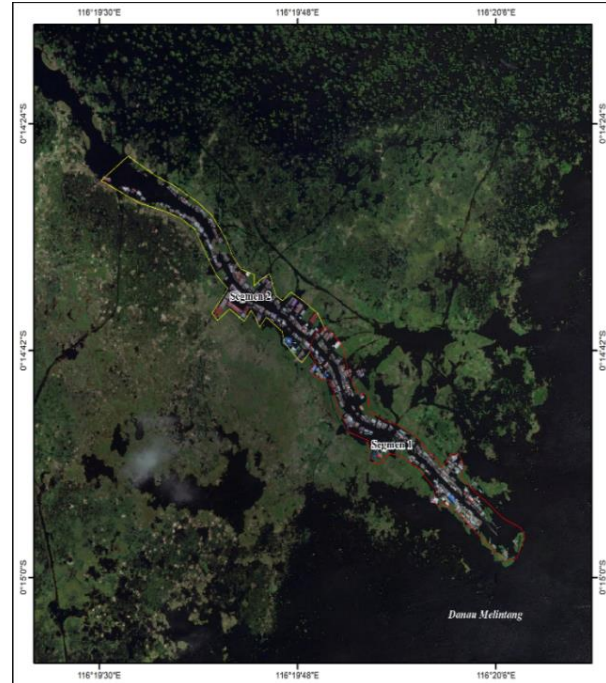


Figure 1. Research Locations and Segment Division

Table 1. Drought Susceptibility Parameters

No	Indicator	Skor	Explanation	Weight
Exposure				
1.	Proximity to lake	1	0 – 1 km	0,3
		2	> 1 – 5 km	
		3	> 5 km	
2.	Proximity to water sources	1	0 – 100 m	0,3
		2	100 – 200 m	
		3	> 200 m	
3.	Ownership of livestock or fisheries	1	Don't have livestock	0,2
		2	Have 1-5 livestock	
		3	Have > 5 livestock	
4.	Population density	1	< 100 person /Km ²	0,1
		2	100–500 person /Km ²	
		3	> 500 person/ Km ²	
5.	Rainfall	1	No drought	0,1
		2	1–2-month drought	
		3	> 2-month drought	
Sensitivity				
6.	Dependence on the lake	1	Not depend	0,1
		2	It just depends	
		3	Very dependent	
7.	Number of family dependents	1	< 4 people	0,1
		2	4 – 6 people	
		3	> 6 people	
8.	Income level	1	> 4.3 million per month	0,1
		2	3.3 million - 4.3 million per month	
		3	< 3.3 million per month	
9.	Level of education	1	High school – higher	0,08
		2	Elementary - Middle School	
		3	No school	
10.	Population age	1	15 – 17 years old	0,09
		2	18 – 60 years	
		3	0 – 14 years & > 60 years	
11.	Livelihood	1	Civil servants, traders	0,2
		2		

		3	Keramba, Nest Swallow Fishermen, fish collectors	
12.	Accessibilities	1	There is a road (cement/asphalt)	0,03
		2	There is a (wooden) road	
		3	There's no road	
13.	Condition of Water	1	Clear, odorless and tasteless	0,05
		2	Clear, taste or smell	
		3	Not clear, smelly and tasteless	
14.	Proportion Of The Number Of Fishermen	1	< 50% earn their living as fishermen	0,2
		2	50 – 75% earn their living as fishermen	
		3	> 75% earn their living as fishermen	
Adaptive capacity				
15.	Supply clean water	1	Available and accessible	0,05
		2	Available but limited	
		3	Not available	
16.	Financial drought preparedness	1	Money savings < 1 million	0,1
		2	Money savings 1 – 5 million	
		3	Money savings > 5 million	
17.	Facility drought preparedness	1	Nothing Available for 1 – 3 days	0,1
		2	Available for > 3 days	
		3	Available for > 3 days	
18.	Food drought preparedness	1	Nothing	0,1
		2	Yes but limited to only 1 month	
		3	Available for (> 1 month)	
19.	Mobile network	1	There's no signal	0,02
		2	Cellular	
		3	Cellular & internet network	
20.	Medical facility	1	Auxiliary health center	0,04
		2	Public health center	
		3	Hospital	
21.	Pamsimas water service or PDAM	1	Tidak ada	0,1
		2	Ada tetapi tidak mengalir setiap hari	
		3	Ada dan mengalir setiap hari	
22.	Alternative livelihoods	1	Don't have alternative	0,1
		2	Have 1 alternative	
		3	Have 2 alternative	
23.	Local wisdom	1	Don't know	0,02
		2	Know, but not implemented	
		3	Know and apply	
24.	Ownership of health insurance	1	Nothing	0,06
		2	Have, but not active	
		3	Have and active	
25.	Home and property insurance ownership	1	Nothing	0,06
		2	Yes, some	
		3	It's all there	
26.	Ownership of business insurance	1	Nothing	0,1
		2	Yes, some	
		3	It's all there	
27.	Community perceptions regarding	1	Don't know	0,04
		2	Know, but not implemented	

