Analysis of Environmental Sanitation Conditions and Improvement Solutions for the Coastal Settlement of Tanjung Uma

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Abstract
Handling sanitation in Batam City is the most pressing environmental challenge also requires special attention to maintain environmental quality and public health, one of the coastal settlement areas is Tanjung Uma. In this research, this coastal settlement experiencing problems with marine environmental sanitation caused by waste that is difficult to decompose in a short time, waste that accumulates in the water will become a source of problems that have a direct impact on life around coastal settlements, even triggering unsuitability. One of the main factors is inadequate environmental sanitation in coastal areas are residents throw wastewater and garbage directly into the sea. If didn't got handle, there's a high risk of environmental damage and affect the surrounding community. Based on that, it's important to do condition analysing coastal areas, also develop solutions and strategies to improve effective sanitation systems in order to solve environmental sanitation problems. This research method uses a qualitative approach through interviews and observations to obtain data with literature review that's related to the implementation. With relevant literature that has been collected and analyzed to obtain theories, ideas according to the research discussed. Based on the conclusion in this research, environmental sanitation issues in the coastal settlement of Tanjung Uma still influenced by inadequate sanitation infrastructure, basic services, and bad habits of some residents. Therefore, by implementing an integrated septic tank, support for the provision of clean water, sustainable waste management, and community participation are strategies to improve the quality of environmental sanitation in the area.

Keywords: Coastal Settlement; Sanitation; Trash; Tanjung Uma

Introduction

Coastal communities are communities that reside in coastal areas, the majority of whom work as fishermen, and possess characteristics that differ from other communities. These differences are influenced by the close relationship with the region's economic characteristics, cultural background, and the availability of supporting facilities and infrastructure (Bastian et al., 2021; Syakila et al., 2022).

Tanjung Uma is one of the urban villages as well as a traditional village located in the Lubuk Baja District, Batam City, Riau Islands Province. Its location on the northern coastal area of Batam Island and its proximity to the Singapore Strait have resulted in a considerable number of coastal settlements within Tanjung Uma District. One of these coastal settlements is located in RT 01 and RT 02, Tanjung Uma. Its location, which is far from the city center, has caused this coastal settlement to remain relatively underdeveloped, particularly in terms of infrastructure. One aspect that has not developed adequately is environmental sanitation.



(a) Tanjung Uma Settlement

(b) The research location was RT 01 and RT 02 Tanjung Uma, Lubuk Baja District, Batam, Riau Islands

Figure 1. *Location of the Research Area in Tanjung Uma, Batam, Riau Islands*

Anggi (1993) defines sanitation as an effort to create an environment free from disease. Sanitation is assessed based on three sub-variables, namely toilets and urinals, handwashing facilities, and the disposal of rainwater and wastewater (Dewi Firdanis et al., 2021). Coastal settlements tend to be unable to meet proper sanitation standards due to various factors, such as socio-economic conditions, lack of infrastructure development, community habits, and other related issues (Krisandriyana et al., 2019).

Sanitation waste discharged into the marine environment causes impacts on both humans and the environment. The impact on humans is primarily the decline in public health levels. In addition, sanitation also affects the environment, including both aquatic and terrestrial ecosystems. According to Baharia, various types of waste are commonly found in Tanjung Uma, particularly plastic waste. Plastic waste is difficult to decompose

in a short period of time; consequently, it accumulates in the water and eventually becomes a threat to the sustainability of coastal life.

From social aspect, the main reason to Tanjung Uma's inadequte environmental sanitation is the behavior of communities who's living in the areas. Unhealthy behaviors and habits that have been passed down through generations have caused the community to be unwilling to change. According to Nurhayati, from an economic perspective, most people living in coastal settlements do not possess sufficient financial capacity to provide proper sanitation systems for themselves and their families. Without assistance from healthcare centers or the government, they tend to use the quickest and most accessible solution for place to sort their trashes, which is the surrounding environment.

Previous studies have concluded that many coastal settlements often face limitations in sanitation quality and waste management systems, with most research focusing on the observation and identification of sanitation conditions in coastal settlements across Indonesia. Several previous studies focusing on waste management conditions in coastal settlements have proposed technological recommendations, such as communal wastewater treatment systems. Therefore, this study aims to focus on identifying appropriate sanitation improvement solutions for the coastal settlement of Tanjung Uma, based on field observations and interviews with local communities. The purpose of this research is to serve as a reference for future sanitation improvement programs in the coastal settlements of Tanjung Uma that may be implemented by the government or other related parties.

