J. Publ. Kes. Masy. Ind., 2026; 13(2): pp. 131-141.
P-ISSN: 2407-1625 | E-ISSN: 2581-0901
DOI: xxx

Original Research Article

Risk Analysis of Settlement Sanitation in Coastal Tourism Areas and Its Association with the Potential Incidence of Environmentally Related Diseases in Biduk-Biduk Subdistrict, Berau Regency, 2024

Syamsir[1], Ayudhia Rachmawati[1*], Vivi Filia Elvira[1], Riyan Ningsih[1], Blego Sedionoto[1], Muhammad Aidil Fitrah[1], Sitti Badrah[1]

[1] Department of Environmental Health, Faculty of Public Health, Mulawarman University, South Sempaja, North Samarinda, Samarinda City, 75242, East Kalimantan, Indonesia
*Corresponding Author, Email: rachmawatiayudhia@fkm.unmul.ac.id

ABSTRACT

Population health is strongly influenced by environmental conditions, particularly in coastal tourism areas where rapid development often outpaces sanitation infrastructure. This study aimed to analyze sanitation-related risks associated with the occurrence of environmentally based diseases in coastal tourism settlements in Biduk-Biduk District, East Kalimantan. A cross-sectional study was conducted in Biduk-Biduk Village and Teluk Sulaiman Village involving 139 households selected through purposive sampling based on predefined criteria. Data were analyzed using Chi-square tests and odds ratio analysis to examine associations between sanitation conditions and disease occurrence. The results showed that household solid waste management was statistically associated with disease occurrence ($p = 0.035$), although the direction of the association was inconsistent and should be interpreted with caution. In contrast, household wastewater management demonstrated a significant and more consistent association ($p = 0.018$), with inadequate wastewater management increasing the likelihood of environmentally based diseases (OR = 3.710; 95% CI: 1.307–10.527). These findings indicate that wastewater management represents a more direct and dominant pathway of environmental health risk compared to solid waste management in coastal tourism settings. Strengthening integrated environmental health risk assessment approaches and prioritizing sustainable household and communal wastewater management systems, supported by cross-sectoral collaboration, are essential to reduce environmental health risks and support sustainable coastal tourism development.

Keywords: Coastal Tourism; Environmental Disease; Sanitation; Settlement

INTRODUCTION

Environmental conditions are widely recognized as fundamental determinants of population health, as inadequate residential environments facilitate the transmission of pathogenic agents through water, food, vectors, and direct environmental exposure. Despite global and national efforts to improve household sanitation, environmentally based diseases remain a persistent public health concern, particularly in ecologically vulnerable settings such as coastal areas. In Indonesia, the Community-Based Total Sanitation (CBTS) program has been implemented since 2014 to promote sustainable sanitation practices and behavioral change at the household level. However, emerging evidence indicates that improvements in sanitation coverage do not consistently translate into reductions in disease burden, suggesting that sanitation-related health risks are influenced by complex, context-specific interactions that remain insufficiently addressed in current intervention frameworks (Ministry of Health of the Republic of Indonesia, 2019; Sekarningrum et al., 2023).

Coastal regions exhibit distinct environmental and infrastructural characteristics that exacerbate sanitation-related health risks. Limited access to safe water, inadequate sanitation facilities, poorly functioning wastewater systems, and suboptimal solid waste management are prevalent challenges in coastal settlements (Ritonga & Susilawati, 2022). These structural deficiencies are often compounded by behavioral factors, including low adherence to Clean and Healthy Living Behaviors and the persistence of open defecation practices in certain coastal communities, further elevating exposure to environmental contaminants (Nurhayati et al., 2024). Although these challenges have been widely documented, most existing studies tend to examine individual sanitation components in isolation, thereby limiting a comprehensive understanding of how multiple sanitation risks interact and collectively influence disease occurrence in coastal environments.