	reducing the risk of drought	3	Know and apply	
28.	Community planning regarding drought	1	Nothing exist, but it doesn't happen	0,04
		2	exist and it's happening	
		3	exist and it's happening	
29.	Drought-related communications	1	Nothing exist, but it doesn't happen	0,04
		2	exist and it's happening	
		3	exist and it's happening	
30.	Perceptions of climate change	1	Don't know	0,04
		2	know but not all	
		3	know the whole	
31.	Level of preparedness in facing fires and land	1	Not ready	0,04
		2	Ready	
		3	Very ready	

Table 2. Vulnerability 'zone' categories based on the triangular structure of the relative values of the drought vulnerability index.

Zone	REI	RSI	RACI	Interpretation of the vulnerability structure
A	≥33,3	<33,3	≥33,3	Exposure and adaptive capacity are key components of vulnerability
B	≥33,3	<33,3	<33,3	Exposure is a major component of vulnerability
C	≥33,3	≥33,3	<33,3	Exposure and sensitivity are the main components of vulnerability
D	<33,3	≥33,3	<33,3	Sensitivity of the main component of vulnerability
E	<33,3	≥33,3	≥33,3	Sensitivity and adaptive capacity are the main components of vulnerability
F	<33,3	<33,3	≥33,3	Adaptive capacity is a major component of vulnerability

Source adapted from (Liu et al., 2013)

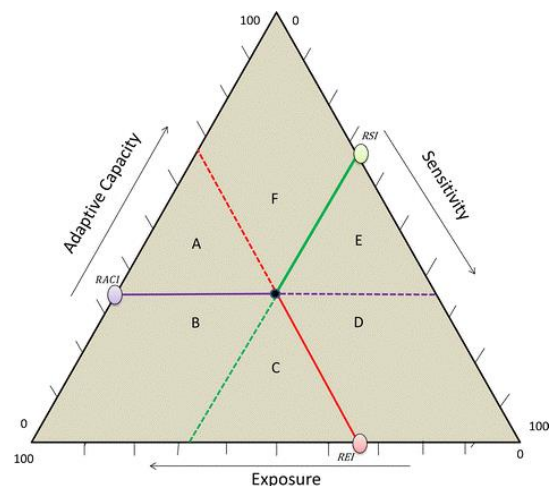


Figure 2. Triangular diagram of the Drought Susceptibility Index. Source adapted from (Liu et al., 2013)

III. RESULTS AND DISCUSSION

Vulnerability, characterized by a community's inability to withstand and mitigate the impact of disasters, can exacerbate conditions when calamities strike (Refnitasari

et al., 2022). It is often intertwined with a community's capacity to shield itself from and manage the repercussions of natural disasters independently, without external aid (Hapsoro & Buchori, 2015). In Muara Enggelam Village, vulnerability manifests prominently, rendering the community more susceptible to the onslaught of disasters.

A. Level of Community Exposure to Drought

The degree of exposure at the research site serves as a barometer of the location's vulnerability to lake drought. Proximity to rivers and water sources heightens community vulnerability, while factors such as rainfall patterns, population density, and livestock ownership contribute to exposure levels. The assessment of indicators pertaining to community exposure to drought is delineated in Table 3.

The calculated exposure value index in Table 3 falls within the low category, registering at 0.41 (value range < 0.5). The collective exposure index evaluation in Muara Enggelam Village, encompassing Segment 1 and Segment 2, corroborates this assessment at 0.41. This finding aligns with vulnerability assessments based on exposure indicators conducted in Pongkai Istiqomah Village, Kampar Regency, which similarly classified the community as low or not vulnerable (Daniaty et al., 2019).

Residents of Muara Enggelam Village reside in close proximity to the lake, positioning them in direct contact with water sources. Whether inhabiting raft/floating houses (at 0 meters) (refer to Figure 3) or elevated stilt houses (at 2-4 meters), the community's reliance on water sources varies based on proximity to the river. Those residing further from the river face greater challenges in accessing water during dry seasons, relying on springs due to their distance from riverbanks (Handoko et al., 2018).