Research Method

This study employs a qualitative research method through interviews and observations. According to Sugiyono, qualitative research is a research method used to examine natural conditions, as opposed to experimental methods, in which the researcher acts as the key instrument, data collection techniques are conducted through triangulation (combination), data analysis is inductive in nature, and the results of qualitative research emphasize meaning (Sugiyono, 2013). Interviews are defined as direct communication between two or more parties, in which one party acts as the interviewer and the other as the informant, with the purpose of collecting information or data (Fadhallah, 2021).

This study uses a qualitative approach with data collection conducted through interviews and observations to directly understand sanitation problems in the coastal settlement of Tanjung Uma. Furthermore, the collected data are processed descriptively to explain the sanitation conditions within the coastal settlement of Tanjung Uma. Data triangulation is then carried out to re-evaluate whether the research findings are consistent with actual field conditions. Therefore, the selection of appropriate sanitation improvement solutions can be carried out accurately and in accordance with the existing conditions in the field.

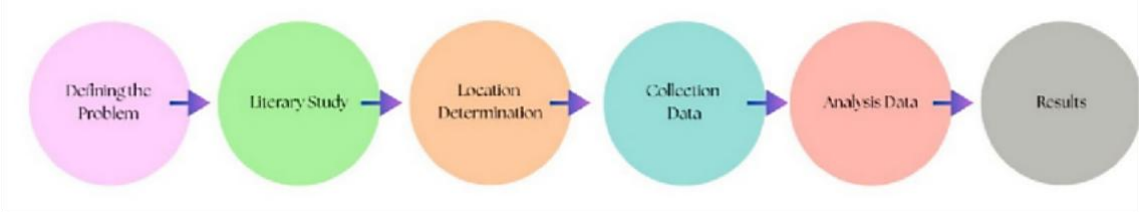


Figure 2. *Stages of the Qualitative Research Method*

This research was conducted in the coastal settlement of Tanjung Uma, located in the Lubuk Baja District, Batam, Riau Islands. The study was carried out over four days, specifically on February 22, March 8, April 10, and April 26, 2026.

Results and Discussions

Wastewater Management in the Coastal Settlement of Tanjung Uma

Wastewater treatment is a crucial aspect of sanitation because it is closely related to environmental health, which indirectly also affects public health (Sembiring et al., 2023). Based on field observations, the coastal settlement of Tanjung Uma does not have septic tank systems to regulate toilet wastewater disposal. On the other hand, residential areas located closer to the mainland already have septic tanks in almost every house. According to Miskiyah et al. (2023), proper toilet facilities are basic facilities that every household must possess in order to maintain environmental health within the community. Furthermore, sanitation facilities must comply with health standards so that human waste does not contaminate the environment or become a source of disease (Hendrajaya et al., 2023).

Inadequate toilet facilities contribute to a decline in public health quality. Previous studies have found that poor sanitation can increase the spread of diseases through contaminated water and environments (Ambodale et al., 2024).

Several factors contribute to the lack of septic tank implementation in the coastal settlement of Tanjung Uma, one of which is financial limitation. Most residents living in coastal settlements work as fishermen; therefore, their economic condition is insufficient to provide individual septic tanks for their homes. As a result, residents dispose of wastewater directly into the sea under the assumption that seawater will carry away the waste and that such practices are more conventional. However, this practice clearly does not meet proper sanitation standards.

It is recommended that both central and local governments strengthen sanitation improvement policies by considering the spatial characteristics of each region. Efforts may focus on optimizing household waste management, providing proper sanitation facilities, and promoting education regarding clean and healthy living behaviors. In addition, increasing employment opportunities and conducting further research using more detailed spatial data are necessary to deepen the understanding of factors influencing access to proper sanitation in Indonesia (Maulidya et al., 2024). One potential solution for addressing this issue is the implementation of communal septic tanks, particularly biofilter septic tank systems.

