



Resilience Analysis of Lake Lot Tawar Coastal Communities to Changes in the Maritime Environment: A Case Study in Aceh Tengah

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ABSTRACT

Changes in the maritime environment, such as ecosystem degradation, climate change and human activities, pose major challenges to coastal communities. This research aims to analyze the level of resilience of coastal communities of Lake Lot Tawar in Central Aceh District to changes in the maritime environment. The approach used in this research is a qualitative method with a case study, where primary data is obtained through in-depth interviews with local stakeholders, as well as field observations. The results show that the level of resilience of coastal communities in this region is influenced by various factors, including socio-economic conditions, government policies, and the level of public awareness of the importance of environmental conservation. Communities that have active involvement in sustainable economic activities, as well as access to information and support from government and non-government institutions, tend to be more resistant to the impacts of environmental change. The study also found a need to improve the adaptive capacity of communities through environmental education programs and adaptation skills training. In conclusion, the resilience of Lake Lot Tawar coastal communities to changes in the maritime environment can be improved through a holistic approach involving various stakeholders.

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INTRODUCTION

Lake Lot Tawar, located in Central Aceh Regency, Aceh Province, has a strategic role as a source of life and economy for the surrounding community. As an ecosystem rich in biodiversity, the lake provides a source of clean water for domestic and irrigation needs, in addition to being a center for the local fisheries and tourism sectors. However, in recent years, environmental pressures on Lake Lot Tawar have increased significantly due to climate change and

human activities, which have a direct impact on coastal communities.

The last few years have shown a decline in water quality in Lake Lot Tawar triggered by increased pollution from domestic and industrial waste. According to the latest data from the Aceh Environmental Service (2022), the level of chemical pollution in the lake has increased, mainly due to uncontrolled disposal of household, agricultural and industrial waste. Increased phosphate and nitrate substances cause eutrophication, which has an impact

on reducing oxygen levels in the water and reducing the survival of various fish species that are the main source of livelihood for the local community.

In addition to water pollution, overfishing practices are also a serious threat. A study by Syiah Kuala University (2023) shows that the fish population in the lake has decreased by almost 30% in the last five years due to overfishing and invasion of foreign species. The impact of this population decline is very pronounced for traditional fishermen who depend on the lake to meet their daily needs. The decline in fish catches affects their economic stability and adds to the economic burden on coastal communities.

Climate change is further worsening conditions in Lake Lot Tawar, with rising water temperatures and changes in rainfall patterns affecting lake conditions. Data from the Meteorology, Climatology, and Geophysics Agency (BMKG) shows that irregular rainfall causes flooding during the rainy season and a decrease in water volume during the dry season. This condition not only threatens the lives of biota, but also damages coastal infrastructure and hinders people's access to clean water.

Socio-economically, coastal communities around Lake Lot Tawar face major challenges in maintaining their livelihoods amidst the changes that are occurring. In addition to declining fish catches, the tourism sector around the lake is also affected by this environmental degradation. The decline in the quality of the lake's water and the decline in tourist attractions reduce the number of visitors, which results in decreased income from the tourism sector. This has the potential to increase the socio-economic vulnerability of communities, especially those who depend on income from the tourism sector.

In facing this threat, a strong resilience strategy is needed from coastal communities. Communities around Lake Lot Tawar need to be empowered with sustainable knowledge and practices that support lake conservation. Efforts to increase resilience can include environmental education, training in environmentally friendly fishing techniques, and the development of alternative livelihoods that do not depend on the lake ecosystem. Collaboration between government, academics, and community organizations is key to providing the necessary support for these communities.

Data shows that some coastal communities have begun to make local adaptations, such as the use of better waste management methods and the formation of community-based fishing groups to maintain the ecosystem. However, these efforts are still limited and require broader and more sustainable support. This research is expected to help design more effective policies and interventions to increase the resilience and adaptation of coastal communities around Lake Lot Tawar.

