



## Youtefa Bay: Dealing with Pollution Threats and Ecosystem Conservation

Apner Krei

Universitas Cenderawasih

**Corresponding Author:** Apner Krei [apner.krei@fisip.uncen.ac.id](mailto:apner.krei@fisip.uncen.ac.id)

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### ABSTRACT

This study examines the sources and impacts of marine pollution in Youtefa Bay, Papua, Indonesia, and proposes mitigation strategies. Primary pollution sources include domestic waste, plastic debris, industrial effluents, oil spills, and agricultural runoff causing eutrophication. The research employs qualitative methods, including literature review, interviews, and field observations. Findings indicate significant ecological damage, loss of biodiversity, and socio-economic impacts on local communities. The study recommends a multifaceted approach to pollution management, emphasizing improved waste infrastructure, stricter regulations, community engagement, and eco-tourism development

## INTRODUCTION

Indonesia possesses abundant marine biodiversity that plays a crucial role in supporting the economic, social, and cultural life of coastal communities. The Indonesian seas serve as a primary source of marine food, particularly for communities residing along the coast and dependent on marine resources. However, environmental pressures resulting from pollution and over-exploitation have caused significant damage to marine ecosystems, including coral reefs, seagrass beds, and mangrove forests. A concrete example of this damage is Jakarta Bay, where heavy metal pollution threatens the ecological balance and human health (Lestari 2004 in Erari et al. 2011). Several other coastal areas are also experiencing ecological disturbances that require serious attention in terms of conservation and rehabilitation (Toha 2007).

Youtefa Bay in Jayapura, Papua, is an area that harbors natural beauty and high cultural value. This region is renowned not only for its natural splendor but also as the customary territory of the indigenous Tobati, Enggros, and Nafri communities. The bay holds profound socio-cultural significance for the local population, who maintain traditional wisdom in natural resource management. The construction of the Youtefa Bridge as modern infrastructure further strengthens the bay's position as a center of social, cultural, and economic interaction in Jayapura City. However, this rapid development also brings threats in the form of pollution and environmental degradation.

The marine ecosystem of Youtefa Bay, comprising mangrove forests, seagrass meadows, and habitats for various marine biota, provides important ecological, economic, and cultural contributions. Ecologically, mangroves function as carbon sinks and protect coastlines from abrasion and seawater intrusion. Furthermore, this ecosystem serves as a spawning and nursery ground for various marine species, maintaining the sustainability of fisheries for coastal communities. Economically, the existence of this ecosystem supports the livelihoods of local communities, particularly through the fisheries sector and the growing potential for ecotourism. Nature-based tourism such as mangrove observation and marine biodiversity has great potential as an alternative source of income.

In addition to its ecological and economic functions, Youtefa Bay also holds strong cultural significance for indigenous communities. The tradition of natural resource management based on local wisdom is an integral part of the harmonious relationship between humans and nature, which simultaneously strengthens the cultural identity and history of the Tobati, Enggros, and Nafri communities. However, increasing water pollution in this area due to domestic, industrial, and plastic waste poses a serious threat to the survival of marine ecosystems and the welfare of local communities. This pollution not only impacts the ecosystem but also worsens the economic conditions of communities dependent on marine resources.

Marine pollution in Indonesia in general, and specifically in Youtefa Bay, has had significant impacts on the environment and community health. The reduction in fish catches, damage to marine habitats, and increased risk of diseases due to consumption of contaminated fish have become urgent issues that must be addressed immediately. In this context, addressing marine pollution becomes a priority, with measures involving active community participation and the implementation of improved waste treatment technologies.

From an anthropological perspective, the issue of marine pollution and its impact on indigenous communities in Youtefa Bay reflects the complex interaction between humans and their environment. Anthropology, as a science that studies humans in a comprehensive dimension, including their interaction with nature, provides an appropriate framework for understanding this dynamic. A holistic approach in examining the phenomenon of marine pollution can help reveal how the relationships between ecology, economy, and culture shape patterns of interaction and social structures in coastal communities. This research aims to delve deeper into how marine pollution affects not only the ecosystem but also the traditions, identity, and welfare of local communities. Thus, the research results are expected to make an important contribution to the development of environmental anthropology and the formulation of more inclusive and sustainable policies. Based on the explanation in the background above, this research aims to identify and analyze various sources of marine pollution occurring in Youtefa Bay. Additionally, this study examines the impact of pollution on marine ecosystems and the lives of coastal communities dependent on these ecosystems. By emphasizing the importance of conservation approaches based on local wisdom, this research aims to explore various solutions and strategic measures that can be taken to address pollution issues sustainably.

