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Community Perception and Environmental Effects of Flood Mitigation Plans in Segamat, Johor

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Abstract: After severe floods in Segamat in 2006 and 2011, the government initiated a flood mitigation plan for the Segamat River, completed in 2015. However, in early 2017, Segamat experienced flooding again, raising questions about the project's effectiveness. This study focuses on Mukim Gemereh, located near the Segamat River. The study examined the flood history in the area, targeting three frequently flooded villages: Kampung Batu Badak, Kampung Gemereh 3, and Kampung Lubuk Batu. Findings reveal a mixed perception, with many acknowledging reduced floods impact but expressing concerns over the disrupted river ecosystem and declining fish and shrimp populations. Fishermen reported significant negative impacts on their income due to decreased catches. Most respondents are people who have experience floods before. Seventy per cent of respondents were satisfied with the flood mitigation project has been done and felt the project successful in reducing the impact of floods. However, for fisherman, the constructed flood mitigation project has affected their income as the project disturbs the habitat inside the river. The study underscores the importance of involving local communities in disaster risk management to enhance disaster management practices, as highlighted by the Sendai Framework 2015-2030. Overall, there are positive impacts, particularly regarding reduced flood risk and property damage. However, issues such as disturbed river ecosystems and stagnant water remain.

Keywords: Flood mitigation, community perception, environmental impact, Segamat River

Introduction

Floods cause approximately 90% of natural disaster-related damages in Malaysia, impacting 4.9 million people annually and resulting in an average yearly property damage of US$100 million (Karki, 2020). Segamat is one of the districts in Johor that has experienced multiple floods, the most recent occurring in 2017 when several areas in Segamat were flooded. However, this flood was not as severe as those in 2006 and 2011, which were historically the worst floods in the area. Historical records indicate that Segamat town was severely impacted by floods in 1969, 1979, 1983, 2007, and 2011, with the 2011 flood causing an estimated USD 146.2 million in damages (Romali & Yusop, 2020). Following the experiences of the 2011 and 2006 floods, various parties, particularly the government, initiated several measures to mitigate the impact of floods in this region, especially concerning the loss of life and property damage. The issue of flooding in this area was also raised in the Segamat district action meetings, with numerous flood-related complaints from the local community. Consequently, the government implemented the Flood Mitigation Project in the Muar River Basin, which also involved the Segamat River located in the Segamat District.

This project was carried out after considering several issues faced by the Segamat River, including flooding and numerous complaints from the local community. The Segamat River flows through the densely populated town of Segamat, making it prone to frequent flooding. Additionally, flash floods in Segamat are often exacerbated by inadequate and clogged drainage systems. In Segamat, flooding issues occur in areas such as Kampung Jawa, Taman Sri Medoi, Kampung Gubah, Kampung Batu Badak, and Kampung Paya Dalam. Prolonged heavy rains lead to flooding, causing traffic congestion and significant property and business losses. When the flood mitigation project on the Segamat River was completed, many parties, including the local community, hoped that the flooding problem in the area would be reduced. However, in early 2017, areas involved in the flood mitigation project were flooded again, including several villages in Mukim Gemereh and other areas around the Segamat River, raising questions about the effectiveness of the flood mitigation project completed at the end of 2015. Additionally, early in 2017, several areas around the Segamat River were flooded once more, including several villages in Mukim Gemereh.

