E-ISSN 3048-152X Vol. 1, Issue 2 (2024)
Doi: https://doi.org/10.37899/mjdpp.v1i2.73

Moccasin Journal De Public Perspective

Public Perception of Flood Mitigation Projects in the Coastal Villages

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Article Info

Article History:
Received: 18 April 2024
Revised: 21 May 2024
Accepted: 24 June 2024

Keywords:
Flood Mitigation
Community
Participation
Social Factors
Cultural Sustainability

Abstract

This study examines community perceptions of flood mitigation projects in the coastal villages of Dumai, Riau Province, Indonesia, with a focus on how social, cultural, and economic factors influence participation and perceived effectiveness. A qualitative approach was employed using semi-structured interviews, focus group discussions, and field observations involving 25 participants selected through purposive sampling. Data were analyzed using thematic analysis to identify key patterns and relationships. The findings reveal that while structural mitigation measures, such as embankments and drainage systems, have reduced flood intensity, their long-term effectiveness is constrained by inadequate maintenance, unequal distribution of benefits, and limited community involvement. Community participation emerges as a critical mediating factor that shapes both the sustainability and acceptance of mitigation efforts. Furthermore, social cohesion, cultural compatibility, and economic capacity significantly influence how communities engage with and evaluate these projects. The study contributes to the literature by proposing an integrated conceptual framework that links contextual factors, participation, and perceived effectiveness in a coastal setting. The results suggest that flood mitigation strategies should adopt a more inclusive, culturally sensitive, and economically sustainable approach to enhance resilience in vulnerable coastal communities.

INTRODUCTION

Flooding is widely recognized as one of the most recurrent and destructive natural hazards affecting coastal regions worldwide, particularly in developing countries with high exposure to climate variability and rapid urbanization. In Indonesia, coastal cities such as Dumai in Riau Province experience increasing flood risks due to a combination of environmental and anthropogenic factors, including sea-level rise, land subsidence, deforestation, and inadequate urban planning (Chirayu et al., 2021; Mulyadi & Hamidy, 2021). These compounded pressures have intensified the frequency and severity of flooding events, posing significant threats not only to infrastructure and economic activities but also to social stability and environmental sustainability. Consequently, flood mitigation has become a critical policy priority,

requiring integrated approaches that combine engineering solutions with social and institutional interventions.

Recent sources emphasize that the efficiency of flood mitigation techniques is not only defined by technical design or infrastructural sufficiency, but also by the level of acceptance, support, and maintenance of local communities (Caillot et al., 2022; Weible et al., 2020). The social perception contributes significantly to the effectiveness of the disaster risk reduction programs since the community members are the beneficiaries and the implementers of such programs. Environmental governance studies highlight that local acceptance leads to a higher rate of compliance, a higher rate of participation, and, finally, to the sustainability of the mitigation measures in the long-term (Yang et al., 2023). Thus, it is imperative to comprehend the community perception of flood mitigation projects to develop effective and inclusive policies.

Nevertheless, even amid the increasing appreciation of the significance of community-centered solutions, numerous flood mitigation initiatives remain to be executed on the basis of top-down governance, whereby the decision-making procedures are largely controlled by the central authorities with little local involvement. These methods tend to overlook local knowledge, overlook socio-cultural nuances, and marginalize vulnerable populations, leading to poorer outcomes and a lack of community ownership (Castro & Vanclay, 2020). Applying this to the situation in Dumai, where livelihoods are deeply entrenched in seaside ecosystems like fisheries and small-scale agriculture, the dissonance between policy design and local realities can serve as a significant source of irrelevance and ineffectiveness of flood mitigation interventions.

Moreover, although governments have been working at both structural (i.e. sea walls, embankments, and drainage systems) and non-structural (i.e. early warning systems and public awareness campaigns) levels (Rogers, 2021; Titko et al., 2021), there is still a significant void in assessing the perceptions of these measures by local populations. Several factors impact the way in which people perceive it, such as trust in government institutions, previous experiences of disasters, and the perceived fairness of resource allocation (Akimova et al., 2020). Mitigation efforts may end up being socially controversial but technically sound without integrating these dimensions.