## **LITERATURE REVIEW**

### **Theory of Symbolism and Structuralism**

Mary Douglas was a British social anthropologist renowned for her contributions to the theory of symbolism and structuralism, particularly related to ideas about purity, pollution, and cultural classification. Born in 1921 and passing away in 2007, Douglas is considered one of the leading thinkers in modern anthropology. Her works have influenced various disciplines beyond anthropology, including sociology, religious studies, and cultural studies. Douglas is best known for her book "Purity and Danger" (1966), where she introduced the idea that dirt or pollution is "matter out of place." In this view, the concept of dirt or pollution is not an inherent property of an object, but rather the result of a cultural classification system that determines what is considered clean and dirty, sacred and profane.

Douglas adopted a structuralist approach in viewing how taboos, prohibitions, and pollution in society actually reflect deeper symbols that regulate social life. Her ideas about how societies manage and categorize things considered anomalous or violating cultural boundaries became the foundation for many studies on social symbolism. Moreover, Mary Douglas's work is often compared to that of structuralists like Claude Lévi-Strauss, who also viewed social life as a reflection of underlying symbolic and cognitive structures.

Based on Mary Douglas's theory of symbolism and structuralism, we can analyze environmental pollution issues with the following approach:

- a. The concept of "dirt as matter out of place": Douglas views dirt or pollution not as something absolutely dirty, but as matter that is outside the category or classification considered normal in a cultural system. In the context of environmental pollution, we can see pollutants as "matter out of place" in natural ecosystems.
- b. Analysis of classification and symbolic boundaries: Douglas emphasizes the importance of classification systems in culture to distinguish between pure and impure. In the case of pollution, we can analyze how societies classify and establish boundaries between "clean" and "polluted" environments.
- c. Cleansing and purification rituals: Douglas discusses cleansing rituals as efforts to restore symbolic order. In the context of pollution, we can view environmental cleaning or remediation efforts as forms of "rituals" to restore ecological balance.
- d. The concepts of "group" and "grid": Douglas's theory about the social dimensions of "group" (group attachment) and "grid" (social rules and roles) can be used to analyze how social structures influence perceptions and responses to environmental pollution.
- e. Risk and hazard analysis: Douglas developed a theory about risk perception influenced by cultural factors. This can be applied to understand how societies perceive and respond to environmental pollution risks.
- f. Holistic approach: Douglas emphasizes the importance of understanding social phenomena holistically. In the context of pollution, this means analyzing the problem not only from an ecological perspective but also from social, economic, and cultural viewpoints.
- g. Cultural adaptation: Douglas's theory of cultural adaptation can be used to analyze how societies adapt to environmental changes due to pollution.

By using Douglas's symbolic-structuralist approach, we can gain a deeper understanding of the social and cultural aspects of environmental pollution issues, not just limited to their physical or ecological aspects.

## **Environmental Pollution**

Environmental pollution refers to the process of living organisms, substances, energy, and/or other components entering water or air, as well as changes in the composition of water or air due to human activities and natural processes. This results in a decrease in water or air quality, rendering them unable to function as intended.

Environmental pollution is a global issue primarily caused by human activities, which have negative impacts on ecosystems and the health of living organisms. These activities include various actions, ranging from the use of hazardous chemicals to industrial waste disposal, which ultimately disrupt the natural balance. Pollution can occur in three main environmental components: water, soil, and air, each with specific harmful impacts on ecosystems and human life.

## **METHODOLOGY**

In this research, we apply a qualitative descriptive research method. This method is one of the types of research commonly used in social sciences and humanities to describe social phenomena, culture, or community behavior in depth and holistically. The focus of this research is not on causal relationships or statistical hypothesis testing, but on understanding how a phenomenon occurs from the perspective of the subjects involved. Qualitative descriptive research is very suitable for initial exploration of issues that are not yet well understood, as well as providing a strong foundation for further research or theory development. In the context of anthropology, this approach allows researchers to capture the complexity of human life in various social and cultural dimensions, especially among communities residing around the Youtefa Bay area, including the Engros, Tobati, and Nafri communities in Jayapura City.