This research has important significance for exploring existing resilience strategies and identifying areas that require further support. With the increasing ecological and economic vulnerability of coastal communities due to environmental pressures in Lake Lot Tawar, this study is expected to provide an in-depth picture of the adaptive capacity and needs of local communities, as well as recommend more appropriate mitigation measures.

METHOD

This research methodology, which focuses on literature review, provides a strong foundation for understanding community resilience in the coastal area of Lake Lot Tawar. With a systematic approach in data collection, analysis, and presentation, this study is expected to provide significant contributions in observing the conditions of maritime communities living in coastal areas and relevance in the field of marine environmental studies..

RESULTS AND DISCUSSION

A. Profile of the Coastal Community of Lake Lot Tawar

The community living around Lake Lot Tawar has a unique and diverse profile in terms of demographics, economy, and socio-culture. Demographically, the majority of the population consists of the Gayo ethnic group who have their own unique culture and traditions, such as the Gayo language used daily. The population in this area is relatively small compared to other coastal areas in Aceh, but they have strong ties to their ancestral lands and the surrounding environment. The coastal community of Lake Lot Tawar is dominated by farming and fishing families who have long settled in the area, maintaining a simple lifestyle that has been passed down from generation to generation.

Economically, the coastal community of Lake Lot Tawar is highly dependent on the agriculture and fisheries sectors. Agriculture is the main livelihood, with rice and coffee as superior commodities grown on land around the lake. In addition, many residents depend on fishing activities for their livelihoods, utilizing the lake's resources to catch fish that are sold in local markets or consumed themselves. However, limited access to modern technology and adequate economic infrastructure often hampers their economic growth, causing the local economy to remain relatively lagging behind other areas in Aceh.

Meanwhile, in terms of socio-culture, the coastal communities of Lake Lot Tawar maintain the traditions and customs inherited from their ancestors. These traditions include various traditional ceremonies, such as kenduri laut or harvest rituals carried out to show gratitude for the abundant natural resources. These

traditional activities not only strengthen social ties between residents, but also preserve the distinctive cultural identity of the Gayo community. Although there has been influence from outside cultures along with the development of the times, coastal communities continue to maintain and respect traditional values that are the foundation of their social life.

The community's dependence on the resources of Lake Lot Tawar is very high, especially in terms of fisheries and clean water sources. Lake water is not only used as a source of irrigation for agricultural land, but also as a source of drinking water and other household needs. This lake also provides fish as an important source of protein for the surrounding population. The high dependence of the community on this lake shows that any change or degradation of the lake's environment can have a direct impact on their lives, both in terms of economy and health. Therefore, the sustainability and preservation of the Lake Lot Tawar ecosystem is a very crucial issue for the local community.

Several studies have highlighted the importance of Lake Lot Tawar for the surrounding community, both in terms of economic and ecological resources. For example, a study conducted by Hidayat et al (2018) showed that overexploitation of fish resources and water pollution pose serious threats to the sustainability of the lake. Therefore, a more sustainable resource management policy is needed so that the coastal communities of Lake Lot Tawar can continue to meet their living needs without damaging the lake environment. Community involvement in sustainable conservation and management programs is essential to ensure that the lake's resources can be utilized by future generations.

B. Maritime Environmental Change

Lake Lot Tawar, located in Central Aceh, is one of the most valuable natural gifts for the surrounding population. However, in recent years, this area has experienced significant changes in the environment, which have a direct impact on people's lives. Research conducted by Yulianda et al. (2020) revealed that these environmental changes not only affect the ecosystem but also have serious implications for the welfare of the local community.

This lake acts as the main source of clean water and is a vital place for fishing and agricultural activities, which are the main sources of livelihood for local residents. However, increasing ecological pressure due to various factors has threatened the sustainability of these resources.