Past research has suggested that participatory methods can be a feasible remedy towards improving the efficacy of disaster risk reduction. The disaster management frameworks that are community-based focus on the involvement of local stakeholders in the planning, implementation, and evaluation procedures, which additionally contributes to the sense of ownership and responsibility (Geekiyanage et al., 2020; Kristian and Ikhsan, 2024). It has been empirically indicated that active communities are likely to have projects that are more adaptive, culturally suitable and long term continuing. Additionally, the incorporation of ecological knowledge in traditional ecology in contemporary mitigation plans has been revealed to enhance contextuality and resilience (Sharifian et al., 2022; Hadlos et al., 2022; Jakes, 2024; Adefila et al., 2024).

Besides participation, social-economic and cultural factors are becoming known to be key determinants of the perception of the population. Poorer communities might be less likely to participate in mitigation initiatives due to their short-term economic needs that are prioritised over long-term projects (Mills et al., 2020; Ahmad and Afzal, 2020). The same way, cultural values and traditional practices may affect communities in the interpretation and response towards infrastructural interventions. Flood mitigation projects can be viewed as disruptive in communities that, in places such as Dumai, cultural identity is strongly tied to the marine and

land-based practices, and such projects do not correspond with the existing practices (Nara and Zevenbergen, 2021; Bhagarathi and DaSilva, 2024). These observations highlight the importance of comprehensive strategies to consider social, cultural, and economic environments.

Nevertheless, even with the growing literature on the topic of community participation and disaster management, there are gaps in research. The majority of available research is related to urban or large metropolitan regions like Jakarta and Semarang, and little attention is paid to smaller cities of the coast, like Dumai (Saputra et al., 2021; Dewa et al., 2022; Suwarlan et al., 2022). Moreover, even though previous studies recognize the significance of participation, they tend to ignore the problem of social exclusion and power relations that determine who participates and whose voices are listened to. Empirical research to investigate the interaction of cultural and economic forces to shape the perception of people about disasters in the coast is also lacking.

This research fills these gaps by offering a thorough analysis of the perception of the people about flood reduction intervention in the coastal villages of Dumai, Riau Province. It particularly looks at the extent to which social inclusion, compatibility of cultures and economics influence the community reactions to mitigation activities. A qualitative approach will bring about subtle perceptions of the experiences, expectations, and concerns of the residents and provide a better picture of the human aspects of disaster risk reduction.

This study is novel as it combines social, cultural, and economic factors analysis in a coastal setting which has been less discussed in terms of scholarship. In contrast to the earlier studies where the key topic is a general concept of participation, this study emphasizes the process of exclusion, the contradictions between modern infrastructure and traditional practices, and the issues of economic sustainability of flood mitigation activities. It is hoped that the findings would be used in theoretical and practical discussions about community-based disaster management and offer policy-specific recommendations regarding more inclusive and context-specific flood management strategies. The end goal of the study is to contribute to the creation of resilient coastal community through the translation of technical interventions and the reality on the ground.

METHODS

The research design used in this study was qualitative to investigate the perceptions of the people towards flood mitigation projects in the coastal villages of Dumai in the Riau Province in Indonesia. A qualitative method was considered suitable because it enables one to understand their experiences, interpretations, and social realities surrounding flood mitigation efforts in a more in-depth manner. The research was informed by a constructivist paradigm that focuses on how people create meaning through their engagements with both environmental and social environments.

The study was carried out in a number of coastal villages in Dumai that are prone to flooding, and where flooding and mitigation efforts are frequent. Purposive sampling was used to select the participants and only those participants with first hand experience of flood events and mitigation projects would be included. The inclusion criteria were that the participants should have lived in the study area at least five years and be exposed or involved in local flood mitigation measures. The sample size was 25 individuals who were recruited as they represented a wide variety of demographic backgrounds in terms of age, gender, occupation, and socio-economic status.