A relevant case study is the implementation of a communal biofilter wastewater treatment system in the densely populated coastal area of Long Buloa, Makassar City. Organic removal processes within biofilter systems can occur anaerobically, aerobically, or through a combination of anaerobic-aerobic processes, utilizing attached biological growth on synthetic/plastic or mineral media. The treated effluent from the biofilter system can then be directed to a final settling tank functioning as a sedimentation basin. Subsequently, the treated water may be discharged directly into water bodies or undergo further treatment for recycling purposes according to specific needs (Hastuti et al., 2014). The biofilter septic tank method was also selected because it requires relatively infrequent maintenance. Nevertheless, there are limitations to the use of this septic tank model, namely that household industrial wastewater must not be mixed with domestic wastewater because the mixed wastewater may contain toxic substances capable of inhibiting biological processes within the wastewater treatment system, such as heavy metal content (Hastuti et al., 2014).

There are also concerns that septic tanks constructed in coastal area couldn't withstand the strong waves from the seas, especially the northern waves around the early time of the year. Therefore, stronger construction planning for septic tank structures is required to ensure long-term durabilit

The Results and Discussion section must be written in a clear, systematic, and integrated manner. Begin by presenting the research findings objectively, based on the data analysis that has been conducted. The results should be displayed in a structured form, such as tables, figures, or descriptive explanations, and must directly address the research questions or hypotheses. Avoid unnecessary interpretation in the initial presentation of results, and ensure that all findings are relevant, concise, and clearly explained.

Solid Waste Management in the Coastal Settlement of Tanjung Uma

Waste management in the coastal settlement of Tanjung Uma initially had a policy solution provided by the government through the procurement of garbage trucks in the form of pick-up vehicles to transport household waste to the final disposal site (TPA). However, the program was suddenly discontinued. Based on the conducted interviews, it was found that this occurred due to the damage to the pick-up vehicle, which was never repaired. Consequently, the community returned to previous habits, namely disposing of waste into the surrounding environment, personally transporting household waste to the final disposal site (TPA), or in some cases directly burning the waste.



(a)
Documentation of one of the residents' houses to have a pipe that goes directly to the sea.



(b)
Documentation of coastal settlement conditions

Figure 3. *Solid Waste Conditions in the Coastal Settlement of Tanjung Uma*

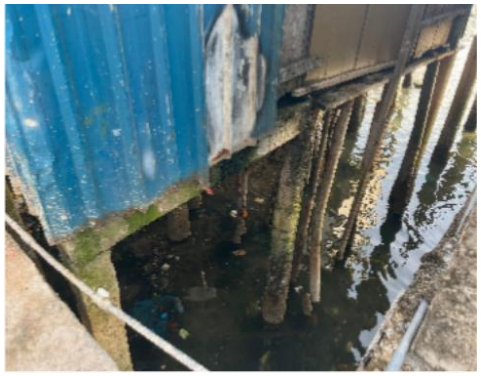
Several environmental communities have initiated waste bank programs in the form of public campaigns encouraging residents to collect plastic waste, such as used plastic bottles, and submit them to the community in exchange for money. However, this program is considered too complicated by residents because they must first remove the labels and bottle caps before the plastic bottles can be deposited into the waste bank. Another environmental community, Seven Clean Seas, which focuses on beach clean-up activities, has also offered voluntary assistance in cleaning waste along the coastal areas of the Tanjung Uma settlement.

However, community participation remains uneven and tends to depend heavily on certain program or helps from environment volunteer. Existing programs are not implemented regularly, and public awareness regarding the importance of the health of environment around them is still relatively low, resulting in uncertain sustainability. This condition is influenced by differences in environmental awareness among residents. Some members of the community possess a strong awareness and concern for environmental preservation, while others are less aware of the importance of maintaining a clean and healthy environment.

One possible solution to address this issue is to encourage the government to continue and improve these waste management programs. In addition, recommendations should be made to develop better spatial planning for coastal settlements in order to improve vehicle circulation and provide more evenly distributed final disposal facilities (TPA). This would reduce the community's dependence on government-provided garbage trucks for transporting household waste.



(a)
Documentation of coastal settlement conditions.



(b)
Documentation of the situation under residents' houses where there is rubbish.

Figure 4. *Solid Waste Conditions in the Coastal Settlement of Tanjung Uma*



Figure 5. *There is a lot of rubbish in the documentation at the location*

Another potential solution is the use of Seabin technology made from lightweight concrete materials to capture and trap waste carried by ocean waves.