This study is necessary to identify the effectiveness of the flood mitigation project in this area. Understanding the impact of mitigation measures is important for evaluating the feasibility of construction and implementing strategies (Posner & Georgakakos, 2017). It also aims to understand the views and perceptions of the local community (flood victims) regarding the effectiveness of the project. Perceived behavioural control refers to an individual's belief in their ability to exhibit specific behaviours, encompassing both their capacity to manage their actions and their confidence in their ability to execute or refrain from these behaviours (Nazri et al., 2023). Furthermore, it seeks to identify the problems faced by the community following the implementation of the flood mitigation project in the Segamat River area. The Sendai Framework 2015-2030 emphasises the importance of involving local communities in disaster risk management to improve disaster management globally (UNISDR, 2015). Community involvement is important because it uses local knowledge, encourages ownership, and builds trust, all of which are necessary for disaster risk reduction (DRR) programs to work. By involving local communities, DRR strategies can be changed to fit different needs, cultural settings, and socioeconomic situations. This makes measures for preparation, response, and recovery more effective. The study focuses on the impact of the flood mitigation project on the community in terms of flood effects and the local economy, as well as the environmental impact

Literature Review

Flood mitigation strategies have been implemented globally to reduce the adverse impacts of floods on communities and ecosystems. These strategies often vary based on local contexts and geographical, social, and economic factors. In Malaysia, floods account for 90% of natural disaster-related damages, affecting millions annually (Karki, 2020). The frequent occurrence of floods in regions like Segamat, Johor, has necessitated significant investments in flood mitigation projects.

Community Perception of Flood Mitigation Projects

Understanding community perceptions is pivotal to evaluating the success of flood mitigation initiatives. As emphasised by the Sendai Framework for Disaster Risk Reduction 2015-2030, community involvement in disaster risk management is critical for effective disaster response and recovery (UNISDR, 2015). Brilly and Polic (2005) highlighted that public perception of flood risks significantly influences the effectiveness of mitigation measures. Similarly, Hong and Chang (2020) argued that community perceptions are shaped by past flood experiences and the perceived inconvenience caused by mitigation projects. In Segamat, a survey revealed that 70% of respondents perceived the flood mitigation project as effective in reducing flood risks, though concerns about its environmental and economic impacts remain.

Environmental Impacts of Flood Mitigation

While flood mitigation projects aim to protect human settlements, they often have unintended consequences on river ecosystems. The common strategy of river widening and deepening can alter

aquatic habitats, leading to declines in fish and shrimp populations (Kono et al., 2020). Such ecological disruptions affect biodiversity and the livelihoods of local communities, particularly those dependent on fishing. Santos et al. (2017) found that construction activities in river basins could degrade water quality and displace native species, further aggravating ecosystem imbalance. In Segamat, fishermen reported a significant decline in aquatic life following the implementation of the flood mitigation project, which impacted their income and necessitated shifts to alternative livelihoods.

Economic Implications of Flood Mitigation

Flood mitigation projects have economic benefits, such as reducing property damage and business losses. However, these projects may also impose economic burdens on specific community groups. For instance, Talbot et al. (2018) noted that while flood control measures protect infrastructure, they can disrupt ecosystem services that support local economies. In Segamat, fishermen—a vulnerable group—reported reduced catches and smaller fish sizes, leading to economic hardships. These findings underscore the need to balance structural flood control measures with ecological and social considerations.

Study Area

Mukim Gemereh is one of the subdistricts located in Segamat District, Johor. It is the smallest subdistrict in Segamat District and has the lowest population in the area, with approximately 6,070 residents. Mukim Gemereh is situated along the Segamat River and at the confluence of the Segamat and Muar Rivers. This subdistrict is divided into five main villages: Kampung Berata, Kampung Gudang Garam, Kampung Gemereh 3, Kampung Lubuk Batu, and Kampung Batu Badak. For this study, the focus is on three main villages: Kampung Gemereh 3, Kampung Lubuk Batu, and Kampung Batu Badak, all located near the Segamat River, and the flood mitigation project implemented in this area. These three villages are classified as areas frequently affected by flooding along the Segamat River. **Fig. 1** shows the map of the study area.