Changes that have occurred in Lake Lot Tawar include declining water quality, changing weather patterns, and damage to the aquatic ecosystem. According to Nasution (2018), one of the main causes

of pollution is domestic waste and agricultural residues that pollute the lake, which have a direct impact on water quality. In addition, the sedimentation process due to erosion also worsens this condition. In the context of climate change, extreme weather phenomena such as sudden heavy rains further worsen environmental conditions in the lake. This poses a major challenge for communities that rely heavily on the lake ecosystem for their daily lives.

This condition is increasingly pressing because many people depend on the fisheries and agriculture sectors for their livelihoods. Research by Rachman et al. (2021) revealed that fishermen now have to travel further to get fish, increasing operational costs and reducing productivity. On the other hand, farmers also have difficulty managing irrigation, which previously relied on water supplies from the lake. Therefore, this environmental change not only has an impact on water quality, but also affects the livelihoods of the community as a whole.

The economic impact of environmental change in Lake Lot Tawar is very real. Local people who mostly work in the fisheries and agriculture sectors feel the consequences of the decline in water quality directly. Research conducted by Rachman et al. (2021) shows that the decline in fish catches has resulted in a drastic drop in fishermen's income. In many cases, fishermen are forced to look for other jobs to meet their daily needs, which of course reduces their competitiveness and skills in the fisheries sector.

Meanwhile, farmers also face decreased productivity due to difficulties in obtaining clean water for irrigation. According to data from the Central Statistics Agency (2021), there has been a decrease in harvest yields of up to 30% in several main commodities, caused by climate change and deteriorating water quality. This not only affects farmers' incomes, but also the food security of local communities. With increasingly limited resources, people are forced to buy food from outside the region at much higher prices. This economic impact also spreads to the local service and trade sectors. With decreasing community incomes, their purchasing power for goods and services is also eroded, which has an impact on small and medium businesses around the lake. This decline in economic activity has the potential to increase unemployment and poverty rates in the area. Therefore, it is very important to carry out interventions that can address this problem sustainably.

In addition to the economic impact, health problems due to environmental changes in Lake Lot Tawar also need serious attention. Water contamination caused by domestic waste and other pollution can trigger various health problems for the community. According to research conducted by Fadli et al. (2019), the health risks that arise from direct interaction with

contaminated water are very high, especially for vulnerable groups such as children and the elderly. Some common health problems include skin diseases, respiratory infections, and digestive disorders.

Not only that, the increasing cost of treatment due to diseases caused by water contamination makes families around the lake have to spend quite a lot of additional costs. This is certainly a heavy economic burden, especially for families who are already struggling to meet their daily needs. Poor health can affect people's work productivity, creating a cycle of poverty that is difficult to overcome.

In this context, the importance of more structured health interventions becomes very clear. Educational programs on the importance of good sanitation and waste management need to be introduced to the community. In addition, collaboration between local governments and non-governmental organizations in providing access to health services is also very necessary to minimize the health impacts caused.

Given the broad impacts on the environment and society, concrete and sustainable steps are needed to mitigate environmental changes in Lake Lot Tawar. One proposed approach is a participatory management model, which involves the community in maintaining and preserving aquatic ecosystems. Research by Kurniawan et al. (2020) shows that involving local communities in monitoring and managing water resources can increase the effectiveness of conservation efforts. Communities involved in resource management will have a greater sense of responsibility for their surrounding environment. Regular lake cleaning activities, education on waste management, and collaboration with local governments and the private sector to build environmentally friendly infrastructure are steps that need to be taken. For example, the construction of an efficient wastewater treatment plant can reduce pollution and improve water quality in the lake. In addition, educational programs on the importance of maintaining environmental cleanliness can increase public awareness of the impact of their actions on the environment.

