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The Impact of Tourism Activities on Marine Ecosystem Degradation and Mitigation Strategies Through Upstream Waste Management in Kabila Bone Subdistrict, Indonesia

Andre Mopili[1], Abdul Wahab Podungge[2], Jefri Polinggapo[3], Nirmala A Sahi[4], Dikson Junus[5], Dewi Walahe[6]
[1]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, andremopili689@gmail.com
[2]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, wahabpodungge@gmail.com
[3]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, jefripolinggapo03@gmail.com
[4]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, nirmalasahi287@gmail.com
[5]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, diksonjunus@unigo.ac.id
[6]Fakultas Ilmu Sosial Dan Ilmu Politik, Universitas Gorontalo, dewi.walahe31@gmail.com

*Corresponding author: andremopili689@gmail.com

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ABSTRACT

The development of coastal tourism provides important economic opportunities for coastal communities but may simultaneously increase anthropogenic pressure on marine and coastal ecosystems. In Kabila Bone Subdistrict, Bone Bolango Regency, Gorontalo Province, tourism activities are accompanied by problems related to coastal waste, water quality, ecosystem disturbance, and the movement of land-based waste through river systems toward the sea. This study aims to analyze the impact of tourism activities on marine ecosystem degradation and identify mitigation strategies based on upstream waste management in Kabila Bone Subdistrict. The study employed a descriptive qualitative approach using a case study design. Data were collected through direct observation, semi-structured interviews, and documentation involving government representatives, tourism managers, coastal communities, and fishers. Data were analyzed through data reduction, data display, and conclusion drawing, supported by NVivo analysis. The findings indicate that marine ecosystem degradation in the study area occurs through four interconnected dimensions: declining coastal water quality, deterioration of coral reefs, mangroves and seagrass ecosystems, accumulation of waste in coastal areas, and disturbance to marine organisms. The findings further indicate that waste originating from settlements and upstream areas and transported through river flows contributes to cumulative environmental pressure on coastal areas. The main constraints are inadequate waste management, limited environmental awareness, insufficient monitoring, and fragmented coordination among stakeholders. Six strategic measures are identified: strengthening environmental regulations, developing local environmental institutions, implementing the 3R principles, strengthening environmental education, managing river flows and upstream waste sources, and establishing multi-stakeholder collaboration. The study concludes that mitigation of marine ecosystem degradation requires an integrated upstream-to-coastal governance approach rather than relying exclusively on coastal clean-up activities. Strengthening local institutional capacity and collaborative governance is therefore essential for developing sustainable coastal tourism in Kabila Bone.

INTRODUCTION

Coastal and marine tourism has become an important component of regional economic development because coastal areas provide recreational, ecological, cultural, and economic resources for local communities. Tourism activities such as beach recreation, snorkeling, diving, boating, and coastal accommodation can generate

employment and increase local income. However, increasing tourism intensity can also create additional environmental pressure when the growth of tourism infrastructure and visitor activities is not accompanied by adequate environmental governance and waste-management capacity.

Marine ecosystem degradation is increasingly recognized as a multidimensional problem resulting from the interaction of tourism, settlements, pollution, resource exploitation, and other anthropogenic pressures. Human impacts on marine ecosystems have accelerated in many parts of the world, creating cumulative pressures that affect water quality, habitats, biodiversity, and ecosystem services (Halpern et al., 2021). Coastal tourism may intensify these pressures through increased generation of solid waste, wastewater, transportation activities, and physical interaction with sensitive habitats.

Waste pollution is particularly important because marine litter does not necessarily originate from activities conducted directly at the coast. A substantial proportion of marine debris is transported from land through drainage systems and rivers. Global research has demonstrated the importance of rivers as pathways for plastic emissions to the ocean (Lebreton et al., 2017; Meijer et al., 2021). Consequently, coastal waste management that focuses only on beach cleaning is insufficient if waste generation and leakage are not controlled at upstream sources.

The relationship between tourism and coastal waste has also been documented in Indonesia. Research in coastal tourism destinations has identified plastic waste and marine debris as important environmental challenges. Barends et al. (2023), for example, highlighted the relationship between coastal tourism development and waste-management challenges in Central Maluku. Similarly, Wijayanti et al. (2025) demonstrated the importance of marine debris management for maintaining beach cleanliness and sustainable tourism in Prigi Bay. Research in Gorontalo has also indicated that tourism and residential activities contribute to coastal pollution (Salam et al., 2023).