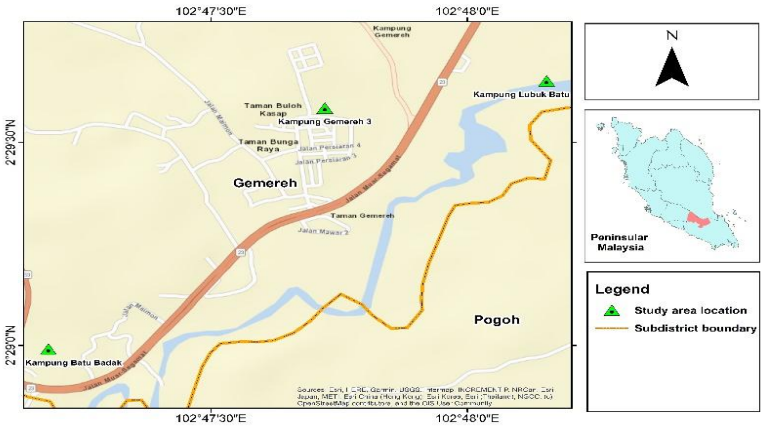

Fig 1. Study Area

Methodology

This study focused on three main villages in Mukim Gemereh: Kampung Batu Badak, Kampung Gemereh 3, and Kampung Lubuk Batu. For the sampling, within these villages, a survey was conducted using a random sampling technique. The target respondents were flood victims, specifically those whose homes or surrounding areas were flooded. Overall, a total of 80 respondents were evenly distributed, with 38 men and 42 women. Quantitative methods play a crucial role in assessing the effectiveness of flood mitigation projects. Posner and Georgakakos (2017) emphasised

the importance of using statistical tools to evaluate community-scale interventions. Descriptive statistics was used to present the overall result. The descriptive statistics provide insights into demographic profiles and community perceptions, forming a basis for targeted recommendations.

Findings and Discussion

Demographic Background of Respondents

Table 1 shows a summary of the demographic profiles of the respondents in the study area. The table presents the breakdown of respondents for each village according to gender, household size, age, occupation, and additional jobs in this study area. On average, most respondents were between 40 and 60 years old. Most respondents were over 40 years old because the younger population prefer living in urban areas. As Mukim Gemereh is the smallest subdistrict in Segamat District, the younger locals tend to relocate. Regarding economic activities, various occupations were observed, including rubber tapping, trading, and fishing. Sixteen respondents have secondary jobs to supplement their income. Among the residents of Kampung Batu Badak, eight respondents work part-time as fishermen. Twelve respondents in Kampung Batu Badak have either full-time or part-time work as river fishermen.

Table 1. Demographic Background of Respondents

Number of respondents = 80			
Demography	**Kg Batu Badak**	**Kg Gemereh 3**	**Kg Lubuk Batu**
Gender			
Male	15	8	16
Female	10	20	12
Household size			
1 - 3 people	8	16	14
4- 6 people	12	7	8
7 - 9 people	5	5	2
10 or more	0	0	3
Age			
20 years or below	0	0	0
21 - 39 years	5	5	8
40 - 60 years	16	11	8
60 years or more	4	12	11
Job			
Business	7	3	3
Rubber Tapper	2	3	2
Fisherman	4	0	0
Housewife	7	8	7
Retire	3	3	7
Others	2	11	8
Part-time job			
Yes	8	4	4
No	17	24	23
Type of part-time job			
Fisherman	8	4	4
Business	0	0	0

Perception of the Effectiveness of Flood Mitigation Project

Following the severe floods in 2006 and 2011 that heavily impacted the Muar River Basin, the government undertook several measures to prevent the recurrence of such events. The floods in those years severely crippled Segamat District. As a result, the government implemented a flood mitigation project in the Muar River Basin, which also involved the Segamat River. The primary goal of this flood mitigation project was to prevent certain areas from flooding and to reduce the damage and loss of property caused by floods. **Fig. 2** shows the breakdown of respondents in the study area regarding their awareness of the flood mitigation plan in their region. According to the survey, 80 per cent of respondents were aware of the flood mitigation project in their area, while 20 per cent were not aware of its existence before it was explained to them.