Daily activities such as washing and bathing utilize lake water, while drinking and cooking necessitate procuring water from Muara Muntai, either through purchase from a Village Government-designated vendor or via delivery using a ces (small boat) for a nominal fee of 5 thousand rupiahs per conductor. Despite drought conditions, the community's exposure remains relatively low, owing to continuous access to lake water facilitated by water pumps (refer to Figure 4). Testimony from respondent no. 1 attests to this: "In times of need, we typically draw water from the lake using a water pump. However, if the lake runs dry, we resort to fetching water from Enggelam River, which never dries up. Thus, even amidst drought, we maintain access to river water." This stands in contrast to the practices observed in Serang Hamlet, where residents resort to spring water retrieval using conductors during droughts (Fariz et al., 2022). By elucidating the community's exposure to drought, this analysis underscores the nuanced dynamics shaping vulnerability levels in Muara Enggelam Village, shedding light on the intricate interplay between environmental factors and adaptive strategies.

Table 3. Calculation of relative values determining index exposure to drought

Exposure Index			
No	Indicator	Segment 1	Segment 2
1.	Proximity to lake	0,1	0,1
2.	Proximity to water sources	0,1	0,1067
3.	Ownership of livestock or fisheries	0,1111	0,1067
4.	Population density	0,0667	0,0667
5.	Rainfall	0,0333	0,0333
Total		0,41	0,41
Value of EI (Exposure Index)		0,41	



Figure 3. Proximity of the raft house to the lake

Despite facing drought conditions, residents of Muara Enggelam Village continue to rely on lake water for their daily necessities. Analysis of responses from all participants indicates that, on average, the lake channels—serving as the primary water source for the village—have remained unaffected by drought, even during prolonged dry spells. This resilience is evident in the rainfall data for 2019, where a dry period persisted for three months or 65 days, punctuated by only 13 days of rainfall within that timeframe (refer to Table 3). Furthermore, a comprehensive examination of rainfall patterns in the Mahakam cascade region over the years reveals consistently adequate precipitation levels. This stark contrast is observed when comparing Muara Enggelam Village to Pongkai Istiqomah Village, where a recurring decline in rainfall is documented annually, indicative of a distinct dry season (Daniaty et al., 2019).

Droughts that last for months do not make the lake water dry. In this way, the community can optimize the use of the lake as a livelihood (fishing) and is reluctant to migrate from the village even if a disaster such as a drought occurs. Not only fishermen, but some people own fish cages and swallow nests (Figure 5). Drought is not an obstacle for people who have fish cages (as long as the lake water level is still above 2 meters, fish cages can still operate) and swallow nests, it's just that the shape of the swallow nest becomes less good when there is a drought. In this condition, the river channel in Muara Enggelam Village is relatively wide, so that water traffic in the middle of the river during drought can still be passed. This is like the results of interviews with respondent No. 2 who said "When the water recedes, this cage has no problems at all because if the water starts to recede usually we will push the cage to the middle of the river so that the cage is still submerged in water, because only in the middle of the river

is there still water and for the swallow "When it's dry, sometimes it doesn't come home because it's looking for something to drink, which makes the shape of its nest less good."



Figure 5. Fish cages and swallow nests.

B. Community Sensitivity Level to Drought

Based on the total score calculated for indicators, community sensitivity to drought in Muara Enggelam Village is high, namely 0.81 (in the value range of 0.75-1). The index value in segment 1 is 0.80 while in segment 2 it is 0.82. Indicators that determine the level of community sensitivity include dependence on the lake, income level, livelihoods, and the proportion of fishermen. The calculation of indicators determining community sensitivity to drought in Muara Enggelam Village can be seen in Table 4.

Table 4. Calculation of relative values determining index sensitivity to drought

Sensitivity Index			
No	Indicator	Segment 1	Segment 2
1.	Dependence on the lake	0,0844	0,0889
2.	Number of family dependents	0,0689	0,0578
3.	Income level	0,0822	0,0867
4.	Level of education	0,0444	0,0462
5.	Population age	0,06	0,06
6.	Livelihood	0,1289	0,1511
7.	Accessibility	0,03	0,03
8.	Water quality	0,05	0,05
9.	The proportion of fishermen	0,2	0,2
10.	Clean water network	0,05	0,05
Total		0,80	0,82
Value of SI (Sensitivity Index)		0,81	

The average community is very dependent on lakes, this is because people use lake water for daily needs such as washing, bathing, and so on. Some people take it directly from the lake and others pump the lake water and then store it in reservoirs such as drums and tendons and are given water medicine. The community in Muara Enggelam Village uses direct lake water for the use and disposal of water, such as MCK (bathing, washing, toilet). Meanwhile, the condition of the lake water in Muara Enggelam Village during times of drought smells a little or the people call it "bangar smell" or fishy smell due to the

release of hydrogen sulfide gas (H₂S) into the water, so that there is a foul smell in the area (Putri et al., 2017). Conditions like this are considered unhealthy for society. However, people still use the lake water for daily activities.