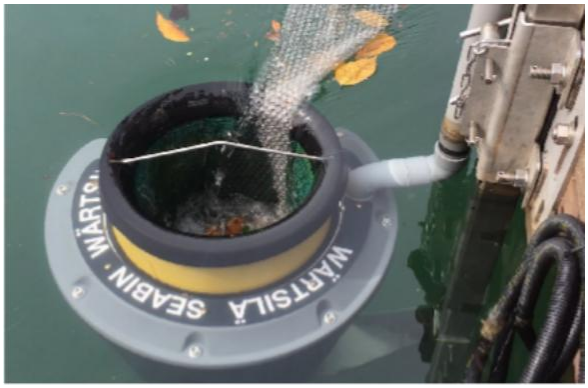


Figure 6. *Seabin*
Source: Robin Hicks. (2018)

One example of the implementation of seabins using lightweight concrete materials can be found in the study entitled *"Analysis of Seabins Using Lightweight Concrete to Clean Up Plastic Waste on the Coast of Semayap Village, Kotabaru Regency"* conducted by Sylvina and Rahman. The study describes a seabin design that can be applied in the coastal area of Semayap Village, Kota Baru.

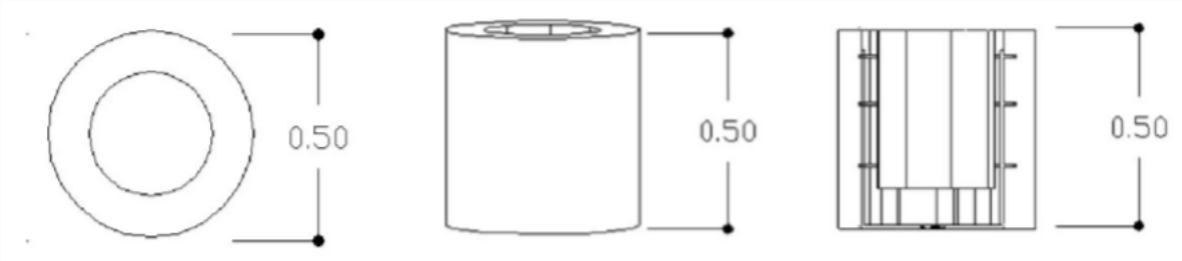


Figure 7. *The design of the seabins is made from lightweight concrete. Source: Permatasari S. (2025).*

Sanitation System Policies in the Coastal Settlement of Tanjung Uma

Another factor contributing to the inadequacy of the sanitation system is the inconsistency and lack of implementation of government programs. Based on the interview results, there had previously been a plan to implement septic tanks initiated by the local public health center approximately three years ago. However, the program was never realized due to a change in leadership.

In addition, waste management facilities in the form of waste collection vehicles that had previously been available also ceased operations without any clear explanation. This inconsistency has reduced public trust in government programs, causing residents to revert to traditional methods that are considered more reliable and less dependent on external parties.

In the Strategic Plan of the Batam City Office of Human Settlements and Spatial Planning (RENSTRA), there are plans for sanitation improvements in mainland hinterland areas. However, there are no sanitation improvement plans specifically directed toward the Tanjung Uma area.

Strategic Issues of Regional Development (RPJMBD)	Determining Factors for Success (RPJMB)	Strategic Issues for the Public Works and Spatial Planning Agency
Developing regions to reduce disparities and ensure equality.	Development of hinterland areas and equal distribution of basic infrastructure.	Increasing the development and management of drinking water supply systems.
		Increasing development of wastewater/sanitation systems.
		Increasing the layout and suitability of buildings and around the environment.

		Increasing the quality and quantity of planning products and the use/management of spatial planning information data.
		Increasing the planning and use of space.
		Increasing control of how space is used.

Table 1. *Table of Strategic Plan for Improvement of Hinterland Regional Development Issues.*
Source: (RENSTRA) Dinas Cipta Karya dan Tata Ruang Kota Batam (2021)

This indicates that the government is aware of development issues in coastal areas that possess inadequate sanitation systems. However, it is unfortunate that there has been no governmental intervention for other coastal areas in Batam City apart from the hinterland regions.

