

ROAD INFRASTRUCTURE ARRANGEMENT IN THE FISHERMAN VILLAGE RESIDENTIAL ENVIRONMENT ACROSS BELAWAN

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Received : 25 July 2025
Revised : 01 August 2025
Accepted : 10 August 2025

Published : 28 August 2025
DOI : <https://doi.org/10.59733/besti.v3i3.131>
Publish Link : <https://bestijournal.org/index.php/go>

Abstract

Environmental infrastructure planning that is effective and appropriate plays an important role in increasing the productivity of fishing communities and supporting sustainable regional development. Kampung Nelayan Seberang Belawan, where the majority of residents depend on the fisheries sector, requires better environmental infrastructure planning to support fishing activities and improve community welfare. This study aims to analyze the existing infrastructure conditions, identify environmental infrastructure needs, and formulate appropriate strategies for environmental infrastructure planning to enhance fishermen's urgent productivity and support regional development. The research uses a qualitative method with a case study approach, interviews, and direct observation. The results show that the current environmental infrastructure is inadequate. Coastal protection infrastructure, such as wave barriers and mangrove planting, is crucial for maintaining environmental resilience and preventing damage caused by abrasion and natural disasters. Proper management of waste and domestic wastewater will also improve environmental quality and public health. The provision of better educational and health facilities will improve the quality of life for fishing communities and create opportunities for a more creative and technologically literate younger generation. This has a positive impact on the environmental infrastructure planning of Kampung Nelayan Seberang in regional development. The planning of environmental infrastructure in Kampung Nelayan Seberang constitutes a strategic key in developing competitive coastal areas. The success of this arrangement greatly depends on multi-party collaboration, sustainable planning, and policy support for marginal areas. By maximizing strengths and opportunities and mitigating weaknesses and threats, this area can grow into an inclusive and productive community.

Keywords:*Infrastructure Planning, Environmental Infrastructure, Seberang Belawan Fisherman's Village.*

INTRODUCTION

Seberang Belawan Fishermen's Village is a coastal area in Medan City with significant potential in the fisheries sector. Most of the residents work as fishermen, relying on marine catches for their primary livelihood. However, this area faces various challenges in regional development, particularly inadequate infrastructure. Roads frequently inundated by tidal flooding, non-functional piers, limited clean water facilities, and inadequate housing are major obstacles for the community. Good infrastructure development plays a crucial role in supporting regional development, particularly in coastal areas like Seberang Fishermen's Village. With adequate infrastructure, not only will the productivity of the fisheries sector increase but also the overall quality of life of the community. Furthermore, environmental sustainability is crucial to maintain coastal ecosystems and the sustainability of fisheries-based economic activities. In the context of regional development, well-planned infrastructure can be a catalyst for driving local economic growth, improving social conditions, and protecting the area from environmental threats such as abrasion and tidal flooding.

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Location Map of Mangrove Restoration (yellow polygon) in Kampung Nelayan Seberang Medan City

Figure 1.1 Sebrang Belawan Fishing Village



Figure 1.2 Residential Environmental Infrastructure of Sebrang Belawan Fishermen's Village

This area is inhabited by a community, the majority of whom work as traditional fishermen, whose livelihoods are highly dependent on marine catches. Besides being a primary source of livelihood, the fisheries sector also drives the local economy, driving regional development. However, this potential has not been optimally utilized due to

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limited infrastructure in the area. Various environmental infrastructure problems in the Seberang Belawan Fishing Village hamper community productivity and reduce their quality of life. Main roads are frequently inundated by tidal flooding, making accessibility difficult, both for daily needs and for the distribution of fisheries products. Limited access to clean water and poor sanitation worsen community health and environmental conditions. The area also faces environmental challenges, such as coastal erosion, seawater intrusion, and increasingly frequent tidal flooding due to climate change. This not only damages existing infrastructure but also threatens the sustainability of the environment and coastal ecosystems. Community housing, largely constructed of non-durable materials, is also highly vulnerable to the impacts of these disasters. Amidst these challenges, proper infrastructure development is a strategic step to support the development of the Seberang Belawan Fishermen's Village. Good environmental infrastructure can increase the productivity of the fisheries sector, improve the quality of life of the community, and protect the area from environmental damage. Furthermore, infrastructure development can also be a catalyst for local economic growth, create new jobs, and enhance regional competitiveness. One of the main challenges facing Seberang Belawan Fishermen's Village is the poor condition of basic environmental infrastructure. Many roads in the area are damaged, narrow, and often unusable during tidal floods. This condition not only complicates community mobility but also hinders the distribution of fishery products to markets outside the area. Poor accessibility increases logistics costs, thus reducing fishermen's incomes. Furthermore, the existing dock is inadequate for community needs. Many fishing boats struggle to dock, especially during the peak fishing season. The lack of modern fisheries facilities, such as adequate fish auction facilities (TPI), catch processing equipment, and cold storage facilities, exacerbates the situation. The catch often spoils before it can be marketed, which reduces its economic value.