The expansion of coastal tourism introduces an additional layer of complexity to sanitation and environmental health dynamics. Tourism-driven population mobility significantly increases solid waste generation, freshwater consumption, and wastewater production, frequently overwhelming existing sanitation infrastructure in host communities (Tolondang et al., 2021). While tourism-related environmental pressures are increasingly acknowledged, empirical evidence that explicitly links tourism-induced sanitation stressors with health outcomes among resident populations remains limited, particularly in low- and middle-income countries. This gap is critical, as coastal tourism areas represent unique socio-environmental systems where rapid environmental change, population dynamics, and infrastructure limitations intersect, yet their combined effects on community health are still insufficiently understood.

Inadequate sanitation in coastal environments has been associated with higher incidences of environmentally based infectious diseases, defined as diseases whose transmission is strongly influenced by environmental conditions such as poor water quality, inadequate waste management, and substandard sanitation infrastructure. These diseases commonly include diarrhea (waterborne), Dengue Hemorrhagic Fever (vector-borne), and Acute Respiratory Infections (airborne or environmentally mediated) (Lestari, 2022). However, despite this established relationship, there remains limited application of integrated risk assessment approaches that simultaneously capture infrastructural conditions and behavioral practices. In particular, the contribution of specific sanitation components, such as household wastewater management, to disease occurrence in coastal tourism settings remains underexplored.

Biduk-Biduk District in East Kalimantan exemplifies these challenges. Covering a vast coastal area with a relatively small and geographically dispersed population, the district faces structural limitations in infrastructure provision, particularly in water supply, sanitation, and waste management services. As a rapidly growing coastal tourism destination, home to iconic sites such as Labuan Cermin Lake and Kaniungan Island, the number of tourist visits has increased in recent years, contributing to rising solid waste generation and environmental pressure in coastal ecosystems (Berau Terkini, 2023). However, this tourism growth has not been accompanied by proportional improvements in sanitation infrastructure. Field reports indicate that many households still rely on limited or unsafe water sources, and wastewater is often discharged directly into the surrounding environment without adequate treatment. Despite these conditions, there are currently no studies applying the Environmental Health Risk Assessment (EHRA) framework in coastal tourism contexts that directly link sanitation risk profiles with household-level disease outcomes. This absence of integrated, context-

specific evidence represents a critical gap, particularly for informing targeted environmental health interventions in rapidly developing coastal tourism areas such as Biduk-Biduk.

These conditions are particularly concerning given the ecological sensitivity of Biduk-Biduk as part of a coastal and marine tourism zone, where environmental degradation can simultaneously affect public health and economic sustainability. The combination of increasing tourism pressure, inadequate sanitation services, and fragile coastal ecosystems underscores the urgency of identifying priority sanitation risks. Without evidence-based assessments that explicitly link environmental sanitation conditions to health outcomes, policy responses risk being fragmented and less effective in addressing the underlying drivers of disease transmission.

To address these gaps, this study applies the Environmental Health Risk Assessment (EHRA) framework to systematically evaluate sanitation risks in coastal tourism settlements, incorporating indicators of solid waste management, wastewater management, access to safe water, and Clean and Healthy Living Behaviors. The novelty of this study lies in its integration of an EHRA-based risk assessment with empirical household-level disease data in a coastal tourism context, enabling direct examination of how specific sanitation risk factors translate into measurable health outcomes, an approach that has not been widely implemented in previous studies. Therefore, this study aims to (1) identify and quantify priority sanitation risk factors, (2) analyze their association with environmentally based infectious diseases at the household level, and (3) provide evidence-based recommendations for targeted environmental health interventions in coastal tourism areas. By explicitly linking sanitation risk profiles to disease occurrence, this study provides context-specific evidence to support more effective and integrated policy and program design.

METHODS

Research Design

This study employed a cross-sectional observational design to examine the association between household sanitation conditions and the occurrence of environmentally based diseases in coastal tourism settlements.

Population and Sample

The research was conducted from October to November 2024 in two coastal tourism villages, Biduk-Biduk Village and Teluk Sulaiman Village, located in Biduk-Biduk District, Berau Regency, East Kalimantan, Indonesia. These locations were selected based on preliminary observations indicating high tourism activity and increasing environmental sanitation pressures. The study population consisted of households permanently residing in the study area. Eligible respondents were household heads or adult household members aged 17 years or older, with one respondent selected per household, who provided informed consent to participate. Households that did not meet the inclusion criteria or declined participation were excluded from the study.