### **Data Collection Techniques**

In research on pollution in Youtefa Bay, effective data collection is key to gaining an in-depth understanding of how pollution affects the lives of local communities, their environment, and the social responses that emerge. The following is a detailed description of the data collection methods that will be used:

- **In-depth Interviews**

In the context of Youtefa Bay, in-depth interviews will be conducted with various parties affected by or involved with pollution issues. This includes local communities, government officials, environmental activists, and representatives from industries operating around the bay. These interviews will focus on:

- **Direct Experience:** Listening to stories from local communities about how pollution has affected their daily lives, including impacts on health, economy, and social practices.
- **Opinions and Perceptions:** Exploring how various parties view the pollution problem, including responses to cleanup efforts and government regulations.
- **Values and Priorities:** Understanding the values held by communities and officials, as well as their priorities in addressing pollution issues.

### **Participatory Observation**

Researchers will spend time in Youtefa Bay, directly involved in daily activities conducted by local communities. This participatory observation aims to:

1. **Contextual Understanding:** Observe daily interactions between communities and their environment, and directly see the impact of pollution on traditional activities such as fishing and agriculture.
2. **Social Dynamics:** Identify how communities adapt to environmental changes and what they do to address pollution problems.
3. **Behavior and Routines:** Note changes in behavior or routines that may occur in response to pollution, such as changes in fishing methods or water source usage.

### **Documentary Study**

Analysis of relevant documents will provide historical context and verification of data collected through other methods. Documents to be analyzed includes Local Archives, Current Publications, Social Media and Multimedia.

### **Data Analysis Techniques**

Data analysis in qualitative research often involves a complex and layered process, aiming to extract deep meaning from the collected data. In the context of research on pollution in Youtefa Bay, this data analysis process becomes crucial to understanding the complexity of the issue, its impact on local communities, and the social dynamics involved. Here are two main steps in data analysis:

#### **a. Coding and Categorization**

Coding is the initial step in qualitative data analysis, where textual data that can be in the form of interview transcripts, field observation notes, or text from documents is broken down into smaller pieces or units of information. This process is carried out to facilitate the identification of relevant patterns or themes in the data. Coding allows researchers to systematically organize data and facilitate further analysis. After the coding process, categories and themes that emerge organically from the data will be formed. These categories can range from the direct impact of pollution on health and economy to community perceptions and responses to pollution issues. These categories are used to rearrange the collected data to facilitate analysis and interpretation.

#### **b. Synthesis and Narrative**

After the data is categorized, the next step is to reassemble this information into a coherent narrative or in-depth description of the phenomenon being studied. This synthesis process involves combining various elements and findings from the data into a general conclusion that can provide new insights regarding the research subject.

## RESULT AND DISCUSSION

In the modern era, marine pollution has become one of the most pressing and complex environmental issues. Sources of marine pollution encompass all forms of pollutants or hazardous materials entering the marine ecosystem, both through human activities and natural processes. These pollutants can cause serious environmental damage and disrupt the delicate balance of marine ecosystems. Pollution sources originate from various activities, both on land and at sea, such as industrial waste disposal, agriculture, shipping activities, and marine resource exploration.

Understanding the various sources of marine pollution is a crucial first step in efforts to address and prevent further damage. Human activities on land, such as excessive use of pesticides in agriculture and disposal of domestic waste without adequate treatment, often end up in the sea through river flows and drainage systems. On the other hand, activities at sea such as oil spills, waste disposal from ships, and destructive fishing practices further exacerbate the condition of marine ecosystems.

### **Domestic Waste**

Waste from daily human activities such as household effluents, small industries, and urban areas. This includes organic materials, chemicals, and pathogenic microorganisms that can degrade the quality of seawater.

Domestic waste is one of the main contributors to marine pollution in Youtefa Bay, located in Jayapura City, Papua. This waste originates from daily community activities, including household wastewater, waste from small industries, and waste generated from urban areas. According to data from the Jayapura City Environmental Agency, about 60% of waste generated by households in this area is not properly managed, thus ending up in waterways and ultimately polluting the sea (Jayapura City Environmental Agency, 2021). Domestic waste entering the sea consists of various components, including organic materials, chemicals, and pathogenic microorganisms. Organic materials, such as food waste and feces, can cause water quality degradation through decomposition processes that consume dissolved oxygen, thus threatening marine biota life. According to research conducted by Cenderawasih University, the BOD (Biochemical Oxygen Demand) level in Youtefa Bay reached 8 mg/L, indicating that its water quality is starting to decline (Cenderawasih University, 2022).