Basic needs like clean water remain a major problem in Seberang Fishermen's Village. Most residents rely on rainwater or buy water in jerry cans, as available water sources have been contaminated by seawater intrusion. This situation not only complicates daily life but also impacts their health. Poor sanitation, coupled with a lack of wastewater treatment systems, exacerbates environmental health conditions, especially for children and vulnerable groups. Most houses in Seberang Fishermen's Village are constructed from simple materials such as wood and planks, making them unable to protect residents from the threat of extreme weather and tidal flooding. Increasingly frequent flooding due to climate change often causes fishermen's homes to be submerged. Furthermore, uncontrolled coastal erosion threatens settlements and reduces land area. The area's environmental vulnerability is exacerbated by a lack of attention to coastal ecosystem management. Mangroves, which should provide natural protection from erosion and ocean waves, have been significantly reduced by human activities. The loss of mangroves not only increases the risk of disasters but also reduces the fish resources that are the mainstay of the community's economy.

Poor infrastructure and environmental damage have led to declining productivity in fishing communities. High operational costs and suboptimal catches have led to unstable incomes. This situation has fueled structural poverty in the region. Many fishermen's children are forced to drop out of school because their families cannot afford their education, perpetuating the cycle of poverty. Furthermore, the lack of alternative employment opportunities outside the fishing sector has made communities increasingly dependent on dwindling marine resources. This dependence places additional pressure on coastal ecosystems, worsening long-term conditions. Global climate change has increased the frequency and intensity of disasters in coastal areas, including Seberang Fisherman's Village. More frequent tidal flooding and rising water levels each year have made the community increasingly vulnerable. The lack of significant mitigation efforts, such as the construction of embankments or proper drainage systems, exacerbates the impact of these disasters. The problems experienced in Seberang Belawan Fisherman's Village reflect the need for serious attention to infrastructure development and environmental management. Inadequate basic infrastructure, limited clean water, vulnerable housing, and environmental threats have created complex challenges for the region's development. Integrated planning efforts based on community needs are an important step to improve socio-economic welfare and protect coastal ecosystems in a sustainable manner.

LITERATURE REVIEW

Understanding Infrastructure

Infrastructure is a crucial element in supporting community activities and regional development. According to Mankiw (2020), infrastructure is the physical facilities necessary to support the economic, social, and environmental functions of a region. Infrastructure includes transportation, energy, clean water, sanitation, and social facilities such as education and healthcare. Saragih (2020) adds that good infrastructure can increase community productivity by accelerating the flow of goods, services, and information, thus contributing to regional economic growth.

Environmental Infrastructure

According to Soemarwoto (2021), environmental infrastructure is the facilities and infrastructure built to support the management of natural resources and the environment so that they remain sustainable and can be utilized sustainably. Environmental infrastructure is all forms of infrastructure and facilities designed to maintain, preserve, and improve the quality of the environment, both natural and artificial, in order to support sustainable community life. It is an important component in development that provides basic environmental services (clean water, sanitation, waste management, green spaces, and environmental protection) to create a healthy, sustainable, and disaster-resilient community life.

Regional Development

Regional development aims to improve the quality of life of communities through optimal resource management. According to Tarigan (2020), regional development is the process of improving the socio-economic well-being of communities within a region through integrated and sustainable planning. In the context of coastal areas, development must take into account the unique characteristics of the region, such as marine ecosystems, fisheries potential, and natural disaster risks. Suharto (2020) stated that coastal area development requires a participatory approach involving the government, communities, and the private sector. This ensures that development strategies not only meet infrastructure needs but also protect the environment and strengthen the capacity of local communities.