Semi-structured interviews and focus group discussions (FGDs) were used to collect data. The development of the interview guide was guided by the existing literature on

disaster risk reduction, perceptions and participation by the community. It involved open-ended questions which covered the knowledge of the participants about the flood mitigation projects, their participation in the same, their perceived effectiveness, social, cultural, and economic impacts of such interventions. Semi-structured interviews provided flexibility to the participants to talk further about their experiences but provided uniformity in important areas.

Besides one-on-one interviews, two focus group discussions of six or eight people were performed. Collective views were captured through FGDs, which facilitated interaction between the respondents and helped in finding out common or divergent views within the community. These discussions had complementary information to the one-on-one interviews, especially the information on the social processes and the community-level reactions. Field observations were also conducted to put the data into context, including environmental conditions, preexisting mitigation infrastructure and community-based activities concerning flood management.

All participants had informed consent and all interviews and discussions were tape recorded to be accurate. The recordings were transcribed word to word and the field notes were also put together to assist in the interpretation of the data. Thematic analysis was used to analyze data and the process was inductive and iterative. First, open coding was done to find meaningful units of data. These codes were further summarized into larger categories and narrowed down into 3 major themes that describe the overall findings of the study: (1) perceived effectiveness of flood mitigation projects, (2) community participation and involvement, (3) social, cultural and economic factors that have a bearing on perceptions and engagement.

To achieve this consistency in the process of analysis, the comparison was done continuously across data sources, such as interviews, FGDs, and observations. NVivo software was employed to help in the organization, coding and management of qualitative data to improve the analytical rigor and transparency. The last themes were created by refining and refining, making sure that they reflected the experiences of the participants and were based on the data.

In order to achieve credibility and trustworthiness of the findings, a number of validation strategies were used. Triangulation was realized through the combination of several sources and approaches of data. Member checking was done by posting initial interpretations with a sample of the participants in order to confirm the validity of the findings. Also, peer debriefing was implemented with colleagues with experience in qualitative research to check the coding process and thematic development. These actions increased the reliability, validity and the rigor of the study.

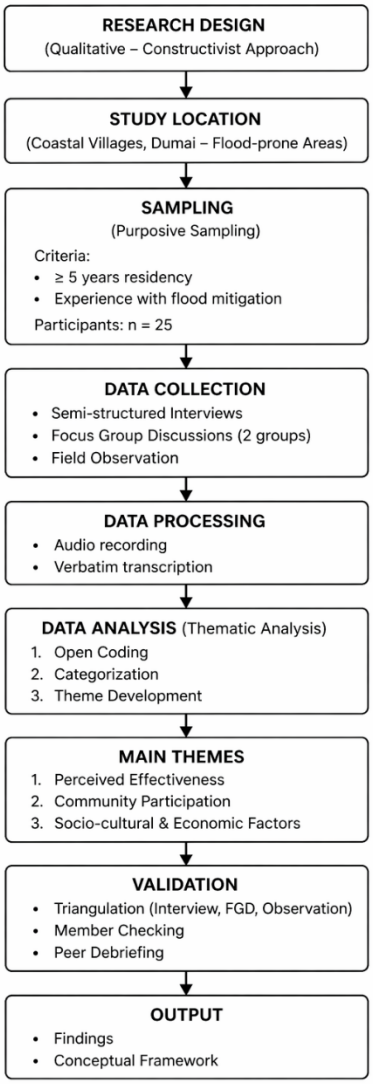

Figure 1. Research Framework of Flood Mitigation Study in Coastal Areas

Source: Author's elaboration (2024)

This framework demonstrates the systematic flow of qualitative research using a constructivist approach, starting with determining the research design and developing findings and a conceptual framework. The research process begins with location selection and purposive sampling techniques, followed by data collection through interviews, focus group discussions (FGDs), and observations. The data obtained is processed through recording and transcription, then analyzed using thematic analysis to identify key themes. Furthermore, the research results are validated through triangulation, member checking, and peer debriefing to ensure data validity.