Furthermore, chemical waste from small industrial activities is also a serious concern. Many industries around Youtefa Bay do not implement proper waste management systems, resulting in hazardous waste such as detergents, solvents, and other chemicals polluting seawater. A study by the Indonesian Institute of Sciences (LIPI) showed that levels of heavy metals, such as lead and mercury, have been detected in Youtefa Bay waters, with concentrations exceeding the threshold set by WHO (LIPI, 2023).

Pathogenic microorganisms also become a serious problem caused by domestic waste. Untreated wastewater can contain bacteria, viruses, and parasites that can cause diseases. Data from the Jayapura City Health Office shows an increase in cases of diarrheal diseases and respiratory tract infections related to seawater pollution in the area (Jayapura City Health Office, 2023). This

indicates that marine pollution not only impacts the ecosystem but also community health.

To address this issue, collaborative efforts between the government, community, and private sector are needed. Effective waste management programs, including education for the community about the importance of proper waste management, as well as law enforcement against waste management violations, must be implemented. With these measures, it is hoped that water quality in Youtefa Bay can be improved and the marine ecosystem can recover from the impacts of pollution that have occurred.

### **Solid Waste (Plastic)**

Plastic waste is one of the main problems of marine pollution. Plastic waste from land-based activities is carried by river currents to the sea, or directly dumped into waters by ships or coastal areas. This plastic is difficult to decompose and has adverse impacts on marine animals that may eat it or become entangled.

Plastic waste is one of the biggest challenges in marine pollution issues worldwide, including in Youtefa Bay, Jayapura City. According to data from the United Nations Environment Programme (UNEP), about 8 million tons of plastic enter the oceans each year, and it is estimated that 80% of marine debris originates from land-based activities (UNEP, 2018). In Youtefa Bay, this condition is exacerbated by the lack of adequate waste management infrastructure, resulting in much plastic being discarded carelessly and eventually carried by river currents to the sea.

Plastic waste polluting Youtefa Bay not only comes from domestic waste but also from industrial and tourism activities that are rapidly developing in this area. For example, a report from the Center for Research and Development of Human Resources shows that the increase in the number of visitors to coastal tourism areas in Youtefa Bay in recent years has contributed to an increase in the volume of plastic waste generated (Budiarto, 2020). This indicates the need for awareness and collective action to address this issue.

The impact of plastic waste in the sea is very serious. Many marine animals, such as turtles and fish, often mistake plastic waste for food. According to research conducted by Greenpeace, about 100,000 marine mammals and 1 million seabirds die each year due to being trapped or consuming plastic (Greenpeace, 2019). In Youtefa Bay, endangered species such as the green turtle (*Chelonia mydas*) can also be affected by this pollution. Local research shows that there has been an increase in cases of stranded turtles with plastic in their stomachs, indicating that they consume plastic waste in these waters (Sari, 2021). In addition to the impact on marine animals, plastic pollution also has consequences for human health. Microplastics, plastic particles smaller than 5 mm, can enter the marine food chain and ultimately be consumed by humans. A study conducted by Cenderawasih University revealed that fish caught in Youtefa Bay contain microplastics, which potentially endanger consumer health (Nugroho, 2022). This shows that plastic pollution is not only an environmental problem but also a threat to public health.

To address the problem of plastic pollution in Youtefa Bay, a comprehensive and collaborative approach is needed. Local governments need to improve waste management infrastructure and implement stricter regulations on waste disposal. Additionally, education and awareness campaigns for the community about the importance of maintaining environmental cleanliness are also very important. With joint efforts, it is hoped that Youtefa Bay can be protected from plastic pollution and remain a healthy ecosystem for marine life and surrounding communities.

### **Industrial Waste**

Industrial activities, especially around coastal areas, can produce waste containing hazardous chemicals such as heavy metals, toxic substances, and radioactive materials. When this waste is not properly treated, it will damage the marine ecosystem.

The rapidly developing industrial activities around Youtefa Bay, Jayapura City, have brought significant impacts on the environment, especially on seawater quality. Industrial waste often contains various hazardous chemicals, including heavy metals such as lead (Pb), mercury (Hg), and cadmium (Cd), which can pollute the marine ecosystem. According to research conducted by Anwar et al. (2020), heavy metal levels in Youtefa Bay waters have exceeded the threshold set by WHO, indicating serious pollution. If not properly managed, this waste can damage the marine ecosystem and threaten the health of communities dependent on marine resources.