Sustainable Development

Sustainable development is a concept that integrates economic, social, and environmental aspects. According to Brundtland (in Sudarmanto, 2020), sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In the context of coastal areas, sustainable development involves protecting coastal ecosystems such as mangroves and coral reefs, which serve as natural buffers against disasters such as abrasion and tidal flooding (Pranata, 2020).

METHOD APPROACH

Qualitative research is a research approach that aims to understand social and cultural phenomena in their natural context. According to Creswell (2020), qualitative research is a method used to explore and understand the meanings individuals or groups attach to a problem or phenomenon. This approach emphasizes the collection of non-numerical data, such as interviews, observations, and document analysis. Sugiyono (2020) states that qualitative research focuses on an in-depth understanding of the research object, using an interpretive approach. The researcher acts as the primary instrument in collecting and analyzing data, so that the research results reflect the respondents' perspectives holistically.

Data analysis in this study was conducted qualitatively, using the interactive model of Miles, Huberman, and Saldana (2020), which includes:

1. Data Reduction: Selection of relevant data based on the results of interviews, observations, and documents.
2. Data Presentation: Organizing data in narrative, tabular, or matrix form to facilitate interpretation.
3. Drawing Conclusions: Compiling findings that are relevant to the research objectives, as well as answering the problem formulation.

To ensure data validity, this study employed triangulation of sources and methods. According to Patton (2020), triangulation is a method of validating data by comparing information from various sources and data collection techniques. This is done to reduce bias and ensure the credibility of the research results.

DISCUSSION

What is the current condition of environmental infrastructure in Sebrang Belawan Fishermen's Village?

Seberang Belawan Fishermen's Village is a coastal area in North Sumatra that serves as a center for local fishing activities. However, the infrastructure in this village still faces various challenges that affect the community's quality of life and the sustainability of economic activities, especially in the fisheries sector. Infrastructure-wise, the main obstacle is the access and footpath between the fishing village houses and the pier, which are still dominated by rotting wooden planks. This condition is a very big problem for the community in Seberang Belawan Fishermen's Village. Challenges faced by the surrounding community include road access, clean water, waste, energy, health, education, the environment, and coordination of aid programs that are not integrated and lack integrated planning. In terms of the strength of the existing infrastructure in the Seberang Belawan Fisherman's Village, the surrounding community has street lighting and electricity available in every location of the community's house. The availability

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of footpaths that connect residents, the road network has been formed although the condition is still made of wooden planks. Water transportation uses motorboats, and there is a mini pier as a stopover for the fishermen's motorboats. Access to education is only an elementary school, but it is widely used by the surrounding community for social function activities such as a children's play area, and often also becomes a place for community gatherings in deliberations in the Fisherman's Village. The geographical location of the Fisherman's Village should be able to attract the local tourism sector, due to the abundance of natural resources in the Seberang Belawan Fisherman's Village. This still requires the Arrangement of the Seberang Fisherman's Village Infrastructure in Regional Development.

Environmental infrastructure reviewed from a transportation perspective

Transportation is the most crucial aspect of the infrastructure development of Seberang Fishermen's Village. Accessibility to Seberang Fishermen's Village in Belawan is a key issue. The village can only be reached by water, such as small boats, as there is no adequate bridge connecting it to the mainland. The existing pier is also suboptimal, with a simple structure and vulnerable to damage from tidal waves. As a result, the distribution of goods, including fish catches, is slow and inefficient. Roads within the village are mostly simple wooden or concrete paths. Some sections have been damaged by abrasion or tidal flooding, making it difficult for residents to move around and hampering economic activity. The main issue in terms of transportation development is the damaged access that connects the community to the pier and the lack of development planning in Seberang Fishermen's Village.

In terms of its strength, the connecting road access already exists, namely the structure of the footpath within the village has been built. The pier is also available, but the obstacle in terms of infrastructure arrangement is that the wooden bridge is very fragile and unsafe to pass, the boat pier does not yet have safety standards. Reviewed from the perspective of the potential development opportunities of the Seberang Fisherman's Village is that it can be used as an educational magraove/ecotourism, assistance from the CSR program is an opportunity to create educational tourism around the Seberang Fisherman's Village. Repairing the pier through a marine program to provide funds for an adequate pier and port for the surrounding fishing community. Improving road access from government funds can be a top priority in the Infrastructure Arrangement of the Seberang Fisherman's Village, Belawan.