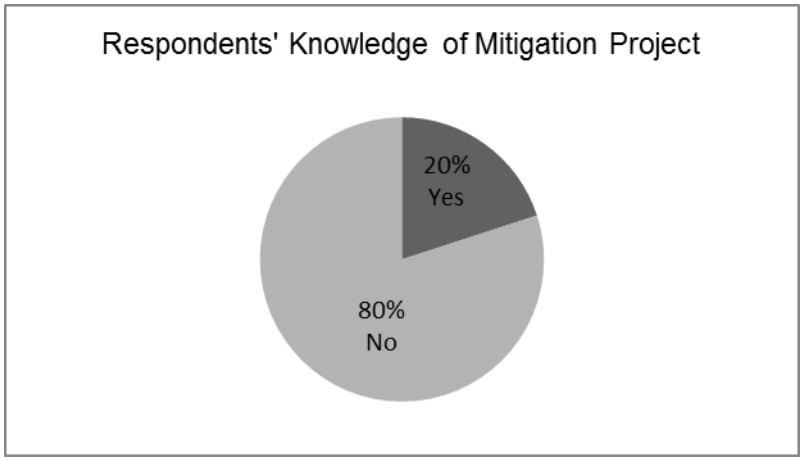

Fig.2 Respondents' Knowledge of Flood Mitigation Project

Fig. 3 shows the percentage of respondents' views on the effectiveness of the flood mitigation project in their area. According to the survey, 70 per cent of respondents answered 'Yes,' while 30 per cent answered 'No.' Those who answered 'Yes' felt that the impact and effects of flooding had decreased since the implementation of the flood mitigation project in their area. In contrast, those who found it ineffective felt that their homes were still being flooded, with some even experiencing worse conditions after the project's completion. Community perception of flood risks is vital for successful flood mitigation, as it influences the effectiveness of measures like solidarity and insurance (Brilly & Polic, 2005).