RESULTS AND DISCUSSION

In coastal areas such as Dumai, Riau Province, flood risks are a persistent threat to livelihoods, infrastructure, and cultural practices. Flood mitigation efforts often require significant financial, social, and technical investments, making community participation and support crucial for their effectiveness. However, perceptions of these projects are influenced by various factors, including social inclusion, cultural relevance, and economic sustainability. By examining the views of local residents, this study aims to provide insights into the challenges and successes of flood mitigation projects, highlighting the role of community engagement and local

dynamics in shaping their outcomes. The findings discussed below reflect these complex relationships and offer a detailed understanding of how public perception impacts the long-term sustainability of such initiatives.

The thematic analysis of interview, focus group discussion, and observational data resulted in three major themes: (1) perceived effectiveness of flood mitigation projects, (2) community participation and involvement, and (3) social, cultural, and economic factors shaping public perception. Each theme comprises several interrelated sub-themes that reflect the complexity of community experiences and evaluations of flood mitigation initiatives in the coastal villages of Dumai, Riau Province.

Perception of Flood Mitigation Effectiveness

Flood mitigation efforts in the coastal villages of Dumai, Riau Province have contributed to reducing the severity of flooding; however, their effectiveness remains uneven and often temporary. Many residents acknowledged that infrastructure such as embankments and drainage systems has helped control water levels, particularly during moderate rainfall. These improvements have increased the sense of safety among residents and reduced immediate damage to homes and livelihoods. However, these benefits are not consistently experienced across all areas, especially during heavy rainfall or in locations with poor infrastructure maintenance.

This situation becomes more apparent when residents describe their direct experiences with the implemented projects. While some acknowledged improvements, they also emphasized that flooding has not been fully resolved and continues to disrupt their daily lives. One participant explained that,

> *"Since the embankments were built, the flooding is not as severe as before, especially during normal rainy days. We feel safer because the water does not rise as quickly as it used to. But when the rain is very heavy or lasts for many hours, the water still comes into our area, and sometimes it even reaches our houses again."*

This experience was echoed by other residents who noted that the improvements are conditional and not always reliable. Another participant stated that,

> *"Before the project, the water would enter our homes very quickly, and we had almost no time to prepare. Now it is a bit better because the water rises more slowly, so we can move our belongings. But flooding still happens, especially when the drainage cannot handle the volume of water."*

These accounts indicate that while structural mitigation measures provide noticeable improvements, they do not fully eliminate the risk, particularly under extreme weather conditions.

The situation is further complicated by the lack of proper maintenance of existing infrastructure. Many residents highlighted that drainage systems, although initially effective, have gradually lost their function due to waste accumulation and the absence of routine management. This issue significantly reduces the long-term effectiveness of the mitigation efforts and contributes to recurring flooding. One resident explained that,

> *"At the beginning, the drainage system worked very well, and we could see the difference immediately. But over time, people started throwing garbage into the drains, and no one came to clean them regularly. Now, when it rains, the water cannot flow properly, and flooding happens again in the same places."*

This concern was reinforced by another participant who emphasized the absence of coordination between authorities and the community, stating that,

> *"We already have the infrastructure, but there is no follow-up after it is built. There is no regular cleaning, no monitoring, and no clear responsibility. Without proper maintenance, even good infrastructure becomes useless after some time."*

These findings suggest that the sustainability of flood mitigation projects is highly dependent not only on physical construction but also on continuous maintenance and collective responsibility.