The ecological consequences of marine waste extend beyond visual pollution. Plastic and microplastic contamination may affect marine organisms and ecosystem processes. Recent studies have emphasized the ecological risks associated with microplastic pollution, including ingestion by marine organisms and potential transfer through food webs (Baby & V S, 2025). Therefore, waste-management interventions need to be designed as preventive measures that reduce waste leakage before it reaches sensitive coastal ecosystems.

The environmental governance perspective is particularly relevant to this problem. Coastal environmental management involves multiple actors, including local governments, tourism managers, communities, fishers, businesses, and environmental institutions. Public administration therefore plays an important role in developing regulations, coordinating stakeholders, monitoring environmental conditions, and ensuring policy implementation. Contemporary public governance emphasizes collaboration among governmental and non-governmental actors in addressing complex public problems (Osborne, 2020; Rosenbloom et al., 2022).

Kabila Bone Subdistrict represents an important case because it combines coastal tourism activities, residential settlements, river systems, and communities whose livelihoods are connected to coastal resources. The study documented concerns regarding waste accumulation, episodic changes in water conditions, environmental pressures around tourism locations, and the movement of waste from land toward the coastal zone. Informants indicated that although coastal water may still appear visually normal under ordinary conditions, turbidity and waste accumulation occur at particular times and locations.

Previous studies in Gorontalo have examined coastal tourism, carrying capacity, community participation, and marine waste. However, the present study focuses specifically on the relationship between tourism activities, marine ecosystem degradation, and **upstream waste management** within a single coastal governance system. This focus represents an important contribution because waste transported through rivers cannot be effectively addressed solely through downstream intervention.

Accordingly, this study addresses two research questions: (1) how does increasing tourism activity contribute to marine ecosystem degradation in Kabila Bone Subdistrict? and (2) what upstream waste-management strategies are appropriate for mitigating such degradation under the environmental, social, and institutional conditions of the area?

METHODS

Research Design

This study employed a qualitative research approach with a naturalistic, exploratory, and interpretive orientation. The qualitative approach was selected because the study sought to understand the social and environmental dynamics surrounding tourism activities, waste management, ecosystem degradation, and stakeholder responses in their actual context. Qualitative research is appropriate for examining complex social phenomena in which meanings, perceptions, experiences, and institutional relationships are important analytical dimensions (Aspers & Corte, 2019; Tracy, 2020).

The research used a qualitative case study design. Kabila Bone Subdistrict was treated as the case because it represents a coastal area where tourism development interacts with residential activities, river systems, waste-management challenges, and marine ecosystem protection. Case study research allows complex phenomena to be examined within their real-life contexts using multiple sources of evidence (Baxter & Jack, 2021; Yin, 2021).

Research Location and Period

The research was conducted in Kabila Bone Subdistrict, Bone Bolango Regency, Gorontalo Province, Indonesia. The area was selected purposively because of its coastal characteristics, tourism development, riverine connections to the coastal zone, and the absence of previous research specifically integrating tourism impacts, marine ecosystem degradation, and upstream waste management.

Field research was conducted during January–February 2026. The research activities consisted of preparation, field observation, interviews, documentation, data analysis, and preparation of the research report.

Data Sources and Participants

The study used primary and secondary data. Primary data were obtained through field observation, semi-structured interviews, and documentation. Informants were selected purposively based on their relevance to the research problem. They included government representatives, tourism managers, coastal communities, and coastal fishers.

The interview instrument was semi-structured, allowing the researcher to explore informants' experiences and perceptions while maintaining consistency across research themes.

Data Collection

Observation

Direct observations were conducted in coastal tourism areas, settlements, river-connected areas, and locations where waste could potentially enter the coastal environment. Observation was used to identify environmental conditions and social practices that might not be fully captured through interviews.

Semi-Structured Interviews

Semi-structured interviews were conducted with selected informants. The interview process explored perceptions of water quality, ecosystem conditions, waste sources, tourism impacts, environmental regulation, institutional capacity, community participation, and potential mitigation strategies.

Documentation

Documentation included field photographs, administrative information, supporting records, and other relevant materials. Documentation was used as supporting evidence and for triangulation.

Data Analysis

Qualitative data were analyzed through three principal stages: data reduction, data display, and conclusion drawing. NVivo was used to support the organization and thematic interpretation of qualitative data.

The analysis identified recurring themes and relationships among tourism activities, waste sources, environmental impacts, institutional responses, and mitigation strategies. The study also used bibliometric analysis supported by Publish or Perish and VOSviewer to map relevant research trends concerning marine debris, coastal tourism, marine pollution, and blue economy. Bibliometric analysis can be used to identify publication patterns and conceptual relationships within a research field (Donthu et al., 2021).