The study population comprised all households residing in coastal tourism areas of Biduk-Biduk District, Berau Regency, East Kalimantan, specifically in Biduk-Biduk Village and Teluk Sulaiman Village. A purposive sampling technique was applied to select households meeting the inclusion criteria (permanent residents, aged ≥17 years or household heads, and willing to participate), while non-permanent residents and those absent during data collection were excluded. The minimum sample size was determined using the Lemeshow formula for

cross-sectional studies, resulting in 139 households, proportionally distributed between Biduk-Biduk Village (83 households) and Teluk Sulaiman Village (56 households).

Research Instruments

Data analysis was conducted using the Environmental Health Risk Assessment (EHRA) approach to evaluate sanitation risks at the household level. EHRA indicators included solid waste management, wastewater management, access to safe water, and Clean and Healthy Living Behaviors (PHBS), measured using a structured questionnaire adapted from the EHRA instrument. Each indicator was scored and categorized into risk levels (e.g., low, moderate, and high) based on predefined criteria to generate a composite sanitation risk profile for each household. The EHRA instrument was adapted and simplified to focus on two main indicators, namely solid waste management and wastewater management. Wastewater management was assessed using three components: safe septic tank, potential contamination from septic tank wastewater, and contamination from domestic wastewater (SPAL). Solid waste management was assessed using four components: waste handling practices, frequency of waste collection, timeliness of collection, and recycling efforts. Each component was scored and combined into a composite score.

Data Analysis

The scoring system was modified into a dichotomous classification, where a total score of 0 (low risk) was categorized as meeting standards, while a score of ≥1 (moderate to high risk) was categorized as not meeting standards. Univariate analysis was used to describe respondent characteristics and sanitation conditions, while bivariate analysis using the Chi-square test to evaluate associations between sanitation variables and disease occurrence. Statistical analyses were performed using SPSS version 22, with a significance level set at $p < 0.05$. The results are presented in the form of tables and narrative descriptions to facilitate interpretation.

RESULTS AND DISCUSSION

Sanitation Conditions and Environmentally Based Diseases in Coastal Settlements

This study analyzed household sanitation conditions as independent variables and the occurrence of environmentally based infectious diseases as the dependent variable. The independent variables consisted of solid waste management and wastewater management, which were assessed based on EHRA criteria and categorized as meeting or not meeting sanitation standards. The dependent variable, environmentally based infectious diseases, refers to diseases influenced by environmental sanitation conditions, specifically diarrhea, Dengue Hemorrhagic Fever (DHF), and Acute Respiratory Infections (ARI), measured based on household reports.

As presented in Table 1, 18.7% of households reported experiencing at least one environmentally based disease, while 81.3% did not, despite a substantial proportion of households having sanitation conditions that did not meet standards, including solid waste management (64.0%) and wastewater management (58.3%). This discrepancy indicates that although inadequate sanitation constitutes an important risk factor, it does not necessarily translate into immediate disease occurrence. This condition may reflect the multifactorial nature of environmentally based diseases, where transmission is influenced by the interaction of environmental exposure, individual susceptibility, hygiene behavior, and duration of contact

with contaminants. In addition, the relatively low reported prevalence may also be influenced by underreporting or temporal gaps between exposure and disease manifestation. In this context, common practices such as discharging domestic waste from kitchens, bathrooms, and washing activities directly onto open land without a closed drainage system likely increase cumulative environmental contamination, thereby creating a latent risk that may not yet be fully reflected in current disease patterns, particularly in sensitive coastal ecosystems.