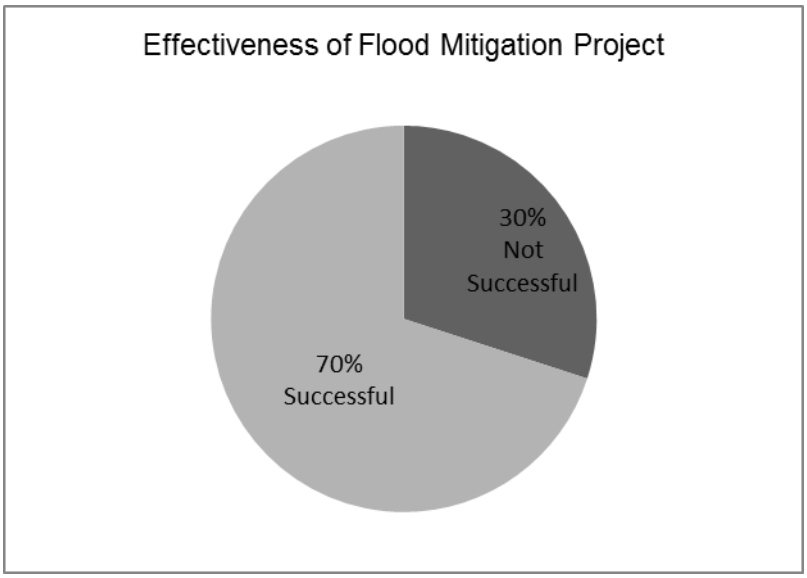

Fig. 3 Community's Perception on the Effectiveness of Flood Mitigation Project

Every project that is carried out leaves some impacts, whether good or bad, on the community and the environment. The main purpose of this flood mitigation project was to prevent floods from recurring. Citizen perceptions of flood risk are important for successful flood mitigation, as they have experienced the inconvenience of previous flood events and the development of downstream regions (Hong & Chang, 2020). Additionally, it aimed to prevent and reduce the loss and damage of public property due to floods. **Fig. 4** illustrates respondents' views on the flood mitigation project's effectiveness in reducing flood risk in their area. In this study, risk is defined as the likelihood of illness, loss of life, or property damage occurring within a system, society, or population over a specific period and is a calculated probability based on danger, exposure, and capability (Ramli et al., 2021). According to the survey, two respondents found it very satisfactory, and 38 respondents found it satisfactory. These respondents felt that their areas or homes were not as flooded as compared to the previous flood events. However, three respondents found it very unsatisfactory, and 26 found it unsatisfactory, feeling that their homes flooded more quickly than before. Some even experienced worse flooding conditions than before. The remaining 11 respondents felt that there was no change, as their homes continued to be flooded as usual, with no significant difference between the floods before and after the project's implementation.

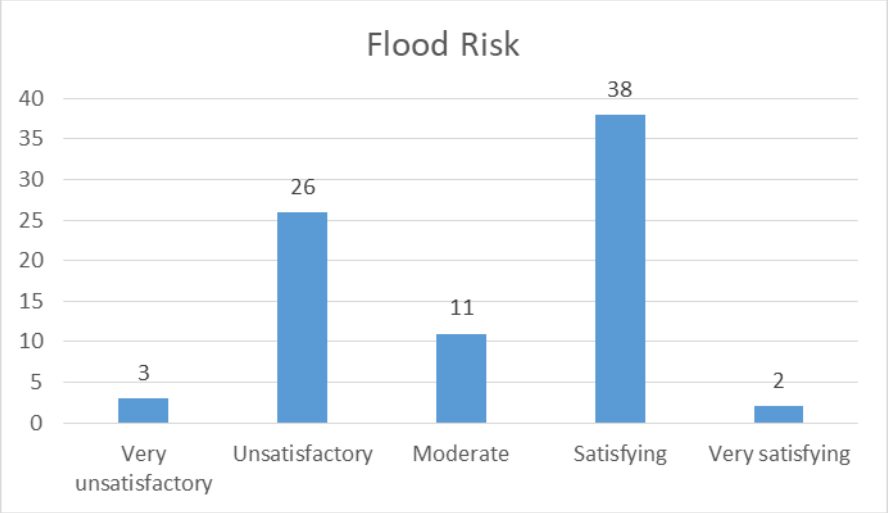

Fig. 4 Perception of Flood Risk Impact

Another aspect examined was the impact of the loss and damage of property due to floods after the flood mitigation project was implemented. Extreme flooding events can cause loss of life and significant destruction to property and infrastructure, while small floods can have neutral or positive effects on certain ecosystems (Talbot et al., 2018). According to the survey, one respondent found it very satisfactory, and 38 respondents found it satisfactory. After the 2017 floods, which occurred after the flood mitigation project was completed, some flood victims did not suffer severe property damage as before. Half of the respondents were satisfied with the project, noting a difference in property loss between before and after the project's completion. However, two respondents found it very unsatisfactory, and 19 found it unsatisfactory, as they still experienced property loss and damage, especially to household furniture (**Fig. 5**).