Environmental infrastructure reviewed from the perspective of Fishermen's House Arrangement

Regarding the environmental infrastructure in Kampung Nelayan Seberang, the primary focus in housing development is sanitation facilities. Residents living in coastal areas often neglect sanitation facilities, which is a major problem and contributes to environmental pollution. Most of the houses in Seberang Fisherman's Village are wooden stilt houses built over water. Although this design is adapted to coastal conditions, many houses are outdated and no longer meet livable standards. The strength of the stilt houses is that they are adapted to tidal conditions, making them iconic. However, the materials used should be more carefully considered and made sturdy, as they are located underwater. Residents work together in building and helping each other repair damaged houses. The use of local materials is relatively inexpensive. The downside is that the house structures are not permanent and are easily damaged due to the location and extreme weather. There is a lack of adequate sanitation and drainage systems, toilets, and household waste, which can damage the marine ecosystem. Opportunities usually come from aid funds such as: CSR funds, Self-Help Housing Stimulus Assistance (BSPS), or the Uninhabitable House Repair Program (RTLH). Marine ecotourism-based housing can be developed, such as houses being converted into marine tourism homestays, thus providing new economic opportunities for residents. Climate-resilient and environmentally friendly housing innovations are driven by the modular stilt house concept, bio-septic tank sanitation, and weatherproof walls, which can be implemented gradually. The threat of abrasion, where sea levels rise, can damage the substructure and cause rapid decay of wooden foundations. Environmental disasters such as storms and strong winds require a storm-resistant home structure or strong fasteners that meet building standards.

Environmental infrastructure reviewed from a social perspective

The only social infrastructure available is the Elementary School facility, this is a place not only for school activities, but also used as a place for deliberations in the Seberang Fisherman's Village. Other social facilities, such as health centers and places of worship in Kampung Nelayan Seberang, also require attention. Schools are limited to elementary level, requiring children to travel long distances to pursue higher education. The health center is a sub-district community health center with very limited facilities, forcing residents to frequently travel to the mainland for better healthcare. The lack of places of worship in Kampung Nelayan Seberang is a major problem. Its strength lies in its strategic coastal location, only a few kilometers from Belawan Port and the Industrial Area. The community's social capital is high, with a strong culture of mutual cooperation and solidarity among coastal communities. Its

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weakness lies in the lack of social facilities such as health facilities, education, and public spaces. Low levels of education and digital literacy result in limited access to information and economic opportunities. From an opportunity perspective, government programs related to modern fishing villages can accelerate access to social infrastructure development in the Seberang Fishermen's Village. The potential for ecotourism development can be an opportunity by creating community-based educational tours. Accelerating village digitalization, a national program that promotes internet access to villages, provides an opportunity for the people of Seberang Fishermen's Village to develop their social and economic well-being, as well as provide training for MSMEs. The threat is the disparity in development between regions, which leaves Seberang Fishermen's Village lagging behind other villages.

Environmental Infrastructure in Seberang Belawan Fishing Village

Coastal erosion and tidal flooding are serious problems in Seberang Belawan Fisherman's Village. The lack of embankments or coastal protection infrastructure makes the village vulnerable to damage from high tides and extreme weather. Furthermore, the mangrove ecosystem, which serves as a natural barrier, has been significantly reduced due to illegal logging and land conversion. Waste management is also a major challenge. The lack of an organized waste management system means that trash is often dumped directly into the sea or left to accumulate around homes, negatively impacting public health and environmental sustainability. Clean water supply is a pressing need in Seberang Fisherman's Village. Most residents still rely on rainwater or purchase clean water from outside at considerable expense. The lack of an integrated clean water network limits access to safe drinking water. Meanwhile, electricity is available, but it is often unstable. Some residents still use private generators to meet their electricity needs, which undoubtedly adds to the economic burden. The current infrastructure in Seberang Belawan Fishermen's Village is far from adequate to support the community's basic needs and fishing activities. Limited accessibility, inadequate fishery sales facilities, inadequate housing, and minimal environmental protection are major obstacles that require serious attention. Comprehensive infrastructure improvements and development are essential to improve the community's quality of life and support the sustainable development of this area.