Table 1. Distribution Of Respondents According to Environmentally Based Disease Occurrence and Household Sanitation Conditions in Coastal Areas Of Biduk-Biduk District

Variable	Frequency	Presentation (%)
Environmentally Based Diseases		
No	113	81.3
Yes	26	18.7
Solid Waste Management		
Meets standards	50	36.0
Does not meet standards	89	64.0
Wastewater management		
Meets standards	58	41.7
Does not meet standards	81	58.3
Total	139	100.0

Although disease prevalence in the present study was lower than reported in some other coastal settings, environmentally based diseases remain a documented and recurring health issue in coastal communities across Indonesia. Previous studies have reported diarrhea as one of the top ten diseases affecting coastal populations in Donggala (Central Sulawesi), Lapulu, Kendari (Southeast Sulawesi), and Sedari Village (West Java), underscoring the ongoing vulnerability of coastal settlements to sanitation-related health risks (Arifin et al., 2021; Fadmi et al., 2020; Putri & Susanna, 2020). Limited access to adequate sanitation services has been consistently identified as a key contributing factor to environmentally based disease transmission in coastal areas (Misdayanti, 2021). This pattern is consistent with the findings of the present study, where a substantial proportion of households still exhibited inadequate sanitation conditions, indicating persistent structural risks despite relatively low observed disease prevalence.

Tourism development further amplifies sanitation pressures in coastal areas. This condition is reflected in the present study, where inadequate sanitation practices remain prevalent among households, suggesting that increasing tourism activities may exacerbate existing environmental health challenges. Increased tourist activity is often not accompanied by proportional improvements in sanitation infrastructure and environmental management. As a result, solid waste generation, water consumption, and wastewater discharge increase substantially, leading to environmental degradation and heightened health risks for local communities (Tolondang et al., 2021). Solid waste accumulation represents one of the most visible environmental impacts of coastal tourism. Not all coastal tourism villages possess sufficient capacity for waste collection, transport, and final disposal, nor have waste reduction strategies such as the 3R (Reduce, Reuse, Recycle) approach been optimally implemented at the household level (Jayantri & Ridlo, 2021). The absence of community-based facilities such as TPS-3R or waste banks further exacerbates waste accumulation and environmental pollution.

An emerging environmental health concern in coastal tourism areas is microplastic pollution derived from unmanaged plastic waste. Indonesia is recognized as one of the major contributors to marine plastic pollution, and inadequate waste management in coastal tourism destinations accelerates the release of plastic debris into marine ecosystems (Ashuri & Kustiasih, 2020; Fikri et al., 2022; Idrus et al., 2022; Purba et al., 2019). Plastic waste that enters the marine environment undergoes fragmentation into microplastics that persist for long periods and pose risks to marine ecosystems and human health (Yang et al., 2021). Although not directly assessed in this study, the high proportion of households with inadequate solid waste management suggests the potential for similar contamination pathways, which may indirectly contribute to broader ecological and health risks in coastal areas.

Microplastics have been detected within marine food chains, including fish species consumed by humans. Evidence from the Makassar Strait indicates that microplastics have reached multiple trophic levels within marine ecosystems (Tahir et al., 2019). This raises concerns regarding potential human exposure through seafood consumption, highlighting that inadequate waste management in coastal settlements may have longer-term and indirect health implications beyond the diseases assessed in this study.

Wastewater management represents another critical sanitation challenge. The proliferation of accommodation facilities and tourism-related infrastructure contributes to substantial increases in domestic wastewater volumes, particularly from kitchen and bathroom activities (Agustina & Aprinica, 2022). When inadequately managed, wastewater containing detergents and organic pollutants can disrupt aquatic ecosystems and contaminate groundwater. In coastal tourism settings, the absence of integrated wastewater treatment systems exacerbates these risks. Ideally, wastewater should be treated through centralized or communal systems prior to discharge; however, such systems require significant financial and institutional investment (Ministry of Health of the Republic of Indonesia, 2021). In coastal areas such as Biduk-Biduk, characterized by permeable soils, rapid infiltration shortens the pathway between contamination sources and human exposure. This environmental condition strengthens the plausibility of the study findings, which demonstrate a significant association between inadequate wastewater management and disease occurrence.

Inadequate septic tank construction and maintenance further increase the risk of groundwater contamination by fecal bacteria, including *Escherichia coli* and total coliforms. National environmental health standards stipulate a minimum distance of 10 meters between septic tanks and water wells and require compliance with Indonesian National Standards, including the presence of soak pits (Ministry of Health of the Republic of Indonesia, 2021). Empirical evidence indicates that poorly constructed septic tanks are strongly associated with microbial contamination of household well water (Aida, 2024). In several coastal tourism areas, including Biduk-Biduk, a proportion of households lack standardized sanitation facilities, posing a significant threat to environmental and public health.