In addition to technical limitations, residents also highlighted inequalities in the distribution of flood mitigation benefits. Those living in peripheral areas reported that they continue to experience frequent flooding and receive less attention compared to central parts of the village. This uneven distribution has created dissatisfaction and a sense of neglect among affected communities. One participant from an outer area stated that,

> *"Most of the projects are focused on the central part of the village where it is more visible. In our area, flooding still happens almost every time it rains heavily, and we rarely see any improvements. It feels like our situation is not considered important."*

This issue was echoed by other residents who felt excluded from both planning and decision-making processes. Another participant explained that,

> *"We are the ones who are most affected by the floods, but we are rarely invited to meetings or discussions. Decisions are made without asking us, so sometimes the solutions do not match the actual problems we face."*

These perceptions highlight that beyond technical effectiveness, issues of inclusivity and fairness play a critical role in shaping public evaluation of flood mitigation projects.

Community Participation and Involvement

Community participation emerged as a crucial factor influencing the success and sustainability of flood mitigation projects in the coastal villages of Dumai. While some residents reported being actively involved in certain stages of the projects, particularly during implementation, participation was not evenly distributed across the community. In many cases, involvement was limited to specific groups, such as local leaders or residents living in central areas, while others were excluded from the process. This uneven participation has implications for both the effectiveness of the projects and the level of community ownership.

This condition is reflected in the experiences of residents who were directly involved in project activities. Some participants described how their involvement in construction and maintenance activities increased their sense of responsibility toward the infrastructure. One participant explained that,

> *"We were involved when the project started, especially in building the embankments and cleaning the drainage areas. Because we participated directly, we felt responsible for taking care of the infrastructure. It also made us understand how the system works and why it is important."*

This positive experience suggests that participation can enhance community ownership and long-term commitment. However, such involvement was not experienced by all residents. Some participants reported that they were not included in the planning stages and only became aware of the projects after implementation had already begun. One resident stated that,

> *"I only heard about the project after the construction had already started. Nobody came to ask for our opinions, even though our area is also affected by*

flooding. If we had been involved earlier, maybe the results would be more suitable for our needs."

This indicates that participation was often limited to implementation rather than inclusive decision-making, reducing the opportunity for communities to contribute their knowledge and perspectives.

Communication barriers were also identified as a significant challenge affecting participation. Information regarding meetings, planning processes, and project activities was not always disseminated effectively to all members of the community, particularly those living in more remote or peripheral areas. One participant explained that,

"People who live in the center of the village usually know about meetings and project plans, but those of us who live farther away often do not receive the information. Sometimes we only find out after decisions have already been made."

This issue was further reinforced by another resident who emphasized the lack of transparency in communication, stating that,

"There should be better communication between the authorities and the community. Many people actually want to participate, but they don't know when or how to get involved. Without proper information, it is difficult for us to contribute."

These findings suggest that improving communication channels and ensuring inclusive participation are essential for strengthening community engagement and enhancing the effectiveness of flood mitigation projects.

Social, Cultural, and Economic Factors

Social, cultural, and economic conditions play a significant role in shaping how communities perceive and engage with flood mitigation projects in the coastal villages of Dumai. These factors influence not only participation levels but also the acceptance and sustainability of the implemented interventions. The findings reveal that community responses to flood mitigation efforts cannot be separated from their social relationships, cultural values, and economic realities. To further explain the relationships identified in the findings, this study proposes a conceptual framework as illustrated in Figure 2.