Figure 4.1 Environmental Infrastructure of Seberang Fishing Village

What are the urgent environmental infrastructure needs to support regional development in Seberang Belawan Fishermen's Village?

Seberang Belawan Fishermen's Village, as a coastal area reliant on the fisheries sector, urgently requires various infrastructure to support regional development and ensure the smooth operation of fishing activities. Adequate infrastructure not only improves the welfare of fishing communities but also plays a crucial role in increasing fisheries productivity, facilitating accessibility, and strengthening environmental resilience. The following are some of the urgent infrastructure needs:

Environmental infrastructure reviewed from the perspective of transportation access

One of the biggest challenges in Seberang Belawan Fishermen's Village is limited transportation access. Much of the area is accessible only by small boat, and the existing dock is inadequate to support the transportation of goods

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and fishery products. Therefore, the construction of a more robust dock and improved road access, both by water and land, is crucial. Building a highway connecting the village to other areas will facilitate the distribution of fishery products and basic necessities. Furthermore, more efficient sea transportation facilities, such as the construction of a small, fisherman-friendly port, will speed up the process of transporting fish to market and increase fishermen's profits.

Environmental Infrastructure reviewed from the perspective of Coastal Resilience

Coastal areas like Seberang Belawan Fisherman's Village are highly vulnerable to natural hazards such as coastal erosion, tidal flooding, and climate change. Therefore, strengthening coastal protection infrastructure is crucial, for example through the construction of wave-retaining embankments and mangrove planting, which can mitigate the impact of abrasion. This infrastructure will also protect housing and other facilities from damage caused by extreme weather. Furthermore, a better waste management system must be implemented immediately. Proper waste management will reduce marine and environmental pollution, which will also impact the quality of fisheries and the health of fishing communities. The Seberang Belawan Fishermen's Village still faces challenges in providing clean water. Residents generally rely on rainwater or purchase expensive water from outside. Therefore, the development of an integrated clean water distribution system is an urgent need. Building water channels, drilling wells, or processing seawater into fresh water would be highly beneficial for the community, particularly in supporting hygiene, sanitation, and household activities.

Environmental infrastructure reviewed from the perspective of education and health

Education and healthcare are two crucial aspects in improving the quality of life for the community. Therefore, it is necessary to build or improve educational facilities, such as secondary schools closer to the village, so that fishermen's children can continue their education without having to travel far to the city. Similarly, adequate healthcare facilities are essential, given the limited access to larger hospitals or clinics in the surrounding area. Health centers with complete facilities and sufficient medical personnel would significantly improve the welfare of fishing communities.

What is the appropriate strategy for arranging environmental infrastructure to increase the productivity of fishing communities and support sustainable regional development?

Proper infrastructure development is a key factor in increasing the productivity of fishing communities and supporting sustainable regional development. In Seberang Belawan Fishermen's Village, where the majority of the population relies on the fisheries sector, infrastructure development must encompass various aspects, from transportation and fishing facilities to environmental protection and the provision of basic social services. Therefore, a holistic and integrated strategy is needed so that each element supports each other in creating long-term prosperity for the fishing community. The following are several strategies for appropriate infrastructure development to support increased productivity and sustainable regional development:

Environmental Infrastructure Development in terms of Efficient and Integrated Transportation

One of the main challenges in Sebrang Belawan Fishing Village is limited transportation access, both to and from the village and within it. To increase fishermen's productivity and facilitate the distribution of fishery products, the following transportation infrastructure development strategies need to be implemented:

1. **Construction of Small Piers and Ports:** Sturdy piers and adequate ports must be built to support maritime transportation activities, both for fishermen who go out to fish, and for transporting fishery products to larger markets or ports.
2. **Road Improvements and Land Access:** Building and improving roads connecting villages with other areas is crucial. Good roads facilitate the distribution of goods and speed up access to public facilities such as hospitals, markets, and educational centers.
3. **Improving Access to Fisherman-Friendly Maritime Transportation:** The development of more efficient maritime transportation facilities such as ships or small boats that can transport goods and fishery products quickly and safely will help reduce losses due to transportation delays.