Association Between Residential Sanitation and Environmentally Based Diseases

Bivariate analysis revealed a statistically significant association between household solid waste management and the occurrence of environmentally based diseases ($p = 0.035$). Households with adequate solid waste management tended to have a lower risk of disease, as indicated by the odds ratio; however, the observed distribution of cases suggests some inconsistency in the pattern. This indicates that the association should be interpreted cautiously, as it may reflect residual confounding, misclassification of exposure, or

J. Publ. Kes. Masy. Ind., 2026; 13(2): pp. 131-141.
P-ISSN: 2407-1625 | E-ISSN: 2581-0901
DOI: xxx

unmeasured contextual factors such as hygiene behavior and environmental conditions. In contrast, a stronger and more consistent association was observed between household wastewater management and disease occurrence (p = 0.018), where households with inadequate wastewater management exhibited a markedly higher proportion of disease cases (25.9%) compared to those with adequate management (8.6%):

Table 2. Association Between Household Sanitation Practices and The Occurrence of Environmentally Based Diseases in Coastal Settlements of Biduk-Biduk District

Independent Variable		Dependent Variable: Environmentally Based Diseases						OR (95% CI)	P-value
		No		Yes		Total			
		n	%	n	%	n	%		
Solid waste management	Meets standards	36	72.0	14	28.0	50	100.0	0.401 (0.168-0.953)	0.035*
	Does not meet standards	77	86.5	12	13.5	89	100.0		
Wastewater management	Meets standards	53	91.4	5	8.6	58	100.0	3,710 (1.307-10.527)	0.018*
	Does not meet standards	60	74.1	21	25.9	81	100.0		
Total		113	81.3	26	18.7	139	100.0		

Notes: (*) significant relationship

The odds ratio analysis demonstrated that households with inadequate wastewater management were significantly more likely to experience environmentally based diseases compared with those with adequate practices (OR = 3.710; 95% CI: 1.307–10.527). This finding can be explained by the direct role of wastewater as a primary transmission pathway, where contaminants from domestic activities can directly infiltrate soil and groundwater, increasing the likelihood of human exposure. The magnitude of the odds ratio indicates a strong and consistent association, suggesting that wastewater represents a more immediate exposure pathway compared to other sanitation factors. This risk is further amplified in coastal environments with permeable soils, where continuous and untreated wastewater discharge facilitates pathogen persistence and spread through multiple exposure routes.

In addition to wastewater management, household solid waste management was also found to be significantly associated with the occurrence of environmentally based diseases, with an odds ratio below one indicating a potential protective effect. However, the higher proportion of disease cases observed among households classified as having adequate solid waste management suggests an inconsistency in the distribution pattern. This discrepancy may indicate the presence of residual confounding, misclassification, or reverse causality, and therefore the association should be interpreted with caution. Compared to wastewater, the impact of solid waste management is likely more indirect, as disease transmission often involves intermediate pathways such as vector presence and environmental conditions, making the relationship more context-dependent and less consistent.

This finding highlights that household wastewater management constitutes a critical determinant of environmental health risks in coastal tourism settlements. Inadequate wastewater disposal facilitates contamination, prolongs pathogen survival, and increases

exposure through domestic water use pathways. In environmentally sensitive coastal settings such as Biduk-Biduk, characterized by permeable soils and shallow groundwater systems, this risk is further amplified. These findings are consistent with global evidence indicating that poor sanitation and wastewater infrastructure are strongly associated with increased risks of environmentally based diseases, particularly in low- and middle-income settings (Prüss-Ustün et al., 2019; Wolf et al., 2022).