C. Resilience of the Lot Tawar Community

The Lot Tawar community has a very rich and valuable heritage of local knowledge. This knowledge has been passed down from generation to generation and plays an important role in building their resilience. Various practices including agriculture, fisheries, and environmental management have proven effective in maintaining the sustainability of natural resources. One example is the implementation of organic farming techniques by local farmers which not only succeeded in increasing crop yields but also contributed to the balance of the ecosystem. As stated by Adger (2016), local knowledge serves as a very important adaptation

tool, allowing communities to respond to challenges caused by climate change and other environmental factors. By utilizing this knowledge, the Lot Tawar community can maintain food security even when faced with extreme weather.

Furthermore, this local knowledge also has a positive impact on the cultural identity of the Lot Tawar community. Traditional practices, such as agricultural rituals and water resource management, not only play a role in the economic aspect, but also strengthen social relationships among community members. The findings of Berkes and Ross (2016) support this, showing that a strong cultural identity can increase a community's resilience to external pressures. By maintaining and preserving local knowledge, the Lot Tawar community not only protects their natural resources but also strengthens their identity as a resilient community.

The existence of strong local knowledge also encourages innovation capabilities within the community. In facing new challenges, such as climate change and natural disasters, they can adapt traditional practices to create more effective solutions. For example, the application of simple technology in water management can improve irrigation efficiency and reduce vulnerability to drought. This shows that local knowledge is not just a legacy, but also a resource that can be optimized for better innovation and adaptation (Norris et al., 2016).

However, it should be noted that local knowledge alone is not always enough to overcome all challenges. In this context, support from external parties, such as the government and other institutions, is very important. The Lot Tawar community must be able to integrate their local knowledge with modern resources and technology to improve their adaptive capabilities. Thus, collaboration between local knowledge and external support can create a stronger synergy in building community resilience (Paton & Johnston, 2017).

To increase this resilience, the Lot Tawar community needs to continue to develop and preserve their local knowledge. One way to achieve this is through education and training programs that involve the younger generation, so that this knowledge does not disappear over time. Thus, local knowledge will remain a solid foundation for the resilience of the Lot Tawar community in the future.

The social aspect in Lot Tawar is also very influential in building community resilience. Social capital formed from close social networks, mutual trust, and cooperation is a valuable asset in facing various challenges. The habit of mutual cooperation and the deliberation system applied in everyday life allow people to support each other and share resources when experiencing disasters or difficult conditions. Mastrorillo et al. (2016) noted that strong social capital

can increase a community's ability to adapt and recover from disasters.

When disasters, such as floods or landslides, occur, the Lot Tawar community immediately forms mechanisms to share information and resources. For example, in emergency situations, they organize mutual cooperation activities to clean up affected areas and distribute aid to those in need. This creates a high sense of solidarity, which in turn strengthens community resilience. Research shows that communities with high social capital tend to have better recovery rates after disasters (Norris et al., 2016).

Social strength is also reflected in the active participation of communities in local organizations. These organizations not only function as a forum for conveying aspirations, but also as a platform for sharing knowledge and experiences. By participating in organizational activities, communities can improve their skills and knowledge, which are very important in facing new challenges. Berkes and Ross (2016) emphasize that strong social interactions can build a community's capacity to adapt and survive.

However, the existence of social strength is not always guaranteed. There are challenges that can reduce solidarity within the community, such as shifting social values and increasing individualism. Therefore, it is important for the Lot Tawar community to continue to strengthen their social networks through activities that encourage cooperation and mutual trust. Programs that involve all community members, including young people, can help rebuild social bonds that may have weakened (Paton & Johnston, 2017).

In conclusion, social strength and social capital are crucial components in building the resilience of the Lot Tawar community. Through cooperation, solidarity, and active participation, communities can increase their capacity to face and recover from various challenges. Therefore, strengthening social capital should be an integral part of community development strategies in Lot Tawar.

Government support also plays an important role in increasing the resilience of the Lot Tawar community. This assistance can be in the form of materials, training, and community empowerment in various sectors, such as agriculture, fisheries, and environmental management. According to Paton and Johnston (2017), planned and targeted government support can help communities overcome the challenges they face and increase their adaptive capacity.