Environmental Protection reviewed from the perspective of Coastal Resilience

In the context of sustainable regional development, environmental protection and natural resource management must be a priority. Several steps that need to be implemented in infrastructure development related to environmental protection are:

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1. Coastal Protection Infrastructure Development: Given the coastal area of Sebrang Fisherman's Village, which is prone to erosion and tidal flooding, the construction of a seawall or mangrove planting project is crucial. This will protect residential areas, fishing facilities, and the marine ecosystem from damage.
2. Marine and Environmental Waste Management: Sebrang Fisherman's Village requires a better waste management system. One way to achieve this is by building a waste treatment facility integrated with a waste-to-energy or fuel system, so that waste does not pollute the ocean or the environment. Proper wastewater management, such as establishing a safe waste disposal system, is also crucial for maintaining environmental cleanliness.
3. Marine Natural Resource Conservation: Natural resource management and conservation infrastructure, such as temporary fishing no-take zones or community-based monitoring systems, will help maintain marine ecosystems and ensure sustainable fisheries yields.
- 4.

Environmental Infrastructure in terms of providing Social Facilities that Support Community Welfare

To support the welfare of fishing communities, social and economic infrastructure must also be considered. Some strategies that can be implemented are:

1. Education and Skills: Building adequate schools, from elementary to secondary levels, will improve the quality of education for fishermen's children. Furthermore, skills training, such as fish processing techniques, small business management, or other technical skills, can improve the community's standard of living.
2. Health facilities, including the construction of community health centers with more comprehensive facilities and trained medical personnel, will improve access to healthcare for fishing communities. This will enable them to be healthier and more productive.
3. Traditional Market Facilities, namely building better fish markets and local economic centers that support MSMEs, will open up business opportunities for the surrounding community, while also encouraging business diversity in the fisheries sector.

Environmental Infrastructure in terms of Sustainable Energy

A stable energy supply is crucial for supporting all activities in Seberang Belawan Fishermen's Village. In addition to improving access and the development of digital technology, sustainable energy infrastructure is also essential. The development of renewable energy sources, such as solar power plants (PLTS) or wind power plants, can be a solution to address the problem of unstable electricity supply. Furthermore, the use of environmentally friendly renewable energy will support sustainable regional development without damaging the surrounding environment. An appropriate infrastructure development strategy to increase the productivity of fishing communities and support sustainable regional development in Seberang Belawan Fishermen's Village must encompass aspects of transportation, fisheries facilities, environmental protection, and the provision of social facilities. The development of infrastructure supporting fishing activities, such as a pier, fish processing facilities, and cold storage, will increase fishermen's productivity. Meanwhile, coastal protection, waste management, and the development of sustainable education, health, and energy facilities will improve the welfare of fishing communities in the long term. With an integrated and sustainable approach, Seberang Belawan Fishermen's Village can develop into a prosperous region that is resilient to environmental and economic challenges.

CONCLUSION

Based on the results of research on infrastructure planning in Seberang Belawan Fishermen's Village, it can be concluded that:

1. Lack of environmental infrastructure development, including transportation, housing, and social aspects. Proper environmental infrastructure development and management plays a crucial role in increasing community productivity in Seberang Belawan Fishermen's Village and supporting sustainable regional development. Comprehensive and integrated infrastructure development can have a significant positive impact on the social, economic, and environmental life of Seberang Belawan Fishermen's Village.
2. Coastal protection infrastructure, such as wave breakers and mangrove planting, is crucial for maintaining environmental resilience and preventing damage from abrasion and natural disasters. Proper waste and household wastewater management will also improve environmental quality and public health. Providing better education and health facilities will improve the quality of life for fishing communities and open up opportunities for a more creative and technologically savvy younger generation. This will have a positive impact on the infrastructure development of the Seberang Belawan Fishing Village within the region.

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3. The infrastructure development of Seberang Belawan Fishermen's Village is a strategic key to developing a competitive coastal area. The success of this development depends heavily on multi-stakeholder collaboration, sustainable planning, and policies that prioritize marginalized areas. By maximizing strengths and opportunities while mitigating weaknesses and threats, this region can grow into an inclusive and productive region.

Overall, appropriate and integrated infrastructure development in Seberang Belawan Fishermen's Village will create better conditions for increasing fishermen's productivity, supporting sustainable regional development, and enhancing the well-being of coastal communities. It is hoped that the implementation of the recommendations and strategies outlined in this study will be the first step toward positive change in Seberang Belawan Fishermen's Village.

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