These findings align with previous studies indicating that inadequate design and maintenance of on-site sanitation systems, such as pit latrines and septic tanks, increase the risk of fecal contamination in household groundwater sources (Graham & Polizzotto, 2013). In coastal and permeable soil environments, infiltration from substandard septic systems can rapidly introduce pathogens into shallow aquifers, increasing exposure risks. Groundwater contamination from domestic wastewater represents an important public health concern in communities lacking centralized treatment systems, particularly where reliance on untreated groundwater remains high (Geary & Whitehead, 2001; Lora-Ariza et al., 2024).

According to the Environmental Health Risk Assessment (EHRA) guidelines issued by the Ministry of Health of the Republic of Indonesia, safe household wastewater management requires regular septic tank desludging and the use of closed drainage systems to prevent environmental contamination (Ministry of Health of the Republic of Indonesia, 2021). While centralized or communal wastewater treatment systems remain the most effective long-term solution, their implementation in small coastal tourism areas is often constrained by financial and institutional limitations (Elliott et al., 2023; Indrawanto et al., 2020). Consequently, reliance on household-level systems without adequate maintenance increases cumulative environmental health risks, as reflected in the findings of this study.

This study has several limitations that should be acknowledged. The cross-sectional design limits causal inference, and the observed associations may be influenced by unmeasured confounding variables such as hygiene behavior, socioeconomic status, and water source. In addition, disease data were based on household reports, which may introduce recall bias or underreporting. The inconsistency observed in the solid waste management variable also suggests potential misclassification or reverse causality that warrants further investigation.

The findings underscore the necessity of integrating sanitation management into sustainable coastal tourism development frameworks aligned with the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation). Community-based sanitation interventions, such as communal wastewater treatment systems, household-scale technologies, and strengthened health promotion programs, have been shown to reduce disease burdens when implemented systematically (Dey et al., 2019; Igaki et al., 2021). In the context of Biduk-Biduk, strengthening local sanitation infrastructure and community participation is essential to mitigate long-term environmental health risks while supporting sustainable tourism development.

CONCLUSION

This study identified key sanitation risk factors in coastal tourism settlements of Biduk-Biduk District using the EHRA approach and examined their association with environmentally based infectious diseases. The findings demonstrate that household wastewater management is a significant and more consistent determinant of disease occurrence, while solid waste management also showed a statistically significant association but with an inconsistent

direction that should be interpreted with caution. These results underscore the critical role of direct environmental exposure pathways, particularly in coastal settings characterized by permeable soils and high vulnerability to contamination. Therefore, improving wastewater management systems through proper septic tank design, regular desludging, and the development of decentralized or communal treatment facilities should be prioritized. Integrating sanitation into coastal tourism planning is essential to mitigate both current and latent environmental health risks and to ensure sustainable community well-being.

REFERENCES

Agustina, A., & Aprinica, N. P. I. (2022). Dampak Pariwisata Terhadap Pencemaran Air Danau Batur Kabupaten Bangli. *Jurnal Ilmiah Hospitality Management*, *12*(2), 81–89. https://doi.org/dx.doi.org/10.22334/jihm.v12i2

Aida, N. N. (2024). Pengaruh Jarak Tangki Septik Terhadap Adanya Pencemaran Bakteri Pada Air Sumur Gali: Sebuah Tinjauan Literature. *Jurnal Kesehatan Tambusai*, *5*(2), 4299–4307.

Arifin, P., Radhiah, S., & Sanjaya, K. (2021). Kerentanan Kejadian Penyakit Berbasis Lingkungan Pada Masyarakat Terdampak Bencana Di Daerah Pesisir Kabupaten Donggala. *Preventif : Jurnal Kesehatan Masyarakat*, *12*, 171–182. https://doi.org/10.22487/preventif.v12i1.225

Ashuri, A., & Kustiasih, T. (2020). Timbulan Dan Komposisi Sampah Wisata Pantai Indonesia, Studi Kasus: Pantai Pangandaran. *Jurnal Pemukiman*, *15*(1), 1–9.