Community activities, especially those who work as fishermen, will be hampered when traveling using ces boats because the lake only has a river channel left. Not only that, but fishermen will also have difficulty finding fish. This is different at the start of the drought season, where fish are so abundant that fishermen can easily find fish in the river, but this condition is only momentary and causes sales prices to drop drastically. This is like the results of interviews with respondent No. 10 who said "When fish gather at low tide, people just work on the river again. You can get a lot. It only takes about 1 week at most, but it's difficult to finish because the fish are almost gone." "The large number of fish also causes the price of fish to drop to up to 2 thousand per kilo, because there is a large supply of fish but the demand for fish remains."

Fish prices which decrease drastically during the dry season are influenced by the law of supply and demand which means that fishermen's income sources also decrease (Turuis et al., 2021). Based on the results of interviews with respondents, the average income of people in Muara Enggelam Village is around 3 million rupiah per month, with an average family responsibility of 4-6 people in one family card. This condition is considered sensitive because it is not by the minimum wage in Kutai Kartanegara Regency amounting to 3.3 million rupiah per month. As a result, people with incomes below the Kukar minimum wage are more sensitive when there is a drought due to decreased income.

Long dry conditions make the level of vulnerability of people who work as fishermen quite high to drought, this is because their livelihood comes from lakes. This condition has similarities with fishermen in Muara Village, Subang Regency, West Java, where the fishing profession feels disturbed by climate variability, causing income as a fisherman to decrease (Azizi & Komarudin, 2021). Difficulties like this are not only experienced by fishermen, but traders also experience problems when there is a drought. Transportation using small boats is an obstacle to buying more goods as usual. Because the only road access that can be passed is via the river channel during the drought. This is like the results of interviews with respondent No. 10 who said "Usually when we go shopping to Muara Muntai we use a ces boat and the shopping schedule is uncertain, it can be once every 2 weeks. When things start to run out, we immediately go shopping. The problem is that we usually shop using a rather large ces boat, when the water is low, we usually use a small ces boat. If you use a large ces boat, it's difficult to get through, especially if there's a lot of goods, the ces boat could run aground on the road. So, you can't buy too many items."

Access to transportation is an obstacle for traders in buying goods. When traders insist on using large ships, the ships carrying goods will run aground in the middle of the river because they are too loaded, so that Muara Enggelam Village traders can only use small ships to buy their

merchandise. There are community professions that are not affected by the drought, such as teachers and employees. This is because this profession is not related to lakes, so it does not make them disturbed by drought. However, most people in Muara Enggelam Village work as fishermen (50%) according to the results obtained from respondents, thus making most people from Muara Enggelam Village vulnerable when there is a drought.

C. Community Adaptive Capacity to Drought

Adaptive capacity is the system's ability to deal with adverse impacts due to disturbances. Based on the total score calculated for the indicator of the community's adaptive capacity for drought in Muara Enggelam Village, it is low, namely 0.49 (in the range of 0.5 – 0.75). Even though they have low adaptive capacity, the people in Muara Enggelam Village can adapt to drought. This condition is the same as the community in Sukoharjo Regency, Central Java, which has a low level of capacity (Wijanarko, 2013). The results of calculating the determining factors for the adaptive capacity of the community in Muara Enggelam Village are presented in Table 5.

Most people in Muara Enggelam Village work as fishermen (50%), some people do not have alternative livelihoods (47%), consisting of traders, employees, and swallow businesses. Meanwhile, the community has 1 alternative livelihood (30%), which consists of fish cages (if the water level is still above 2 meters, fish cages can still be managed), and swallow nests. Some people have 2 alternative livelihoods (23%), consisting of nest wallets, traders, and LPM leaders. This is the same as the people in Rokan Hilir Regency who have alternative livelihoods such as blood cockle ponds (Amika et al., 2022). People who have alternative sources of livelihood are more economically resilient because of increased income and are not dependent on just one job. However, this is different from the condition of the bibilo fishermen in Lake Limboto, where the community does not have other alternative livelihoods (Hasim & Yasin, 2018).