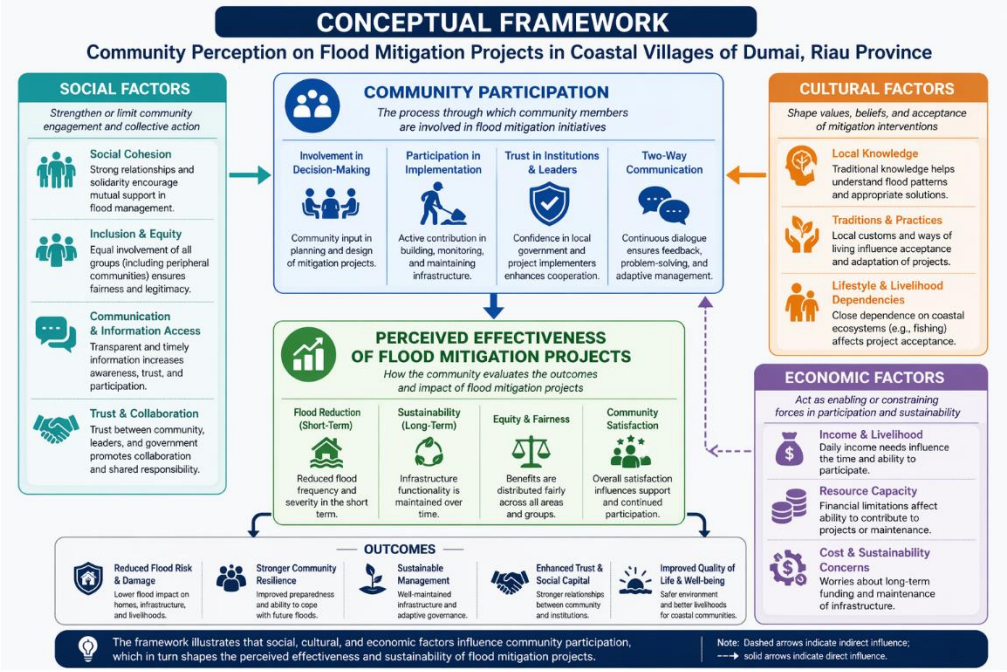

Figure 2. Conceptual Framework of Community Perception on Flood Mitigation

Source: Author's conceptualization based on thematic analysis of interview and FGD data

The framework has shown that the social factors like community cohesion and inclusion have a direct effect on the extent of involvement in flood mitigation programs. Increased trust and enhanced social networks are more likely to enhance engagement and collective responsibility. Participation, in its turn, mediates the perception of the effectiveness of flood mitigation projects by communities, especially regarding their sustainability and equity.

Interpretation and acceptance of interventions are influenced by cultural factors such as traditional knowledge and practices in the area. Mitigation strategies that are in line with the local cultural values have higher chances of being supported and sustained by the community. On the other hand, the lack of alignment can cause opposition or lack of participation. Economic factors are enabling and limiting factors. Although better flood control can improve livelihoods, the limited financial capacity limits community involvement and is an issue of sustainability in the long term. Thus the economic conditions have an effect of participation and perception at the same time. Socially it is observed that the better the community connections, the easier it is to cooperate and take collective action especially when dealing with flooding. A significant number of residents highlighted the significance of unity and support in addressing environmental issues. One participant explained that,

> *"We have lived here for many years and experienced floods together, so when something happens, we usually help each other. During the projects, people worked together, especially in cleaning and preparing the area, because we all know how serious the flooding can be."*

However, not all residents experienced the same level of inclusion. Newcomers or individuals with weaker social connections reported difficulties in participating in community activities. One participant stated that,

> *"I am relatively new in this area, so I don't feel fully included in community discussions. Most decisions are made by people who have lived here longer, and sometimes it is hard for us to express our opinions."*

This indicates that social dynamics can both support and limit participation, depending on an individual's position within the community.

Cultural factors also influenced how residents perceived flood mitigation projects. Many participants emphasized the importance of local knowledge and traditional practices in understanding flood patterns and managing risks. They expressed concern that these aspects were not fully considered in project planning. One resident explained that,

> *"We have our own ways of understanding the environment because we have lived here for generations. We know when the floods will come and which areas are most affected. But sometimes the projects do not take this knowledge into account."*

This concern was echoed by another participant who highlighted the potential impact of mitigation measures on traditional livelihoods, stating that,

> *"Some of the projects are helpful, but we are also worried about how they affect our daily activities, especially fishing. The sea and the land are part of our lives, so any changes can affect how we work and live."*

These findings suggest that cultural compatibility is an important factor in determining the acceptance of mitigation strategies.