Berau Terkini. (2023). Sampah Masih Jadi Momok di Lokasi Wisata Biduk-Biduk. Bupati Beri Peringatan Keras Kepada Kepala Kampung dan Camat. *Berau Terkini*. https://berauterkini.co.id/sampah-masih-jadi-momok-di-lokasi-wisata-biduk-biduk-bupati-beri-peringatan-keras-kepada-kepala-kampung-dan-camat/

Dey, N., Parvez, M., Islam, M., Mistry, S. K., & I.Levine, D. (2019). Effectiveness of a community-based water, sanitation, and hygiene (WASH) intervention in reduction of diarrhoea among under-five children: Evidence from a repeated cross-sectional study (2007–2015) in rural Bangladesh. *International Journal of Hygiene and Environmental Health*, *222*(8), 1098–1108. https://doi.org/10.1016/j.ijheh.2019.08.006

Elliott, M. A., Bakchan, A., Maxcy-Brown, J., D'Amato, V. A., Hallahan, D., White, K. D., Stallman, C., & Bradley, S. (2023). Sustainable wastewater management for underserved communities using federal infrastructure funds: Barriers, bottlenecks, and tradeoffs. *Water Security*, *20*(100152), 1–7. https://doi.org/https://doi.org/10.1016/j.wasec.2023.100152

Fadmi, F. R., Mauliyana, A., & Mangidi, Z. M. (2020). Faktor-Faktor Yang Berhubungan Dengan Kejadian Diare Pada Anak Balita Di Wilayah Pesisir Kelurahan Lapulu Kecamatan Abeli Kota Kendari. *Miracle Journal of Public Health*, *3*(2), 197–205.

Fikri, I., Nedi, S., & Elizal. (2022). Analysis Of Microplastic Content In Seawater At Padang And Pariaman Tourism Beaches, West Sumatra Province. *Asian Journal of Aquatic Sciences*, *5*(3), 416–420.

Geary, P., & Whitehead, J. (2001). Groundwater Contamination from On-site Domestic Wastewater Management Systems in a Coastal Catchment. *9th National Symposium*

on Individual and Small Community Sewage Systems Proceedings, 479–487. https://doi.org/10.13031/2013.6055

Graham, J. P., & Polizzotto, M. L. (2013). Pit latrines and their impacts on groundwater quality: A systematic review. *Environmental Health Perspectives*, *121*(5), 521–530. https://doi.org/10.1289/ehp.1206028

Idrus, F. A., Roslan, N. S., & Harith, M. N. (2022). Occurrence of Macro- and Microplastics on Pasir Pandak Beach, Sarawak, Malaysia. *Jurnal Ilmiah Perikanan Dan Kelautan*, *14*(2), 214–230. https://doi.org/10.20473/jipk.v14i2.34034

Igaki, S., Duc, N. T. M., Nam, N. H., Nga, T. T. T., Bhandari, P., Elhamamsy, A., Lotify, C. I., Hewalla, M. E., Tawfik, G. M., Mathenge, P. G., Hashizume, M., & Huy, N. T. (2021). Effectiveness of community and school-based sanitation interventions in improving latrine coverage: a systematic review and meta-analysis of randomized controlled interventions. *Environmental Health and Preventive Medicine*, *26*(1), 26. https://doi.org/10.1186/s12199-021-00934-4

Indrawanto, D., Subadyo, A. T., Budiyanto, H., Pengelolaan, R., Air, S., Domestik, L., & Berbasis, T. (2020). Rekayasa Pengelolaan Sanitasi Air Limbah Domestik Terpadu Berbasis Ipal Komunal Di Kampung Selumit Pantai Kota Tarakan. *Mintakat Jurnal Arsitektur*, *21*(2), 105–115.

Jayantri, A. S., & Ridlo, M. A. (2021). Strategi Pengelolaan Sampah Di Kawasan Pantai. *Jurnal Kajian Ruang*, *1*(2), 147–159.

Lestari, H. (2022). Identifikasi Masalah Kesehatan Berbasis Lingkungan pada Masyarakat Pesisir Wilayah Kerja Puskesmas Mata. *Miracle Journal Of Public Health (MJPH)*, *5*(2), 127–135.