Table 5. Calculation of relative values determining the Adaptive Capacity index against drought

Adaptive Capacity Index			
No	Indicator	Segment 1	Segment 2
1.	Financial drought preparedness	0,0867	0,08
2.	Facility drought preparedness	0,0333	0,0333
3.	Food drought preparedness	0,0533	0,0533
4.	Communication and information tools	0,0067	0,0067
5.	Medical facility	0,0133	0,0133
6.	Pamsimas water service or PDAM	0,0333	0,0333
7.	Alternative livelihoods	0,0667	0,0511
8.	Local wisdom	0,0067	0,0067
9.	Ownership of health insurance	0,0507	0,052
10.	Home and property insurance ownership	0,02	0,02

Adaptive Capacity Index			
No	Indicator	Segment 1	Segment 2
11.	Ownership of business insurance	0,0333	0,0333
12.	Community perception regarding reducing the risk of drought	0,013	0,013
13.	Community planning regarding drought	0,0222	0,0258
14.	Drought-related communications	0,013	0,013
15.	Perceptions of climate change	0,0249	0,0178
16.	Level of preparedness in facing fires and land	0,0267	0,0258
Total		0,50	0,48
Value of CI (Capacity Adaptive Index)		0,49	

Increasing people's income can become business capital or savings. Most respondents have savings of < 1 million (3%), 1-5 million (43%), and > 5 million (54%). This percentage difference is influenced by people's alternative livelihoods, the more side jobs, the more savings they have. On average, 54% of people have savings in the form of cages or wallet nests that can be harvested within a certain period. This condition is different from the people in Pamor Hamlet, where most people only have savings of <1 million rupiahs to buy water as well as farming costs and household needs (Wilhan Hastanti & Purwanto, 2020).

This income can provide preparation or savings in the face of drought disasters. That way, people can buy food for their daily needs during the drought. Some people do not have food stocks (40%), this is because people are only able to buy food every day due to limited finances. Meanwhile, 60% of people can afford to buy food for a month's stock, such as rice, oil, sugar, and others. Because during the drought, the people of Muara Enggelam Village never received assistance such as necessities. People also need clean water for drinking and cooking which can be purchased at Muara Muntai or from Village-Owned Enterprise (Badan Usaha Milik Desa). Likewise, people in Pongkai Istiqomah Village also buy clean water from outside their village (Daniaty et al., 2019). Muara Enggelam Village has Pamsimas for access to clean water, which is delivered to people's homes, but this has not been implemented.

Installation of PAM (Drinking Water Company) water itself is not carried out in all houses, only the houses of people who want to use PAM water have PAM water pipes installed. This is because there will be additional costs that will be incurred to pay for PAM water so that people who do not install PAM water will still use lake water for their daily needs. The Muara Enggelam Village community does not even have rainwater storage to prepare for drought (100%). Because people believe that river water (lake flow) never dries up. In contrast to the villages in Sukoharjo district, they built drilled wells, water pumps, and water reservoirs to meet water needs (Wijanarko, 2013). Likewise, people in Blora Regency collect clean water using jerry cans or create private water reservoirs in their homes (Dhuhita, 2022). People are also used to using lake water, even during the dry season, the lake water

becomes dirty and smells bad or fishy due to fish dying in the river because the water temperature is quite hot, but people still use the water.

Unsanitary and unhealthy environmental conditions using dirty and smelly lake water during drought usually cause itching in some people in Muara Enggelam Village. This also affects health facilities. Muara Enggelam Village only has an Assistant Community Health Center. This health center can only treat mild illnesses. If you have a history of serious illness, you will be referred to the hospital in Bangun City.



Figure 6. Healthy Community Care Forum



Figure 7. Signs that the water is starting to recede.

The majority of respondents have active health insurance (60%), however, some respondents do not have health insurance at all (3%) and several other respondents' insurance (37%) is no longer active. Respondents were hampered in payments due to uncertain financial problems. This is why several respondents' health insurance is no longer active. Apart from that, Muara Enggelam Village also formed the Healthy Community Care Forum (Figure 6) which makes it easier for people who want to go to the hospital for treatment by providing facilities such as longboats and ambulances. Meanwhile, for home and business insurance, 100% of the people of Muara Enggelam Village do not have it. This makes people vulnerable to business failure and disasters that strike when a disaster occurs.

In the face of drought, the people of Muara Enggelam Village know that low and high-water flows through house

poles (Figure 7) or peilschaal which are attached to poles under the bridge. People also cannot predict when the dry season and rainy season will occur, they usually rely on certain months when the dry season occurs. Muara Enggelam Village itself is very prone to land fires because the location of this village is in a peatland area. There was a land fire in Muara Enggelam Village which caused the trees to become bare because of the fire (Figure 8).