Economic conditions were also identified as a key factor influencing participation and perception. Many residents in the study area depend on daily income from activities such as fishing and small-scale trade, which limits their ability to engage in community-based initiatives. One participant explained that,

> *"We want to participate in community activities, but we also have to work every day to support our families. If we spend too much time on meetings or activities, it affects our income."*

In addition, concerns were raised about the long-term sustainability of flood mitigation projects, particularly in terms of funding and maintenance. One resident stated that,

> *"The projects are good, but we are worried about what will happen in the future. If there is no budget for maintenance, the infrastructure will not last, and we will face the same problems again."*

These perspectives highlight that economic constraints not only affect participation but also shape how communities evaluate the sustainability of flood mitigation efforts.

The results of this paper indicate that the flood control initiatives in the villages of Dumai in Riau Province are partially effective, not only determined by the technical aspects of the performance but also by social, cultural, and economic factors in the community. Although structural interventions like embankments and drainage systems have helped in minimizing the intensity of floods, they are limited in the long-term because of poor maintenance, poor distribution and poor integration in the community. This reinforces the idea that engineering-based solutions are inadequate to mitigate disaster risks but should involve social aspects to be sustainable (Rogers, 2021; Titko et al., 2021).

The perceived immediate effectiveness of flood mitigation infrastructure, according to the narratives of the participants, is more consistent with existing literature that highlights that structural interventions can provide immediate protection but may not eliminate systemic resilience (Fraser et al., 2020). Residents in this study recognized the benefits on flood control but they were conditional and reduced overtime because of poor maintenance practices. This observation supports the idea

that infrastructure in itself can never be effective without institutional support and community engagement systems. According to Manzoor et al. (2022), flood management systems must be sustainable and controlled through continuous monitoring, maintenance, and adaptive governance, and not by a one-time project implementation.

One important lesson that came out of this research is the importance of maintenance as a defining factor of perceived effectiveness. Although the literature mainly concentrates on the design and implementation of the mitigation infrastructure, this study notes a gap in practical management post-implementation. The common problem of blocked drainage systems demonstrates the intersection of institutional constraints and the behavior of communities, i.e. the way people dispose of their waste. This result complements the current body of research by showing that both technical systems and everyday social practices co-produce the success of flood mitigation. In this respect, the research adds to the increasing amount of literature that recommends combined strategies that incorporate development of infrastructure with behavioral and governance-related interventions (Trogllić et al., 2022).

Moreover, the research shows that community involvement is a decisive factor that determines the effectiveness and sustainability of flood control actions. As it is in the study of Geekiyanage et al. (2020), active participation of the local communities will establish a sense of ownership and responsibility that contributes to the sustainability of the projects. Those participants who had engaged in implementation activities showed greater commitment towards sustaining infrastructure. Nevertheless, the present study transcends the current literature by establishing high inequalities of participation in the community. There are groups of people who were not involved in decision making especially those in peripheral locations as well as those with weaker social ties. This observation aligns with Sanders and Scanlon (2021), who emphasize the way structural inequalities may restrict inclusive participation, but it goes further to explain how structural inequalities occur in localized disaster management settings.

The problem of unequal participation is intertwined with communication barriers that were detected in this study. The absence of information dissemination about the project planning and implementation led to unequal community involvement. This observation highlights the significance of open and participatory communication approaches in participatory governance. Trust and collaboration among stakeholders is a key to successful policy implementation, which Weible et al. (2020) argue is essential in a complex environmental problem like flood management. The absence of inclusive communication in the present study implies that participatory frameworks should not just engage in formal inclusion but make sure that the information and decision-making processes are equally accessible to everyone.