One concrete example of government support is the agricultural subsidy program implemented in Lot Tawar. With this subsidy, local farmers can access quality fertilizers and seeds at affordable prices, which in turn increases their agricultural productivity. Data shows that farmers who receive subsidies experience up to 30% increase in yield compared to those who do not

receive assistance (Berkes & Ross, 2016). This shows that government support can significantly improve community food security.

In addition, training provided by the government in natural resource management is also very valuable. The Lot Tawar community was trained in modern, environmentally friendly techniques, such as agroforestry and sustainable fish farming. By adopting these practices, the community not only increased production but also maintained environmental sustainability. According to Adger (2016), a knowledge-based approach to natural resource management can improve the ability of communities to adapt to changes that occur.

However, challenges in terms of accessibility to government assistance remain. Some communities may have difficulty accessing information about available programs or feel marginalized in the decision-making process. Therefore, it is important for the government to ensure that all levels of society are involved in existing programs and that they have equal access to resources. This is in line with the findings of Mastroiello et al. (2016) who emphasized the importance of social inclusion in building community resilience.

Thus, the role of the government in improving the resilience of the Lot Tawar community is very important. Through appropriate and inclusive support, communities can obtain the resources and knowledge needed to face existing challenges. Therefore, collaboration between the government and the community must continue to be improved to create more effective strategies in building community resilience.

Government policies that support the welfare of local communities are an important factor in improving resilience in Lot Tawar. Policies that provide protection to communities in the management of local natural resources can ensure the sustainability and welfare of communities. For example, regulations governing land use and protection of water ecosystems are essential to maintaining the resources that are the backbone of community life (Berkes & Ross, 2016).

One of the policies that has been successfully implemented is the community-based natural resource management program. This program gives local communities the right to manage and utilize natural resources in their area, while still paying attention to sustainability aspects. With this policy, communities feel responsible and have ownership of natural resources, which in turn encourages them to maintain and preserve them. Data shows that communities involved in community-based management have a higher success rate in maintaining their ecosystems (Adger, 2016).

However, challenges in policy implementation often arise. Some policies may not fully suit local needs

and conditions, which can hinder their effectiveness. Therefore, it is important for the government to involve the community in the policy formulation process.

D. Community Adaptation Strategies

Communities living on the coast of Lake Lot Tawar are now facing increasingly complex challenges, especially those caused by climate change and the decline in the quality of natural resources. One of the most important adaptation strategies in dealing with this situation is diversifying livelihoods. Sari and Putra (2020) explain that income diversification can help communities reduce dependence on one source of income, while increasing their overall economic resilience.

In the Lake Lot Tawar area, communities not only rely on the fisheries sector, but have also begun to shift to dry land farming and the development of nature-based tourism. The findings revealed by Hafiz and Nasution (2021) show that coastal communities in Aceh have succeeded in implementing diversification strategies to overcome the negative impacts of climate change that they experience.

One of the concrete steps taken by the community is to plant various vegetables and fruits that can be sold in local markets. Research by Zulkarnain and Rahman (2022) highlights that the use of existing land not only provides additional sources of income for the community but also contributes to local food security. In the context of climate change that causes fluctuations in fish catches, diversifying these sources of income is very important to ensure the economic resilience of the community.

The development of nature-based tourism is also an important pillar in economic diversification. Local communities have begun to develop homestays and offer tour packages that highlight the beauty of their nature and local culture. Wahyuni and Sari (2022) noted that this community-based tourism model not only provides additional income for the community but also increases their awareness of the importance of protecting the environment. By involving the community in tourism management, they feel they have a greater responsibility to maintain the sustainability of natural resources that are tourist attractions.

It is important to note that diversification is not only limited to the economic sector, but also concerns the social aspect. Communities involved in various economic activities tend to have stronger social networks, which help them support each other in facing various challenges. A study conducted by Budi and Hidayah (2021) showed that communities with diverse livelihoods are better able to survive the economic and environmental crises.