However, the village government and the community also work together if a land fire occurs. The Muara Enggelam Village Government itself has formed a fire extinguishing community because of the high risk of fires occurring near the village. This was conveyed by the Village Secretary who said, "Because the land here is prone to fires because the land here is predominantly peat, the village government has formed a community called the Fire Care Community, so that the community is always ready when a fire occurs. "Then we will also inform the entire community that when the dry season enters, we will not allow throwing away cigarette butts, burning them, and using electric shock devices to catch fish."



Figure 8. Dead trees due to land fires in Muara Enggelam Village

It is hoped that the formation of the Fire Care Community will be able to help the community when fires occur, whether at home or on land. The members of the Fire Care Community themselves are residents of Muara Enggelam Village, so the community is ready when a fire occurs. Then, warnings such as not to throw away cigarette butts during the dry season are a form of preparedness to prevent fires from occurring in the village.

Another effort made by the community when there is a drought is to help dredge the river channel from mud so that their ships can pass. This effort was carried out due to a lack of assistance from the government or aid-related institutions, so the community worked together to dig up mud in the river so that their ships could still traverse the river channel. Apart from that, the community also

provides road markers along the river channel (Figure 9) which can be passed by community boats.

Then another thing that also influences the adaptive capacity indicator is local wisdom. Muara Enggelam Village does not have traditional rituals to prevent disasters that befall the village. People continue to carry out activities as usual when there is a drought, this is because people are used to dealing with drought. This is different from the people in Kampung Naga, Tasikmalaya Regency, who still hold strong culture and customs, believing that sacred forests act as protected forests because they protect the area below from landslides and floods. The community also understands that forests can regulate water management so that it does not flood in the rainy season and dry out in the dry season (Dewi et al., 2016). A long drought usually causes the people of Muara Enggelam Village to change professions from fishermen to farmers. This is like the results of interviews with respondent No. 4 who said "People who used to work as fishermen when drought occurs usually become farmers. Usually, if you plant rice near the sheet pile (gate) when the lake is dry, you can get two harvests and the results can be sold or kept for yourself. Finally, in 2019, we also planted rice. "Now it's not possible because the season is difficult to predict, before the rice has been harvested, the lake water has risen again, so it's rare to have a long dry season like in the last few years."



Figure 9. Community Mutual Cooperation Provides Road Markers in the River Channel

People are changing professions from fishermen to farmers because it is very difficult to find fish. They change professions to be able to meet their daily needs. Likewise, people in Kanigoro Village, Gunung Kidul Regency have also changed professions, from farmers to fishermen (Wardono, 2017). The rice harvest obtained is usually sold or for consumption. This event was last carried out by the community in 2019 when they experienced a drought until they were able to harvest rice.

Based on Table 6, the vulnerability index of Muara Enggelam Village states the value of REI (Relative Exposure Index), 41, RSI (Relative Sensitivity Index), 81, and RACI (Relative Adaptive Capacity Index), 49. This shows that the community in Muara Enggelam Village is included in the category Zone D (Sensitivity of the main component in the vulnerability).

Table 6. Drought vulnerability index in Muara Enggelam Village

No	Indicator	Skor	Relative Value	Category
1	Exposure	0,41	41	D
2	Sensitivity	0,81	81	
3	Adaptive Capacity	0,49	49	

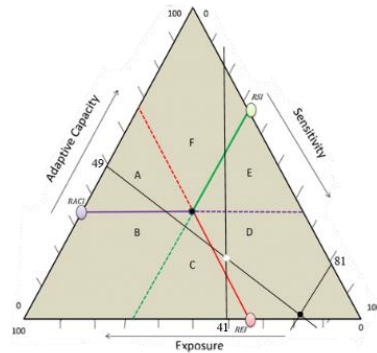


Figure 10. Triangular Diagram of Drought Vulnerability Index for Muara Enggelam Village

Communities are increasingly vulnerable because dependence on lakes is quite high. This is because people need water for transportation, fishing, and other activities. With the lake drying up, people will be isolated because transportation routes will be cut off and this will affect the supply of daily necessities. Apart from that, people will lose their main livelihood as fishermen, even if they switch to becoming farmers on the lake, but people with fishing skills will not be able to optimize farming. This condition causes people to experience a decrease in income and makes them increasingly vulnerable because their sensitivity is higher.

To deal with unpredictable climate change, it is difficult for the government to prevent the negative impacts of the danger of drought. However, the government can provide some assistance to the community to survive the drought, either through food assistance, clean water, or effective agricultural training that can be carried out when drought strikes. Apart from that, assistance can also build bridges connecting villages over water to facilitate the movement of people and goods from and between villages.