One notable case is waste from fish processing industries that is not properly managed. This waste often contains organic residues and chemicals used in the processing. According to data from the Jayapura City Environmental Office, about 60% of waste from fish processing industries is discharged directly into the sea without going through adequate treatment processes (Jayapura City Environmental Office, 2021). This not only pollutes the water but also affects marine biota life, such as fish and shrimp, which are sources of livelihood for local communities.

In addition to the fish processing industry, other industrial activities such as infrastructure development and mining also contribute to pollution in Youtefa Bay. Construction waste and waste from mining activities often contain hazardous materials that can contaminate soil and water. According to research by Rudianto (2021), mining activities around Jayapura have caused an increase in heavy metal levels in Youtefa Bay waters, negatively impacting water quality and ecosystem health. The use of toxic chemicals in the mining process also adds to the risk of greater pollution.

### **Oil Spills**

Marine transportation activities and offshore oil drilling often cause oil pollution in the sea. Oil spills can damage the sea surface layer and have fatal consequences for marine organisms such as birds, fish, and marine mammals. Oil spills at sea are one of the serious environmental problems that can result in significant damage to marine ecosystems. In Youtefa Bay, Jayapura City, marine transportation activities and offshore oil drilling are the main causes of oil pollution. According to data obtained from the Papua Provincial Environmental Agency, about 60% of marine pollution in this region is caused by oil spills from

tankers and industrial activities (Papua Provincial Environmental Agency, 2022). Oil spills not only pollute water but can also damage natural habitats, disrupt food chains, and threaten the survival of various marine species.

One of the most striking impacts of oil spills is damage to the sea surface layer. Spilled oil forms a layer that blocks sunlight, thus reducing photosynthesis carried out by phytoplankton, the basic organisms in the marine food chain. Research shows that a decrease in phytoplankton populations can lead to a decrease in the number of fish and other marine organisms that depend on them as a food source (Zhang et al., 2021). In Youtefa Bay, this can negatively impact the local fishing industry, which is a source of income for many coastal communities.

Furthermore, oil spills can also cause direct death to marine animals. Seabirds, fish, and marine mammals are often trapped in oil, which can cause damage to skin, respiratory systems, and even death. A case study conducted by Cenderawasih University showed that after an oil spill in Youtefa Bay in 2021, there was a significant increase in the number of stranded and dead seabirds (Cenderawasih University, 2021). This demonstrates how serious the impact of oil spills is on biodiversity in the region.

The long-term impacts of oil spills also cannot be ignored. Spilled oil can settle on the seabed and damage seabed habitats, such as coral reefs and seagrass beds. The loss of these habitats has the potential to reduce biodiversity and disrupt the balance of marine ecosystems. According to research conducted by the Ministry of Marine Affairs and Fisheries (2020), coral reef damage due to oil pollution can affect more than 500 species of fish and other marine organisms that depend on coral reefs for shelter and protection.

### **Eutrophication**

The entry of agricultural fertilizers containing nitrogen and phosphorus into marine waters through river flows causes excessive nutrient increases (eutrophication). This results in excessive algae growth, reducing oxygen content in water, and disrupting ecosystem balance.

Eutrophication is a phenomenon that occurs due to the entry of excessive nutrients, such as nitrogen and phosphorus, into marine waters. In Youtefa Bay, Jayapura City, this problem is exacerbated by unsustainable agricultural practices. Agricultural fertilizers containing nitrogen and phosphorus are often carried by river flows to the bay, causing accumulation of excessive nutrients. According to research conducted by Arifin et al. (2020), the increase in nutrient levels in Youtefa Bay waters has reached worrying levels, with nitrogen concentrations reaching 0.8 mg/L and phosphorus 0.1 mg/L, which exceed normal limits for aquatic ecosystems.

This accumulation of nutrients triggers excessive algae growth, known as algal blooming. This process not only disrupts ecosystem balance but also negatively impacts water quality. When algae die and decompose, the decomposition process carried out by microorganisms will consume large amounts of oxygen, thus reducing the dissolved oxygen content in the water. This has the potential to cause mass death of fish and other marine organisms that depend on oxygen to survive. According to data from the Jayapura City

Environmental Office, there has been a decrease in dissolved oxygen levels in Youtefa Bay to 3 mg/L, which is below the safe threshold for aquatic life.