Access to Clean Water in the Settlement of Tanjung Uma

Access to clean water in the Tanjung Uma area is obtained from two main sources, namely the regional water supply company—PDAM (*Perusahaan Daerah Air Minum*) and groundwater wells. Before the availability of PDAM services, residents commonly used dug wells that were collectively constructed through community cooperation for bathing and washing purposes, and some of these wells are still utilized today. Meanwhile, drinking water is predominantly supplied through bottled gallon water for daily consumption.



Figure 8. *Spring Well in Tanjung Uma Coastal Settlement*

However, PDAM services are considered not optimal because experiencing water distribution disruptions, such as unstable water flow or sometimes it stops at certain times, it is from 3:00 PM to 10:00 PM, even the water came at dawn. In addition, the ATB registration fee is also relatively high, reaching IDR 5,500,000. Also not included is the

cost of installing pipes from the meter to the house water and monthly water bill. Sometimes the water often goes off at certain times. This is an obstacle for some people to fully access clean water services.

Waste management system in this area has experienced changes in recent years. Previously, there was a waste transportation facility from the government in the form of a vehicle, there were waste transportation facilities from the government in the form of vehicles to facilitate waste collection services from homes to temporary disposal sites. Currently, some society throw garbage into a temporary disposal in other regions like in the Jodoh area, while others still burn or dump garbage in an uncontrolled manner. This has resulted in a reduction in the quality of waste management services.

In response to complaints from local residents regarding the difficulty of getting clean water, the government and related parties give assistance in the form of water distribution using water tanker trucks that distribute water to communal water reservoirs. Without complaints from local residents, public access to clean water is expected to remain extremely limited. However, the level of difficulty in accessing clean water is different at all each in Tanjung Uma coastal settlement. Some areas still have a relatively stable water supply, while others, especially around the market area and areas closer to the coastal, experience more frequent water distribution disruptions. Therefore, the existence of groundwater wells is an important alternative that helps society to fulfil their daily clean water needs.

One of the biggest issues regarding access to clean water is cost. The government can provide financial support for initial installation costs, including household pipe connections, and implement more affordable water tariffs for local residents. Tax collection rate scheme can also be adjusted to ensure that basic water needs are affordable without burdening the community financially.

Development of communitybased water distribution systems can be implemented through shared water storage tanks; public water taps at location certain points. In this system, clean water is managed collectively by a group of local community members (RT/RW). Such a system is more efficient and can reduce water installation costs for individual households.

Therefore, the provision of clean water in the coastal settlements of Tanjung Uma is not only through an infrastructure development approach but also by considering the community's economy. So that the services provided can be used in a sustainbility by all members of the local residents.

Conclusion

Based on research results, sanitation conditions in the coastal settlements of Tanjung Uma are still largely inadequate, especially in areas near to the coast. This is indicated by the continued practice of discharging domestic wastewater directly into the sea and waste management issues that have the potential to degrade the quality of the coastal environment. In this condition is influenced by some local resident's behavior, which they still dispose of waste into the aquatic environment due to limited sanitation infrastructure and basic services. That's why, improving sanitation conditions is not only

about the availability of facilities and infrastructure, but also requires active community participation in maintaining environmental cleanliness and reducing marine pollution.

As a management strategy, the authors of this research recommend the implementation of a septic tanks system supported by a good sanitation system to reduce direct waste disposal into the sea. And also, to increase the access of clean water through the development of communal clean water systems, do a support funding for installing house pipe connections, application of more affordable clean water cost, as well also optimizing existing well water that has been used by local residents, but for greater safety, it is recommended to do filter or disinfecting well water to support public health. On the other hand, waste management can be supported by implementing waste suction devices (Seabins) as a practical solution to help reduce sea pollution and also to improve the cleanliness of the Tanjung Uma coastal area in a sustainable manner so as to create development prosperity in a healthier and safer environmental life for local residents in coastal settlements areas.

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Competing Interest

The authors state that there is no conflict of interest in the publication of this article.

Generative AI Statement

During the preparation of this manuscript, the authors used ChatGPT to translate article into English. After the process has been done, the authors conducted a review and then translated it into understandable language and critically validated the results to ensure scientific accuracy. The authors are fully responsible for the final content. AI was used solely as a supporting tool, serving as a reference during writing, which was then further modified for the text.