IV. CONCLUSION

The vulnerability of the lake to drought disaster in Muara Enggelam Village is included in the Zone D category (Sensitivity of the main component of vulnerability). The high sensitivity index of the people of Muara Enggelam Village influences this condition. The high sensitivity value in Muara Enggelam Village is influenced by the low level of income and the large proportion of fishermen in the community. As a suggestion, the village government can create a superior program to overcome or reduce the impact of drought, especially on river channels that are difficult to pass during a drought. Communities can also work together to help

create river channels, making it easier for people to cross dry river channels. Apart from that, to stimulate the economy, it is necessary to diversify livelihoods to maintain the income of village communities during times of drought.

REFERENCES

- Amika, I., Warningsih, T., & Nugroho, F. (2022). Kontribusi mata pencaharian alternatif terhadap pendapatan rumah tangga nelayan: Studi kasus di Kelurahan Bagan Hulu, Kecamatan Bangko, Kabupaten Rokan Hilir, Indonesia. *Jurnal Ilmiah Pertanian*, 19(1), 38–47. <https://doi.org/10.31849/jip.v19i1.8738>
- Ayantunde, A. A., Turner, M. D., & Kalilou, A. (2015). Participatory analysis of vulnerability to drought in three agro-pastoral communities in the West African Sahel. *Pastoralism*, 5(1). <https://doi.org/10.1186/s13570-015-0033-x>
- Azizi, & Komarudin, N. (2021). Analyses of livelihood vulnerability fisherman dealing with climate variability (case muara village blanakan sub-district, subang district). *Jurnal AKuatek*, 2(2), 140–147.
- Daniaty, H., Sujianto, S., & Siregar, S. H. (2019). Kerentanan Dan Strategi Adaptasi Masyarakat Tepi Waduk Desa Pongkai Istiqomah Terhadap Dampak Kekeringan Dari Perubahan Iklim. *Jurnal Ilmu Lingkungan*, 13(2), 141. <https://doi.org/10.31258/jil.13.2.p.141-154>
- Dewi, I. K., Istiadi, Y., & Istiadi, Y. (2016). Mitigasi bencana pada masyarakat tradisional dalam menghadapi perubahan iklim di kampung naga kecamatan salawu kabupaten tasikmalaya (Disaster Mitigation on Traditional Community Against Climate Change in Kampong Naga Subdistrict Salawu Tasikmalaya). *Jurnal Manusia Dan Lingkungan*, 23(1), 129. <https://doi.org/10.22146/jml.18782>
- Dhuhita, N. A. K. (2022). *Identifikasi Kerawanan Bencana Kekeringan Dan Pola Adaptasi Masyarakat Terhadap Bencana Kekeringan Kabupaten Blora*. <http://eprints.ums.ac.id/id/eprint/98672>
- Direktorat Bendungan dan Danau. (2021). *Preparation of WR Strategic Implementation Plan For Priority Lake-East Region (Cascade Mahakam) Prov Sum: Hidrologi*.
- Direktorat Pengendalian Kerusakan Perairan Darat. (2019). Rencana Pengelolaan Danau Kaskade Mahakam. In *Kementrian Lingkungan Hidup dan Kehutanan*. Kementrian Lingkungan Hidup dan Kehutanan. <https://doi.org/10.1088/1751-8113/44/8/085201>
- Engström, J., Jafarzagdegan, K., & Moradkhani, H. (2020). *Drought vulnerability in the United States: An integrated assessment*. *Water (Switzerland)*, 12(7). <https://doi.org/10.3390/w12072033>
- Fariz, T. R., Nugraha, F. A., Putra, G. A. Y., Nugroho, A. A., Salima, D. R., Pradiny, L. E., & Mubarizi, A. F. (2022). Kajian Kapasitas Masyarakat Berbasis Aset Penghidupan Terhadap Bencana Kekeringan. *LaGeografia*, 21(1), 31. <https://doi.org/10.35580/lageografia.v21i1.37174>
- Handoko, U., Boer, R., Aldrian, E., & Dasanto, D. (2018). Persepsi Kerentanan Bahaya Banjir dan Kekeringan Akibat Perubahan Iklim di DAS Batanghari. *LIMNOTEK Perairan Darat Tropis Di Indonesia*, 25(2)(2), 110–124.
- Hapsoro, A. W., & Buchori, I. (2015). Kajian Kerentanan Sosial Dan Ekonomi Terhadap Bencana Banjir (Studi Kasus: Wilayah Pesisir Kota Pekalongan). *Jurnal Teknik PWK*, 4(4), 542–553.
- Hasim, & Yasin, I. (2018). Kerentanan Sosial Ekonomi Nelayan Bibilo Danau Lomboto Provinsi Gorontalo. *Kerentanan Sosial Ekonomi Nelayan Bibilo Danau Limboto Provinsi Gorontalo*.
- Jayanti, A. D., Fitriya, W., Setyobudi, E., Budhiyanti, S. A., Suadi, S., & Kune, S. J. (2018). The vulnerability of fishermen's community and livelihood opportunity through drought and seasonal changes in border area of Indonesia-Timor Leste. *IOP Conference Series: Earth and Environmental Science*, 139(1). <https://doi.org/10.1088/1755-1315/139/1/012030>
- Liu, X., Wang, Y., Peng, J., Braimoh, A. K., & Yin, H. (2013). Assessing vulnerability to drought based on exposure, sensitivity and adaptive capacity: A case study in middle Inner Mongolia of China. *Chinese Geographical Science*, 23(1), 13–25. <https://doi.org/10.1007/s11769-012-0583-4>
- Putri, M. R. A., Hartati, S. T., & Satria, F. (2017). Kematian Massal Ikan Dan Sebaran Parameter Kualitas Air Di Teluk Jakarta. *BAWAL Widya Riset Perikanan Tangkap*, 8(2), 77. <https://doi.org/10.15578/bawal.8.2.2016.77-90>
- Refnitasari, L., Cahyaka, H. W., Handayani, K. D., & Amudi, A. (2022). Analisis Kerentanan Fisik Wilayah Pesisir Utara Kota Surabaya Terhadap Bencana Banjir Rob Physical Vulnerability Analysis in the Northern Coastal Area of Surabaya City To the Tidal Flood Disaster. *Jurnal Tata Kota Dan Daerah*, 14(2), p. <https://doi.org/10.21776/ub.takoda.2022.014.02.2>
- Smur, J., Rusim, D. A., & Manalu, J. (2021). Analisis Faktor Penyebab Dan Strategi Pengendalian Kekeringan Danau Ayamaru Kabupaten Maybrat. *Jurnal ELIPS (Ekonomi, Lingkungan, Infrastruktur, Pengembangan Wilayah, Dan Sosial Budaya)*, 4(1). <https://doi.org/10.31957/jurnalelips.v4i1.1606>
- Thao, N. T. T., Khoi, D. N., Xuan, T. T., & Tychon, B. (2019). Assessment of Livelihood Vulnerability to Drought: A Case Study in Dak Nong Province, Vietnam. *International Journal of Disaster Risk Science*, 10(4), 604–615. <https://doi.org/10.1007/s13753-019-00230-4>
- Turuis, A., Kumenaung, A. G., Kalangi, J. B., Permintaan, A., Laut, I., Kabupaten, D. I., Sangihe, K., Turuis, A., Pembangunan, J. E., & Ekonomi, F. (2021).