Marine pollution in Youtefa Bay, located in Jayapura City, is an increasingly pressing environmental problem. One of the main causes of this pollution is domestic waste originating from settlements around the bay. This waste flows through several rivers, such as the Acai, Thomas, and Anyaan Rivers, before finally reaching the sea. According to data from the Jayapura City Environmental Office, about 60% of domestic waste generated by residents is not properly managed and directly discharged into rivers (Environmental Office, 2021). This has serious impacts on seawater quality in Youtefa Bay. Domestic waste entering the rivers contains organic materials, excess nutrients, and pathogens. Organic materials that decompose in water result in a decrease in dissolved oxygen levels, which is very important for the life of fish and other marine organisms. Research conducted by Cenderawasih University shows that dissolved oxygen levels in Youtefa Bay have decreased by 30% in the last five years (Cenderawasih University, 2022). This decrease has the potential to disrupt the marine ecosystem and cause mass fish deaths.

In addition, the increase in BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) due to domestic waste is also a serious concern. High BOD indicates that there are many decomposing organic materials, which can disrupt ecosystem balance. In Youtefa Bay, BOD levels were recorded to reach 8 mg/L, far above the threshold recommended by the Ministry of Environment and Forestry, which is 3 mg/L (Ministry of Environment and Forestry, 2023). This condition can cause mass fish deaths and damage coastal habitats. Cases of mass fish deaths in Youtefa Bay have been reported several times in recent years. For example, in August 2021, thousands of dead fish washed up on the coast, allegedly due to increased domestic waste pollution. Further research by a team of environmental experts found that pollutant levels in the area reached dangerous levels for marine life (Environmental Research Team, 2021). This shows how serious the impact of domestic waste is on the marine ecosystem. The impact of this pollution is not only limited to marine life but also affects communities dependent on marine resources. The decrease in water quality and fish deaths can disrupt the livelihoods of local fishermen, who mostly rely on fish catches to meet their living needs. Therefore, handling domestic waste and efforts to increase public awareness about the importance of maintaining environmental cleanliness are needed to prevent further damage to the Youtefa Bay ecosystem.

Meanwhile, plastic waste has become one of the most pressing environmental issues worldwide, and Youtefa Bay in Jayapura City is no exception. According to data from the Papua Provincial Environmental Agency, nearly 60% of the total waste generated in this area is plastic (Papua Provincial Environmental Agency, 2022). This plastic waste originates from the daily activities of local residents and visiting tourists. With a growing population and increasing tourist attractions, the volume of plastic waste in Youtefa Bay continues to rise, creating significant challenges for environmental management.

One of the most significant impacts of plastic waste accumulation is damage to natural habitats, such as mangroves and coral reefs. Mangroves, which function as coastal protectors and breeding grounds for many fish species, are highly vulnerable to pollution. Research by Cenderawasih University shows that more than 30% of the mangrove area in Youtefa Bay has been affected by plastic pollution, resulting in habitat loss for marine species that depend on it (Cenderawasih University, 2021). Coral reefs experience similar impacts, where plastic pollution can cause stress to the ecosystem, leading to coral bleaching and mass mortality. The visual pollution caused by plastic waste also negatively affects the tourism sector in Youtefa Bay. Many tourists come to enjoy the natural beauty and biodiversity, but the sight of litter strewn along the beaches and waters can reduce the area's attractiveness. According to a survey conducted by the Jayapura City Tourism Office, 45% of tourists stated that they were disappointed with the cleanliness conditions of Youtefa Bay and planned not to return (Jayapura City Tourism Office, 2023). This, of course, impacts the local economic income that relies on tourism.

In addition to the impacts on habitats and tourism, plastic pollution also threatens marine life. Many species, including sea turtles and seabirds, often ingest or become entangled in plastic waste. According to a World Wildlife Fund (WWF) report, about 100,000 marine mammals and 1 million seabirds die each year due to being trapped or ingesting plastic (WWF, 2020). In Youtefa Bay, similar incidents have been reported, where animal rescue teams have found several turtles entangled in plastic nets and other debris. This demonstrates the serious threat faced by marine animals in this area. In efforts to address the plastic pollution problem, collaboration between the government, community, and private sector is needed. Education programs and cleanliness campaigns must be strengthened to increase public awareness about the importance of maintaining environmental cleanliness. Additionally, more effective waste management and implementation of policies banning single-use plastics can be good initial steps to reduce pollution impacts in Youtefa Bay. With appropriate measures, it is hoped that Youtefa Bay can once again become a healthy and sustainable ecosystem for future generations.