Thematic interpretation was conducted by comparing interview findings, observations, documentation, and relevant literature. This approach strengthened the credibility of the findings through triangulation and systematic thematic analysis (Nowell et al., 2022).

RESULTS

Marine Ecosystem Degradation in Kabila Bone

The findings demonstrate that marine ecosystem degradation in Kabila Bone is multidimensional. Four major themes emerged from the qualitative analysis: declining water quality, deterioration of coastal ecosystems, waste accumulation, and disturbances to marine organisms. These dimensions are interconnected rather than independent.

Declining Coastal Water Quality

The findings indicate that coastal water quality in Kabila Bone is not yet perceived as severely degraded under ordinary visual conditions. However, informants reported episodic changes, particularly increased turbidity in several coastal locations. These changes were associated with periods of increased community activity and the movement of waste and materials from land through river flows.

One tourism manager explained that the water generally appeared normal but could change at particular times, especially when land-based waste entered the sea through rivers. Another informant identified household waste and improperly discarded materials as important sources of the problem.

The findings suggest that the degradation process can be characterized as **latent or gradual degradation**. The absence of obvious visual pollution does not necessarily indicate that the ecological condition is fully healthy. This is important from a public-management perspective because environmental management based exclusively on visual observation can become reactive rather than preventive.

The river system represents an important pathway connecting inland waste sources to the coastal environment.

Therefore, interventions limited to the coastal area may have limited effectiveness if waste generation and leakage upstream remain uncontrolled.

Degradation of Coral Reefs, Mangroves, and Seagrass

The second major finding concerns changes in the condition of coral reefs, mangroves, and seagrass ecosystems. Informants indicated that these ecosystems remain present in the study area, but several locations have shown signs of declining condition compared with previous observations.

The degradation was particularly associated with areas close to human activities and tourism locations. Informants also perceived waste accumulation as a potential factor affecting these ecosystems.

These findings indicate that the three ecosystems should be considered as an integrated ecological system. Coral reefs provide habitat and coastal protection, mangroves function as a transition and filtering ecosystem, while seagrass beds provide nursery habitat and contribute to sediment stabilization and carbon storage (Novita Sari et al., 2021; Triwibowo, 2023).

Consequently, degradation of one component may reduce the resilience of the wider coastal ecosystem. The findings therefore support the need for ecosystem-based coastal management rather than isolated interventions.

Accumulation of Waste in Coastal Areas

Waste accumulation was one of the most consistently identified environmental problems. Waste was observed in several coastal locations, particularly around residential areas and tourism sites. Plastic materials and household waste were identified as common forms of coastal debris.

The distribution of waste was not uniform. Instead, waste tended to accumulate at particular locations and times because of marine currents and river flows. Informants identified three broad sources: residential activities, tourism activities, and waste transported through rivers from inland areas.

This finding is important because it demonstrates that coastal waste is not exclusively a tourism problem. Tourism activities may increase local waste generation, but the coastal environment is also affected by waste originating outside the immediate tourism area.

The situation is consistent with the broader literature demonstrating that rivers are important pathways for transferring land-based plastic waste into marine environments (Lebreton et al., 2017; Meijer et al., 2021).

Disturbance to Marine Organisms

The fourth dimension concerns disturbances to marine organisms. The study identified concerns regarding changes in marine organisms and the potential effects of waste and declining environmental quality on fish and other marine life.

The concern is particularly relevant to coastal communities because fishers depend directly on the health and productivity of marine ecosystems. Environmental degradation may therefore produce ecological as well as socioeconomic consequences.

The study discussion also highlights the importance of marine megafauna, including the whale-shark tourism context in Botubarani. However, because the present research is qualitative and did not undertake biological population surveys or laboratory measurements, the findings should be interpreted as evidence of perceived ecological pressure rather than quantitative evidence of population decline.

Upstream Waste-Management Mitigation Strategies

The second major research focus identified six interconnected strategies for mitigating marine ecosystem degradation.

Strengthening Environmental Regulation

The study found that environmental regulation exists as an important policy foundation, but implementation remains insufficiently mature. Local actors reported that waste-management arrangements were still developing and that environmental education and training were needed.

The situation can be described as a transition from policy socialization toward stronger implementation. The existence of regulation does not automatically guarantee environmental improvement. Effective implementation requires operational procedures, monitoring, enforcement, resources, and clear institutional responsibilities.