Although diversification offers many benefits, challenges remain. Communities need to be trained and have access to capital to move into these new sectors. Therefore, support from NGOs and the government is essential in providing the necessary training and technical assistance. Iskandar and Nuraini (2022) emphasize that the success of diversification is highly dependent on good collaboration between communities, governments, and NGOs to create an environment that supports local initiatives.

Awareness of the importance of preserving Lake Lot Tawar has sparked a collective movement among the community to maintain water and environmental quality. One concrete step taken is a campaign to reduce plastic waste. According to Fitria and Ramadhan (2021), environmental campaigns carried out by coastal communities are very important to raise awareness of the negative impacts of waste on the ecosystem. In Lake Lot Tawar, the community initiated a waste management program that involved all members of the community.

These activities include collecting waste around the lake and socializing about the use of environmentally friendly materials. Community groups routinely hold clean-up activities and provide education to residents about the importance of disposing of waste in its place. Research by Khalid and Lestari (2023) shows that community involvement in environmental management contributes to improving ecosystem quality.

As part of environmental management efforts, the community also developed a simple waste management system. They group organic and non-organic waste, and process organic waste into compost. This not only reduces the volume of waste dumped into the lake but also provides additional benefits for local agriculture. Zulkarnain and Rahman (2022) noted that good waste management can improve water quality and support ecosystem sustainability.

This campaign also creates awareness of the importance of maintaining the ecotourism appeal of Lake Lot Tawar. By keeping the lake clean, the community not only protects clean water resources but also strengthens tourism potential that can provide additional income. Research by Wahyuni and Sari (2022) shows that well-managed ecotourism can provide economic benefits without damaging the environment.

However, challenges in environmental management remain. Communities need support and training to implement sustainable practices. Support from the government and non-governmental organizations is essential in providing the necessary training and resources. With good collaboration, communities can strengthen their efforts to maintain the

sustainability of Lake Lot Tawar and improve their quality of life.

In facing the challenges of fisheries productivity, the coastal communities of Lake Lot Tawar have adopted simple but efficient technologies that have a positive impact on the sustainability of the ecosystem. The use of more selective nets and adjustments to fishing times are among the innovations implemented. Khalid and Lestari (2023) explained that the right technology can increase catches while maintaining the balance of the ecosystem.

Local communities have started using nets with larger holes to prevent the capture of small, immature fish. In this way, they contribute to the preservation of fish populations and maintain biodiversity in the lake. This shows a deep understanding of the interaction between nature and human activities, which is key to sustainable resource management.

In addition, communities also observe fish migration and reproduction patterns to determine the right time to catch fish. Research by Rizki and Setiawan (2020) shows that adjusting fishing times can increase catches and support fisheries sustainability. By utilizing local knowledge and experience, communities can manage fishery resources more wisely.

This innovation not only has an impact on the sustainability of the ecosystem, but also provides economic benefits to the community. With better catches, they can increase their income and improve their quality of life. A study by Hafiz and Nasution (2021) shows that fisheries sustainability is highly dependent on community involvement in resource management..

However, to ensure the success of this innovation, communities need to receive support in the form of training and access to better technology. Non-governmental organizations and the government can play an important role in providing technical assistance and the necessary resources. With the right support, the coastal communities of Lake Lot Tawar can continue to adapt and manage their fisheries resources sustainably.

The development of community-based tourism in Lake Lot Tawar has become an effective adaptation strategy for coastal communities. By utilizing the natural beauty and local culture, the community has begun to offer authentic tourism experiences to visitors. According to Wahyuni and Sari (2022), this tourism model not only provides additional income for the community but also raises awareness of the importance of environmental conservation.

Local communities play an active role in managing tourism, from becoming tour guides to providing homestay facilities. With independent management, they can ensure that the presence of tourists does not burden the environment around the lake. Research by Budi and Hidayah (2021) shows that community-based

tourism management can strengthen the community's sense of ownership of their natural resources.