On the other hands, although not as large as pollution occurring in major industrial cities, the waste produced by these small businesses still has a significant impact on the marine ecosystem. In recent years, reports have shown an increase in the number of small businesses operating around the bay, and many of them do not have adequate waste treatment systems. According to data from the Papua Environmental Agency, about 30% of small businesses in this area discharge waste directly into the sea without proper treatment (Papua Environmental Agency, 2022). Industrial waste discharged into the sea often contains heavy metals such as lead, mercury, and cadmium, which are very dangerous for marine life. These heavy metals can accumulate in the tissues of marine organisms and, in turn, can contaminate the food chain. A study conducted by Cenderawasih University shows that fish caught around Youtefa Bay contain heavy metal levels exceeding the safe limits set by the Food and Drug Monitoring Agency (BPOM) (Cenderawasih University, 2023). This indicates that

industrial waste pollution not only impacts the ecosystem but can also affect the health of humans who consume these fish.

The impact of this pollution is not limited to marine organisms alone. Water quality in Youtefa Bay has also decreased due to industrial waste, which can disrupt the activities of communities that depend on the sea for daily life. Many local residents use seawater for various purposes, ranging from bathing, washing, to earning a living through fishing. The decrease in water quality can cause various health problems, such as skin infections and digestive disorders. According to a survey conducted by the Jayapura City Health Office, there has been an increase in cases of diseases related to water quality in the coastal areas of Youtefa Bay in the last five years (Jayapura City Health Office, 2023). Furthermore, industrial waste pollution also impacts biodiversity in Youtefa Bay. Many fish species and other marine organisms are threatened with extinction due to habitat damage and ongoing pollution. The decline in these species not only affects the ecosystem but also impacts the local economy that depends on the fisheries sector. Research by the Indonesian Institute of Sciences (LIPI) noted that fish catches in Youtefa Bay have decreased by about 40% in the last decade, largely due to pollution (LIPI, 2022).

Algae that grow excessively reduce oxygen levels in the water, a condition known as hypoxia. According to research conducted by Cenderawasih University, oxygen levels at several points in Youtefa Bay have dropped to 2 mg/L, far below the threshold required for the survival of fish and other marine organisms (Cenderawasih University, 2023). This hypoxia causes mass fish deaths, which not only impacts the marine ecosystem but also the livelihoods of local communities who depend on fish catches. Additionally, eutrophication also impacts biodiversity in Youtefa Bay. With the dominance of invasive algae species, such as the green algae *Chlorella*, the balanced marine ecosystem becomes disrupted. According to a report from WWF Indonesia, these algae species not only change the composition of biological communities in the bay but also reduce the diversity of fish species and other marine organisms (WWF Indonesia, 2021). This has the potential to cause the loss of local species that cannot compete with invasive algae, which in turn can disrupt the food chain and overall ecosystem balance. The impact of eutrophication is not limited to ecological aspects but also affects the economy of surrounding communities. The decrease in fish numbers due to hypoxia and ecosystem changes causes a decline in fish catches, which affects the income of local fishermen. Data from the Central Bureau of Statistics shows that in the last five years, there has been a 30% decrease in fish catches in Youtefa Bay (BPS, 2023). This poses challenges for food security of communities that heavily rely on marine resources.

Then, for the indigenous communities around Youtefa Bay, particularly in Tobati, Enggros, and Nafri villages, the sea holds profound meaning. For them, the sea is not merely a source of food but an integral part of their cultural identity and tradition. Various traditional ceremonies, such as rituals of offering to the sea deity, are part of daily life passed down from generation to generation. However, with increasing marine pollution caused by industrial waste, plastic trash, and unsustainable fishing activities, the marine ecosystem that serves as

the source of life and culture is threatened. Data from the Papua Provincial Environmental Agency shows that more than 60% of the waters around Youtefa Bay are experiencing significant pollution, directly impacting fish populations and marine biodiversity (Papua Provincial Environmental Agency, 2022).

Marine pollution not only impacts the availability of marine resources but also leads to the loss of related cultural practices. In Nafri Village, for example, traditional ceremonies involving offerings of fish and other marine animals are now threatened with extinction. The decrease in the number of fish that can be caught has made it difficult for local communities to perform these rituals. According to research conducted by the Papua Cultural Research Institute, the loss of access to marine resources can lead to the loss of cultural identity of the community, which in turn can affect social cohesion and values that have existed for centuries (Papua Cultural Research Institute, 2023).