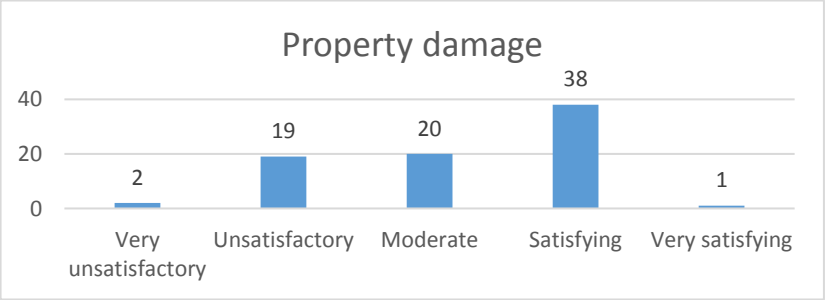

Fig. 5 Perception on the Impact on Property Damage

The next factor examined in this study was the river water level after the river widening and deepening work. **Fig. 6** shows respondents' satisfaction levels with the impact of the flood mitigation project based on the river water level. The result shows that 38 respondents found it unsatisfactory, while one respondent found it very unsatisfactory. Respondents were dissatisfied because the water level was too shallow during non-rainy seasons and worsened during the dry season. Additionally, nine respondents felt there was no impact, 24 found it satisfactory, and eight found it very satisfactory. They stated that the consistently shallow river water level reduced the likelihood of flooding in their area. According to Kono et al. (2020), river deepening affects aquatic organisms' biomass distribution and alters the river's water depth and velocity.

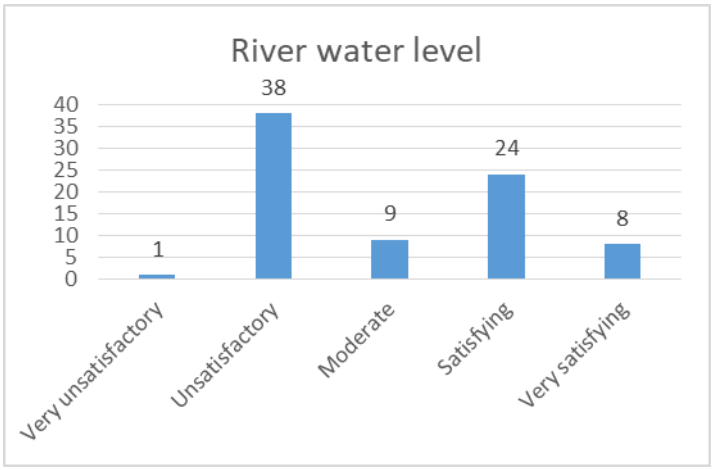

Fig. 6 Perception on the Impact on River Water Level

Moreover, the impact on the ecosystem was also surveyed to gather feedback from respondents. The flood mitigation project, completed in 2015, had undoubtedly affected the ecosystem in the Segamat River. **Fig. 7** shows respondents' satisfaction levels with the impact of the project on the Segamat River ecosystem. According to the survey, 14 respondents were very dissatisfied, and seven were dissatisfied. Respondents noted a significant decrease in fish and shrimp populations in the Segamat River. Many respondents stated that the number of fish and shrimp had decreased even during the flood season. Before the flood mitigation project, flood victims would supplement their income by catching fish trapped by the floodwaters. Studies have shown that flood mitigation projects, such as levees, dams, and channel modifications, can alter river ecosystems by disrupting natural flow regimes, reducing habitat complexity, and impeding the movement and reproduction of aquatic species (Nilsson & Berggren, 2000). These changes can lead to a decline in fish and shrimp populations due to the loss of floodplain habitats that are critical for spawning and feeding (Kuiper et al., 2014). However, during the most recent flood, the number of fish caught had significantly decreased. Based on the survey, 37 respondents found it very satisfactory, and 20 found it satisfactory. These respondents were not involved in activities related to the Segamat River and felt that the flood mitigation project was worthwhile because it reduced the flood impact in their area.

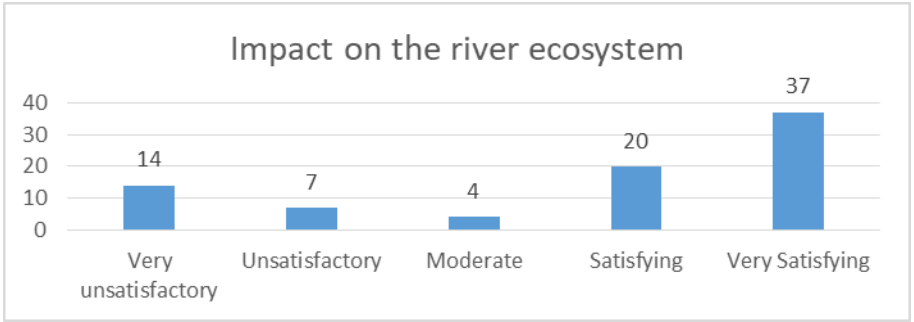

Fig. 7 Perception on the Impact on River Ecosystem

Impact of Flood Mitigation on Fisherman

The results indicate that fishermen were the most affected group by the flood mitigation project on the Segamat River. Although the number of fishermen in the area is small, this community was the most significantly impacted by the flood. Tables 2 and 3 show the satisfaction levels of respondents working as fishermen.