In addition, this tourism development also provides an opportunity for the community to promote local products, such as handicrafts and traditional foods. Thus, tourism is not only a source of income but also helps preserve local culture. Zulkarnain and Rahman (2022) noted that well-managed tourism.

E. Policy Implications for Resilience

Climate change is one of the most pressing challenges facing the world today. This phenomenon not only impacts the environment, but also affects social, economic, and cultural life, especially for coastal communities that are often more vulnerable. In Lake Lot Tawar, adaptation policies are crucial to increase community resilience to the impacts of climate change. According to research conducted by Adger and Vincent (2019), the adaptive capacity of a community is largely determined by the policies implemented. With the right policies, communities can be better prepared to face various risks, such as extreme weather and rapid ecosystem changes.

Responsive and evidence-based policies are key to facing the challenges of climate change. A comprehensive evaluation of the risks faced by coastal communities is essential for local governments. In the context of Lake Lot Tawar, adaptation policies must take into account local knowledge and specific conditions. Research by Mastrorillo et al. (2021) shows that local knowledge can strengthen adaptation policies. When communities are involved in the planning process, the resulting policies will be more relevant and effective. For example, they can provide valuable information on changing weather patterns and their impacts on daily activities, which can be used to formulate better adaptation policies.

Cross-sector collaboration is also key to formulating effective adaptation policies. Zhou et al. (2020) emphasize the importance of collaboration between the government, non-governmental organizations, and the private sector in addressing climate change. In Lake Lot Tawar, this collaboration can be realized through programs involving various stakeholders. By integrating resources and knowledge from various sectors, common goals can be better achieved. For example, the private sector can contribute with weather monitoring technology that helps communities predict extreme weather.

Successful adaptation policies must also include increasing community capacity in disaster mitigation. Khan and Hossain (2021) point out that community involvement in disaster risk reduction is essential to increasing community resilience. Training and outreach programs on disaster management should be an integral part of adaptation policies in Lake Lot Tawar. By

providing knowledge and skills to the community, they will be better prepared to deal with potential emergencies. Training programs can cover a variety of aspects, from emergency response to post-disaster recovery..

Regular monitoring and evaluation of implemented policies are essential to ensure their effectiveness and relevance. Patterson and Smith (2022) emphasize that regular evaluation can help identify achievements and challenges faced. By conducting regular evaluations, local governments can improve and update policies to remain appropriate to existing conditions in Lake Lot Tawar. An integrated approach to adaptation policies is essential to increasing the resilience of coastal communities.

Berkes and Ross (2020) suggest that community resilience can be built through an approach that involves various aspects, including social, economic, and environmental. In Lake Lot Tawar, this approach must consider local conditions and community needs. For example, policies that integrate ecosystem protection with improving community livelihoods will be more effective in building resilience. One example of an integrated approach is the development of programs that combine environmental conservation with local economic development.

Local governments can promote sustainable agricultural and fisheries practices, so that communities not only gain economic benefits but also maintain ecosystem sustainability. Research shows that communities involved in sustainable practices have better resilience to the impacts of climate change (Smit & Wandel, 2019). Community involvement in policy planning and implementation is also an important element of an integrated approach. By involving the community, the resulting policies will be more in line with local needs and conditions.

An integrated approach should also include collaboration between various sectors. Zhou et al. (2020) stated that cross-sector collaboration can increase the effectiveness of adaptation policies. In Lake Lot Tawar, collaboration between the government, private sector, and non-governmental organizations can create beneficial synergies in addressing climate change. For example, the private sector can provide technology that supports sustainability, while non-governmental organizations can assist in strengthening community capacity.