The study identifies the Regional Regulation of Bone Bolango Regency No. 1 of 2015 concerning waste management as an important local legal foundation. At the national level, coastal management is also supported by sectoral regulations concerning integrated and sustainable coastal management.

Strengthening Local Institutions

The findings show that local actors already participate in environmental activities, including government institutions, tourism managers, communities, and fishers. However, their involvement is not yet sufficiently integrated.

The NVivo project-map analysis suggests a form of **fragmented governance**, in which several actors recognize the same environmental problems but do not always operate through an integrated system. The tourism manager, community, fishers, and government each have different roles, but coordination between them requires strengthening.
A stronger local institutional arrangement could include a dedicated coastal environmental-management group, clear division of responsibilities, regular coordination meetings, shared environmental data, and community-based monitoring.

Implementation of the 3R Principles
The third strategy is the implementation of Reduce, Reuse, and Recycle.
The study recommends strengthening waste separation at source, reducing single-use plastics, increasing reuse, and developing recycling activities. Community-based waste-management groups can support the implementation of the 3R principles.
The 3R approach is particularly important because it moves waste management from a downstream collection model toward prevention and resource recovery. It can also provide opportunities for community participation and circular-economy activities.

Environmental Education
Environmental education is identified as a key behavioral intervention. The study found that environmental awareness remains an important challenge, meaning that infrastructure and regulation alone are unlikely to solve the problem.
Education should target residents, tourism managers, tourism workers, visitors, fishers, students, and local businesses. The messages should emphasize the relationship between household waste, rivers, coastal pollution, marine ecosystems, and local economic sustainability.
Environmental education can also strengthen social ownership. When residents understand that waste generated inland may ultimately affect their own coastal resources, they may become more willing to participate in upstream waste prevention.

River and Upstream Waste Management
River management is a central finding of this research because the river represents a pathway through which land-based waste can reach the marine environment.
The study therefore argues that coastal waste mitigation must begin upstream. Waste interception points, community-based river monitoring, waste collection in upstream settlements, improved household waste services, and regular river clean-up activities can reduce the amount of waste reaching the sea.
This approach is consistent with the watershed-to-coast perspective. The management of river basins and coastal zones should be connected because environmental problems occurring upstream can produce consequences downstream (Asdak, 2021; Juwono & Subagiyo, 2019).

Collaboration among Government, Communities, and the Private Sector
The sixth strategy is collaborative governance.
The study indicates that government cannot address the problem independently. Communities possess local environmental knowledge, tourism managers control important visitor activities, private businesses influence waste generation, and government institutions possess regulatory authority and public resources.
Effective collaboration should therefore involve:

government regulation and monitoring;
community participation and environmental surveillance;
tourism-manager responsibility;
private-sector support;
waste-management infrastructure;
environmental education;
shared data and reporting mechanisms.

Collaborative governance can transform fragmented responses into an integrated coastal-management system. This is particularly important because waste flows across administrative and sectoral boundaries.

DISCUSSION

Tourism and Cumulative Coastal Environmental Pressure
The findings demonstrate that tourism should not be treated as the sole cause of marine ecosystem degradation in Kabila Bone. Instead, tourism is one component of a broader cumulative pressure system involving tourism activities, residential waste, river transport, and limitations in environmental governance.
This distinction is important. A narrow interpretation could lead policymakers to focus exclusively on tourist

behavior. However, the evidence indicates that waste from settlements and upstream areas also reaches the coast. Therefore, tourism management must be integrated with broader land-based pollution control.
The finding corresponds with studies showing that coastal tourism can contribute to marine debris and environmental pressure, while river systems can transport waste generated far from the coastline (Barends et al., 2023; Lebreton et al., 2017; Meijer et al., 2021).

Latent Water-Quality Degradation and the Need for Monitoring
One important contribution of the study is the identification of a discrepancy between visual perceptions of water quality and the possibility of gradual ecological change.
Informants generally perceived the water as visually normal but acknowledged episodic turbidity and the movement of waste toward the sea.
This indicates the need for systematic environmental monitoring. Visual observation should be supplemented by periodic measurement of physical and chemical parameters, including turbidity, temperature, pH, dissolved oxygen, nutrients, and relevant pollution indicators.
Because this study did not conduct laboratory measurements, it cannot establish statistically measured deterioration in water quality. Its contribution is instead to identify perceived and observed environmental changes and the mechanisms through which these changes may occur.