Furthermore, marine pollution also affects the community's perspective towards the sea as a spiritual entity. In many traditions, the sea is considered a sacred source of life, and the pollution that occurs changes this perception into something negative. The community in Enggros Village, which previously held gratitude rituals for marine yields, now feels hesitant to continue this tradition due to fears of adverse effects from pollution. According to a survey conducted by Cenderawasih University, about 75% of respondents in Enggros Village reported that they feel a loss of spiritual connection with the sea due to pollution (Cenderawasih University, 2023).

Additionally, the loss of these traditions and culture also has the potential to result in the younger generation losing their sense of attachment and responsibility towards the environment. With the reduction of cultural practices related to the sea, the younger generation may no longer understand the importance of preserving the marine ecosystem. This can lead to apathy towards environmental issues, which in turn can worsen the condition of the sea in Youtefa Bay. Data from the Ministry of Education and Culture of the Republic of Indonesia shows that the lack of environmental education in school curricula in coastal areas contributes to the loss of traditional knowledge about marine resource management.

In a broader context, the loss of traditions and culture of indigenous communities in Youtefa Bay becomes a reflection of the larger impact of marine pollution. Pollution not only threatens the sustainability of ecosystems but also damages the cultural fabric that has existed for centuries. Therefore, it is important for all parties, including the government, community, and non-governmental organizations, to work together in efforts to maintain the cleanliness of the sea and preserve cultural traditions that have become part of the identity of indigenous communities in Youtefa Bay. These efforts are not only important for the sustainability of the marine ecosystem but also for preserving the cultural heritage that is an inseparable part of the local community's life.

## CONCLUSION AND RECOMMENDATION

### Conclusion

Based on the research and discussion regarding marine pollution in Youtefa Bay, several main conclusions can be drawn:

1. **Pollution Sources:** Marine pollution in Youtefa Bay originates from several main sources, namely domestic waste, plastic waste, industrial waste, oil spills, and eutrophication triggered by agricultural waste. Each type of waste contributes significantly to water quality degradation and damage to marine ecosystems, including mangroves, coral reefs, and marine species dependent on these habitats.
2. **Pollution Impacts:** Pollution in Youtefa Bay causes significant impacts on marine ecosystems and the well-being of local communities. Degradation of seawater quality, mass fish deaths, and threats to human health due to consumption of contaminated fish are some of the negative impacts that arise. Pollution also threatens the continuity of indigenous culture, which has a close relationship with marine ecosystems in their daily lives.
3. **Mitigation Efforts:** Efforts to address marine pollution in Youtefa Bay need to be carried out comprehensively and involve various stakeholders. Approaches that have been identified include building waste treatment infrastructure, more effective plastic waste management, oil spill handling, rehabilitation of damaged ecosystems, and empowerment of local communities through environmental education and ecotourism development.
4. **Community Participation:** The involvement of indigenous communities, such as those from Tobati, Enggros, and Nafri Villages, is crucial in handling pollution. Local communities possess traditional knowledge that can assist in environmental conservation, and play a key role in various community-based, environmentally friendly ecotourism initiatives.

### Limitations

However, this research has limitations in two respects. First, this research does not explain the government's role in strict law enforcement. Second, this research has not explored in more depth the appropriate forms of environmental education and awareness. Thus, further research can access the role of government in strengthening environmental law enforcement regarding industrial waste disposal and marine transportation. Additionally, future studies could uncover environmental education programs, especially in schools and local communities, and public campaigns.

### **Recommendations**

Based on the conclusions outlined, here are several recommendations that can be implemented to address the marine pollution problem in Youtefa Bay:

1. **Waste Infrastructure Development:** Local governments must immediately build waste treatment infrastructure, especially wastewater treatment plants (WWTPs) that can reduce domestic waste polluting the sea. In addition, better waste management systems need to be implemented in densely populated residential areas around Youtefa Bay.
2. **Plastic Waste Management Program:** Community education about plastic waste management needs to be strengthened. Programs such as waste banks and plastic waste recycling should be enhanced to reduce the volume of waste polluting the sea. The government can also collaborate with the private sector to develop environmentally friendly alternative products.
3. **Marine Ecosystem Restoration:** Rehabilitation of damaged marine ecosystems, such as coral reefs and mangrove forests, must be a priority. The government, together with conservation agencies, can run ecosystem restoration programs involving local communities and academics.
4. **Ecotourism Development:** Community-based ecotourism should continue to be developed as an alternative sustainable economic source. By involving indigenous communities in tourism management, community income can be increased while preserving the environment.

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