It is important to ensure that the adaptation policies implemented are inclusive. Inclusive policies will ensure that all levels of society, including vulnerable groups, benefit from adaptation programs. This is in line with the principle of social justice that must be upheld in every public policy. With an integrated and inclusive approach, it is hoped that coastal communities in Lake Lot Tawar can build better resilience to climate change.

Community involvement in disaster mitigation is essential to increase community resilience. Training and outreach programs on disaster mitigation should be an integral part of adaptation policies in Lake Lot Tawar. By providing knowledge and skills to the community, they will be better prepared to face emergencies that may occur. For example, communities can be trained to recognize early signs of natural disasters, such as floods or landslides, and how to respond effectively.

It is important to build effective communication networks among communities. In emergency situations, fast and accurate information is essential to reduce risk. Local governments can facilitate the formation of volunteer groups tasked with disseminating information and assisting communities in dealing with disasters. With a good communication network, communities will be better prepared and responsive in emergency situations.

Evaluation and updating of training and disaster mitigation programs is also very important. By conducting regular evaluations, local governments can identify areas that need improvement and ensure that the programs implemented remain relevant to existing conditions. Thus, communities will continue to have the skills and knowledge needed to better cope with disasters.

Access to adequate resources and infrastructure is essential to increasing the resilience of coastal communities. Local governments need to ensure that communities have access to the funds and facilities needed to adapt to climate change. According to Smit and Wandel (2019), strong and environmentally friendly infrastructure can help communities face the challenges posed by climate change. In Lake Lot Tawar, the provision of special funds for climate change adaptation should be a priority.

One way to increase community access to resources is to provide financial assistance programs. This assistance can be used to update agricultural or fishing tools, as well as repair infrastructure damaged by disasters. Data shows that communities that receive financial support have a better ability to adapt to climate change (Patterson & Smith, 2022). Therefore, local governments need to design assistance programs that are targeted and easily accessible to the community.

Disaster-resilient infrastructure development is also very important. Good infrastructure, such as roads, bridges, and drainage systems, can help reduce the impact of disasters and accelerate post-disaster recovery. Local governments need to invest in sustainable and environmentally friendly infrastructure development. This will ensure that coastal communities in Lake Lot Tawar have a strong foundation to adapt to climate change.

It is also important to involve the community in the infrastructure planning and development process. By involving the community, the government can ensure that the infrastructure built is in accordance with local needs and conditions. Berkes and Ross (2020) emphasize the importance of an approach that involves the community in infrastructure development. Thus, the community will feel ownership and responsibility for the existing infrastructure. Monitoring and evaluation of the use of resources and infrastructure are also very important. Local governments need to conduct regular evaluations to ensure that resources are used efficiently and infrastructure is functioning properly. By conducting evaluations, the government can identify areas that need to be improved.

CONCLUSION

The coastal communities of Lake Lot Tawar, which are dominated by the Gayo ethnic group with distinctive social, economic, and cultural profiles, are highly dependent on the lake for agriculture, fisheries, and clean water. The sustainability of the lake ecosystem is crucial because various environmental changes, such as declining water quality and extreme weather, have a direct impact on community well-being. Coastal communities demonstrate resilience through local knowledge, social strength, and adaptation to change by diversifying livelihoods, managing waste, and utilizing simple technology in fisheries. External support, such as government assistance and pro-environmental policies, strengthen the resilience of these communities in facing environmental and economic challenges. Responsive adaptation policies from the government are needed to increase community resilience. These policies should include cross-sector collaboration, increasing disaster mitigation capacity, access to finance and infrastructure, and regular policy evaluation. This evidence-based and collaborative approach is expected to ensure the sustainability of the Lake Lot Tawar ecosystem and the well-being of the surrounding community in the long term. Various adaptation strategies, such as economic diversification, environmentally friendly practices, and the use of simple technologies, have been implemented by coastal communities to face the challenges of environmental change. These strategies, supported by cross-sector collaboration, show that community-based adaptation can be an effective solution to maintain the balance between economic needs and environmental conservation in Lake Lot Tawar..

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