- 1439 *Jurnal EMBA Vol . 9 No . 1 Januari 2021 , Hal . 1439-1446*. 9(1), 1439–1446.
- Vargas, J., & Paneque, P. (2017). Methodology for the analysis of causes of drought vulnerability on the River Basin scale. *Natural Hazards*, 89(2), 609–621. <https://doi.org/10.1007/s11069-017-2982-4>
- Wardono, B. (2017). Perubahan Mata Pencapaian Dari Petani Ke Nelayan Perikanan Tangkap Laut Di Desa Kanigoro Kecamatan Saptosari, Kabupaten Gunungkidul. *Buletin Ilmiah Marina Sosial Ekonomi Kelautan Dan Perikanan*, 2(2), 73. <https://doi.org/10.15578/marina.v2i2.4966>
- Wijanarko, D. (2013). *Kesiapsiagaan Masyarakat Terhadap Bencana Kekeringan di Kecamatan Weru Kabupaten Sukoharjo*.
- Wilhan Hastanti, B., & Purwanto, P. (2020). Analisis Keterpaparan, Sensitivitas Dan Kapasitas Adaptasi Masyarakat Terhadap Kekeringan Di Dusun Pamor, Kradenan, Grobogan. *Jurnal Penelitian Hutan Dan Konservasi Alam*, 17(1), 1–19. <https://doi.org/10.20886/jphka.2020.17.1.1-19>
- Yoenus, M. (2015). *Tiga Desa Terisolasi Akibat Danau Melintang Kering*. www.Tribunnes.Com. <https://www.tribunnews.com/video/2015/11/08/tiga-des-a-des-a-terisolasi-akibat-danau-melintang-kering>