Table 2 illustrates the fishermen's satisfaction with the impact of the flood mitigation project on the river ecosystem. The results show that six fishermen expressed a very unsatisfactory perception of the impact of the river ecosystem, while six others expressed an unsatisfactory perception. This is due to the reduced number of fish and shrimp in the Segamat River, which has affected their income sources. Since the flood mitigation project has a big effect on fishermen, it is important to look into other options that restore the fish populations and help them make a living. For example, habitat restoration projects, like restoring natural riverbanks, can help fish and shrimp populations. Regular checking can help with improving water quality and limiting pollution from waste from farms and cities. Lastly, encouraging environmentally friendly fishing methods can stop overfishing and help fish stocks to recover.

Table 2. Fishermen's Perception on the Impact on River Ecosystem

Job	**Fisherman**	
Impact	**Full time**	**Part-time**
Very unsatisfactory	2	4
Unsatisfactory	2	4
Moderate	0	0
Satisfying	0	0
Very Satisfying	0	0

Table 3 highlights the impact of the flood mitigation project on the fishermen's income. Overall, six respondents stated that they were very dissatisfied, and another six were dissatisfied. The number of fish and shrimp has decreased, and some fish species have become increasingly rare. Based on Santos et al. (2017), the river construction led to significant water quality changes, causing severe declines in native fish species and the invasion of exotic species and affecting benthic macroinvertebrate assemblages. The study area identified 12 fishermen, but only four fish regularly, while eight fish on a part-time basis. These eight part-time fishermen have switched to rubber tapping. Thus, it is probable that due to the difficulty in obtaining as much catch as before, these fishermen have to change their primary occupation to rubber tapping, with fishing as a secondary activity. The surveyed fishermen expressed concern because the size of the fish caught is also getting smaller, and the overall catch is declining. In terms of the ecosystem, the flood mitigation project has disrupted the ecosystem in the Segamat River. The habitats of fish in the Segamat River have been disturbed, leading to a reduction in the number of fish and shrimp in the area.

Table 3. Opinion on the Impact on Income

Job	**Fisherman**	
Income	**Full time**	**Part-time**
Very unsatisfactory	1	5
Unsatisfactory	3	3
Moderate	0	0
Satisfying	0	0
Very Satisfying	0	0

Conclusion

Overall, there has been a positive change in flood risk following the completion of the flood mitigation project in this area. In Segamat, more areas are no longer experiencing flooding. In the study area, the satisfaction levels regarding flood risk and property damage range from moderate to satisfactory. Nearly nine years after the flood mitigation project was implemented, there are positive effects on the community. However, concerns remain about the affected ecosystem in the Segamat River. The number of aquatic lives, such as fish and shrimp, has decreased compared to before. Satisfaction levels also range from unsatisfactory to moderate. Besides, the government should also plan new mitigation with the current situation, such as climate change factors. The disaster events in Malaysia in 2021 highlight the necessity for local-level disaster risk assessments to better understand and address the increased exposure of communities and organisations due to climate change-induced extreme event (Ramli et al., 2023). This issue needs to be addressed to prevent more severe problems, as it will also affect the fishermen's sources of income.

Co-Author Contribution

The authors confirmed that there is no conflict of interest in this article. Author 1 carried out the fieldwork and prepared the literature review. Author 2 wrote the research methodology and did the statistical analysis and interpretation of the results. Author 3 proofread and revised the study while also contributing insights into it.

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