Lora-Ariza, B., Piña, A., & Donado, L. D. (2024). Assessment of groundwater quality for human consumption and its health risks in the Middle Magdalena Valley, Colombia. *Scientific Reports*, *14*(11346), 1–17. https://doi.org/10.1038/s41598-024-61259-0

Ministry of Health of the Republic of Indonesia. (2019). *Panduan Pelaksanaan Sanitasi Total Berbasis Masyarakat (STBM)*. Ministry of Health of the Republic of Indonesia.

Ministry of Health of the Republic of Indonesia. (2021). *Panduan Praktis Pelaksanaan EHRA (Environmental Health Risk Assessment)* (M. Fadhila, Ed.; 2nd ed.). Ministry of Health of the Republic of Indonesia.

Misdayanti, S. (2021). Gambaran Sanitasi Lingkungan pada Masyarakat Pesisir Desa Bajo Indah. *Afiasi: Jurnal Kesehatan Masyarakat*, *6*(1), 19–29.

Nurhayati, Nasution, A. M., Masry, R., Ramhmadani, A. D., & Sari, D. P. (2024). Systematic Review : Sanitasi Lingkungan Di Wilayah Pesisir. *Jurnal Kesehatan Tambusai*, *5*(2), 4439–4448.

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health*, *222*(5), 765–777. https://doi.org/https://doi.org/10.1016/j.ijheh.2019.05.004

Purba, N. P., Handyman, D. I. W., Pribadi, T. D., Syakti, A. D., Pranowo, W. S., Harvey, A., & Ihsan, Y. N. (2019). Marine debris in Indonesia: A review of research and status.

Marine Pollution Bulletin, *146*, 134–144. https://doi.org/https://doi.org/10.1016/j.marpolbul.2019.05.057

Putri, S. R., & Susanna, D. (2020). Kondisi Sanitasi Dasar Dengan Kejadian Diare Di Kawasan Pesisir Pantai Desa Sedari, Kabupaten Karawang, Jawa Barat Tahun 2018. *Jurnal Nasional Kesehatan Lingkungan Global*, *1*(2), 115–121. https://doi.org/10.7454/jnklg.v1i2.1038

Ritonga, Mhd. D. R., & Susilawati, S. (2022). Masalah Sanitasi Di Wilayah Pesisir Sumatera Utara. *Humantech : Jurnal Ilmiah Multidisiplin Indonesia*, *1*(8), 1046–1054.

Sekarningrum, B., Nurwati, N., & Wibowo, H. (2023). Sanitasi Lingkungan Di Wilayah Pemukiman Perkotaan (Kasus Pada Masyarakat di Wilayah Kelurahan Kebon Jeruk Kota Bandung). *Sosioglobal : Jurnal Pemikiran Dan Penelitian Sosiologi*, *8*(1), 102–114.

Tahir, A., Samawi, M. F., Sari, K., Hidayat, R., Nimzet, R., Wicaksono, E. A., Asrul, L., & Werorilangi, S. (2019). Studies on microplastic contamination in seagrass beds at Spermonde Archipelago of Makassar Strait, Indonesia. *Journal of Physics: Conference Series*, *1341*(2), 1–6. https://doi.org/10.1088/1742-6596/1341/2/022008

Tolondang, A. S., Joseph, W. B. S., & Sumampouw, O. J. (2021). Gambaran Sanitasi Lingkungan Pesisir Di Desa Watuliney Kecamatan Belang Kabupaten Minahasa Tenggara Tahun 2021. *Jurnal KESMAS*, *10*(3), 1–8.

Wolf, J., Hubbard, S., Brauer, M., Ambelu, A., Arnold, B. F., Bain, R., Bauza, V., Brown, J., Caruso, B. A., Clasen, T., Colford Jr, J. M., Freeman, M. C., Gordon, B., Johnston, R. B., Mertens, A., Prüss-Ustün, A., Ross, I., Stanaway, J., Zhao, J. T., … Boisson, S. (2022). Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis. *The Lancet*, *400*(10345), 48–59. https://doi.org/10.1016/S0140-6736(22)00937-0

Yang, H., Chen, G., & Wang, J. (2021). Microplastics in the marine environment: Sources, fates, impacts and microbial degradation. *Toxics*, *9*(41), 1–19. https://doi.org/10.3390/toxics9020041