The other significant contribution of this study is that it analyzes cultural aspects in flood reduction. Though the significance of implementing traditional ecological knowledge in disaster risk reduction has been underscored in previous research (Sharifian et al., 2022; Hadlos et al., 2022), this study reveals the friction that arises between implementing modern infrastructure interventions and local cultural practices. In Dumai, where people have a strong relationship with the coastal ecosystems due to their livelihoods, the flood mitigation projects were at times seen to interfere with the normal lifestyles. This is a new finding that adds to the current body of knowledge by showing that cultural compatibility is not just a knowledge integration, but also maintenance of socio-cultural relationships with the environment.

There are other economic factors that make community engagement and perception complicated. The results demonstrate that although the residents have realised the positive impacts of flood prevention in sustaining their living, their financial capacity restricts their engagement in community-based projects. This is supported by the earlier studies that have shown that economically vulnerable groups have trade-offs in the short-term survival necessities and the long-term risk reduction actions (Mills et al., 2020; Ahmad and Afzal, 2020; DeLuco et al., 2024). Nevertheless, this research brings some depth by demonstrating that economic constraints do not always affect the desire to participate but only limit the ability to participate. Such difference is significant in policy making that does not only offer the participation opportunities but also support mechanisms to facilitate it.

Also, the issue of the long-term financial viability of flood mitigation projects became a major concern. Respondents were unsure of the sustainability of government assistance and access to resources in maintaining infrastructure. This observation is consistent with the works of Fraser et al. (2020), who believe that the risk reduction in case of disaster necessitates long-term investment and institutional dedication to a project beyond the first stages. This study also adds to the discussion of the relevance of financial planning and continuity in governance in the context of sustainability of mitigation efforts through raising awareness of community concerns over funding and maintenance.

This study provides a more nuanced understanding of flood mitigation by integrating technical, social, cultural, and economic perspectives within a specific coastal context. Unlike many previous studies that focus primarily on participation as a general concept, this research reveals the underlying dynamics of exclusion, inequality, and contextual mismatch that influence project outcomes. It also emphasizes the interconnected nature of these factors, where technical limitations, social structures, cultural values, and economic conditions interact to shape community perceptions and responses.

The novelty of this study lies in its holistic approach to examining flood mitigation in a coastal setting that has received limited scholarly attention. By focusing on Dumai, this research fills an important geographical gap in the literature, which has predominantly concentrated on larger urban areas such as Jakarta and Semarang (Saputra et al., 2021). Moreover, the study advances theoretical discussions on community-based disaster management by demonstrating that participation, cultural integration, and economic considerations must be addressed simultaneously rather than in isolation.

These findings have important policy implications. First, flood mitigation strategies should adopt a more integrated approach that combines infrastructure development with community engagement and behavioral interventions. Second, inclusive participation mechanisms must be strengthened to ensure that all community groups, including those in peripheral areas, are involved in decision-making processes. Third, cultural considerations should be incorporated into project design to enhance local acceptance and sustainability. Finally, long-term financial planning and institutional commitment are essential to maintain the effectiveness of mitigation infrastructure.

CONCLUSION

This study demonstrates that the effectiveness of flood mitigation projects in the coastal villages of Dumai, Riau Province is not determined solely by technical infrastructure, but is strongly shaped by the interaction of social, cultural, and economic factors within the community. While structural interventions such as embankments and drainage systems have contributed to reducing flood impacts, their long-term sustainability remains constrained by inadequate maintenance,

unequal distribution of benefits, and limited community participation. The findings reveal that community participation serves as a critical mediating factor, linking contextual conditions to the perceived effectiveness and sustainability of mitigation efforts. Social cohesion enhances collective action, cultural compatibility influences acceptance of interventions, and economic capacity determines the extent of community engagement. The study contributes to the literature by providing an integrated empirical framework that highlights the interconnected nature of these factors in a coastal context that has received limited scholarly attention. From a policy perspective, the results suggest that flood mitigation strategies should move beyond purely technical approaches by incorporating inclusive participation mechanisms, culturally sensitive planning, and sustainable financial support systems. Strengthening these dimensions is essential to achieving resilient and adaptive coastal communities in the face of increasing flood risks.

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