Interconnected Coastal Ecosystems
The findings regarding coral reefs, mangroves, and seagrass reinforce the importance of integrated ecosystem management. These ecosystems perform complementary functions and collectively contribute to coastal resilience. Waste accumulation, sedimentation, poor water quality, and uncontrolled human activities may place pressure on multiple ecosystem components simultaneously. Therefore, ecosystem protection should not be limited to individual habitat rehabilitation projects.
The findings are consistent with the ecological role of coral reefs, mangroves, and seagrass as interconnected components of coastal systems (Novita Sari et al., 2021; Triwibowo, 2023).

From Beach Cleaning to Upstream Prevention
A major policy implication is that routine beach cleaning should not be considered the principal solution.
Beach cleaning is necessary, but it primarily addresses the symptom rather than the source. If waste continues to enter rivers from households, commercial activities, and settlements, coastal clean-up activities will remain repetitive and costly.
Upstream waste management offers a preventive alternative. The approach begins with waste reduction and segregation at source, followed by collection, recovery, recycling, river interception, and downstream monitoring. This is particularly relevant because global research identifies rivers as significant pathways for plastic entering the ocean (Lebreton et al., 2017; Meijer et al., 2021).

Environmental Governance and Institutional Fragmentation
The study's NVivo analysis suggests fragmented governance. Multiple actors are aware of environmental problems, but their activities are not yet sufficiently integrated.
This finding can be interpreted through the environmental-governance perspective. Complex environmental problems require cooperation between institutions rather than isolated bureaucratic interventions. Osborne (2020) emphasizes the importance of networks and collaborative relationships in contemporary public service governance. In Kabila Bone, a collaborative governance mechanism could connect the subdistrict government, village governments, tourism managers, environmental agencies, fishers, communities, businesses, and universities.
The objective should not simply be to increase the number of actors involved but to clarify responsibilities and establish mechanisms for coordination, monitoring, financing, and accountability.

Implications for Sustainable Coastal Tourism
The sustainability of tourism ultimately depends on the ecological quality of the environment that attracts visitors. If waste accumulation, water-quality deterioration, habitat degradation, and biodiversity disturbance continue, the environmental assets supporting tourism may decline. Thus, environmental protection should not be regarded as an obstacle to tourism development but as an investment in the long-term competitiveness of the destination.
Sustainable tourism therefore requires simultaneous attention to economic benefits, social participation, and ecological carrying capacity. Research in Gorontalo and other Indonesian coastal areas similarly indicates the importance of community participation and environmental management in tourism development (Lahay et al., 2020; Mansur et al., 2020).

CONCLUSION
This study demonstrates that tourism activities in Kabila Bone Subdistrict are associated with increasing environmental pressure on coastal and marine ecosystems. The degradation identified through qualitative evidence

consists of four interconnected dimensions: declining coastal water quality, deterioration of coral reefs, mangroves and seagrass ecosystems, accumulation of coastal waste, and disturbance to marine organisms. The environmental pressure cannot be attributed exclusively to tourism because residential activities and waste transported through river systems also contribute to the problem.

The study further demonstrates that upstream waste management represents a strategically important mitigation approach. Six interventions are considered essential: strengthening environmental regulations, strengthening local institutions, implementing the 3R principles, expanding environmental education, managing river and upstream waste flows, and establishing collaboration among government, communities, tourism actors, and the private sector. The central implication is that marine ecosystem protection in Kabila Bone requires an integrated **upstream-to-coast governance system**. Coastal clean-up activities should therefore be complemented by prevention at waste-generation sources, river monitoring, community participation, and stronger institutional coordination. Because the present study uses a qualitative approach and does not include quantitative measurements of water quality, ecosystem health, or waste volume, future research should employ mixed methods, environmental laboratory measurements, spatial analysis, and longitudinal monitoring to quantify the magnitude of ecological change and evaluate the effectiveness of mitigation interventions.

RECOMMENDATIONS

1. **For local government:** develop an integrated upstream-to-coast waste-management policy connecting villages, river systems, tourism destinations, and coastal areas.
2. **For environmental agencies:** establish routine monitoring of coastal water quality, waste accumulation, and pollution pathways.
3. **For tourism managers:** provide segregated waste facilities, reduce single-use plastics, establish visitor environmental rules, and integrate environmental education into tourism services.
4. **For local communities:** strengthen household waste separation, participate in river and coastal monitoring, and develop community-based recycling initiatives.
5. **For tourism businesses:** adopt environmentally responsible operational practices and contribute financially or materially to local environmental-management programs.
6. **For researchers and universities:** conduct quantitative studies on water quality, marine debris, microplastics, coral reefs, mangroves, seagrass, and marine biodiversity to complement the qualitative findings of this study.

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