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RESEARCH ARTICLE

PERCEPTIONS OF RIVERSIDE COMMUNITIES TOWARD WATER POLLUTION IN THE MAHAKAM RIVER, INDONESIA

Vita Pramaningsih[a]*, Sarva Mangala Praveena[b], Deny Kurniawan[a]

[a]Department of Environmental Health, Faculty of Public Health, Universitas Muhammadiyah Kalimantan Timur, Indonesia
[b]Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia
**Corresponding Author Email: vp799@umkt.ac.id*

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ABSTRACT

River pollution remains a serious environmental issue in Samarinda, Indonesia, largely driven by domestic waste and human activities along riverbanks. This study aims to assess the relationship between community knowledge, attitudes, and practices toward environmental health and to evaluate the physical and chemical quality of river water. A cross-sectional survey was conducted among 130 respondents using a structured questionnaire, and water samples from ten locations were analyzed for turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), conductivity, pH, and salinity. Results showed that 62.3% of respondents had high knowledge, but only 7.7% demonstrated good environmental practices. Statistical analysis revealed weak yet significant correlations between knowledge and practice ($r = 0.217$; $p = 0.013$) and between attitude and practice ($r = 0.206$; $p = 0.019$). Water analysis indicated high turbidity (up to 39.10 NTU), COD levels above 10 mg/L, and acidic pH values (5.0–5.8), exceeding the national standards. These findings highlight the gap between environmental awareness and behavior, alongside poor river water quality. Strengthening community participation, environmental education, and enforcement of water quality regulations are essential to promote behavioral change and improve river ecosystem sustainability.

KEYWORDS

Community participation, pollution control, public awareness, river ecosystem, sustainability

1. Introduction

Urbanization is a worldwide phenomena, frequently accompanied by increased industrial activity, population density, and infrastructure development. The consequences of urbanization significantly influence public health challenges within urban environments, necessitating effective interventions to address associated issues (Kuddus et al., 2020). Along with these urban transitions, there is growing worry over the destruction of natural resources, notably water bodies. Urbanization leads to urban stream syndrome, characterized by heightened storm runoff due to the proliferation of impervious surfaces, consequently altering stream flow, morphology, temperature, and both the quantity and quality of water (Zipperer et al., 2020). Rivers, being vital parts of urban ecosystems, are vulnerable to a variety of contaminants from both point and non-point sources within cities. The decline of river water quality poses serious concerns to human health since populations rely on these water supplies for a variety of functions, including drinking, domestic use, and recreation. The convergence of climate change, biodiversity loss, and pollution is posing a triple crisis, endangering the water quality of rivers, lakes, and groundwater sources and putting over 3 billion people at risk of disease worldwide (Murray, 2021).

East Kalimantan province's capital, Samarinda, has seen tremendous urban growth as a result of mining and industrial activity, as well as an expanding population. It is impact to the Mahakam River in Samarinda including river water quality. The water quality of the Mahakam River, which serves as a raw water source for drinking water in Samarinda, must be maintained, along with the surrounding environmental sanitation conditions (Sutapa et al., 2022). The dominant land use of settlement and domestic activities effect to the increasing pollution especially in Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) parameter in the river (Pramaningsih et al., 2020). Understanding how riverside communities perceive and respond to these issues is vital for developing effective management strategies. Therefore, this study aims to evaluate community perceptions contain knowledge, attitudes, and practices toward water pollution in the Mahakam River and explore the relationship between those responses. The findings are expected to support evidence-based interventions that strengthen community participation and regulatory enforcement in sustainable river management. This study is important because it connects community behavior with actual river water quality, providing insights into how awareness and actions affect pollution. Readers benefit by gaining practical knowledge for designing community-based and policy-driven strategies to improve water management and sustainability.

2. Research Methods

2.1 Research Location and Samples

The study was conducted in the riverside communities of Samarinda, East Kalimantan, Indonesia, along the Mahakam River as Figure 1. Water samples were taken from along the Mahakam River and tributaries which is densely populated in Samarinda City, East Kalimantan Province. Water samples measured are 10 spots located along the segment Intake PDAM Gunung Lipan until Selili around the Mahakam River. There are (1) Intake

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PDAM Gunung Lipan, (2) Mahakam Bridge, (3) Karang Asam River/tributary, (4) Pertamina, (5) Muara Ijabah River/tributary, (6) Ijabah, (7) Tentara, (8) Pelabuhan, (9) Karang Mumus River/tributary, (10) Selili. The location is an urban area along a river that is densely populated and bustling with service and commercial activities. Sample respondents were selected using purposive sampling, there are 130 respondents.

Figure 1 : The Riverside Communities Along Mahakam River

2.2 Parameter Measurement

Parameters water quality was measured including turbidity, BOD, COD, conductivity, salinity and pH. The questionnaire as an instrument included demographic data, awareness level, attitudes toward river pollution, and self-reported mitigation behaviors.

2.3 Data Analysis

Water samples were analyzed in the Laboratory of the Center for Standardization and Industrial Services, Samarinda. The results compared with the regulation of East Kalimantan Province Regional No. 2 of 2011 concerning water quality management and water pollution control. Data were processed using SPSS version 25. Descriptive statistics summarized demographic variables and perception levels. Chi-square tests were conducted to examine the association between education level and mitigation behaviors.

3. Results And Discussions

3.1 Demographic Characteristics

Demographic characteristics of the Mahakam Riverside communities show in Table 1. The nearly balanced gender distribution (53.8% male and 46.2% female) supports inclusivity in capturing diverse perspectives. Previous studies highlight that both men and women contribute differently to environmental practices, often influenced by social roles and responsibilities. Greater gender equality awareness is positively correlated with stronger willingness to pay for environmental protection (Ren et al., 2025).

Table 1: Demographic characteristics

Gender	Frequency	Percentage (%)
Male	70	53.8%
Famale	60	46.2%
Total	130	100%
Ethnicity	**Frequency**	**Percentage (%)**
Javanese	44	33.8%
Buginese	34	26.2%
Kutai	26	20.0%
Others	26	20.0%
Total	130	100%
Education Leve[	**Frequency**	**Percentage (%)**
No Schooling	3	2.3%
Elementary School	30	23.1%
Junior High School	28	21.5%
Senior High School	65	50.0%
Bachelor Degree	4	3.1%
Total	130	100%
Occupation	**Frequency**	**Percentage (%)**
Trader	41	31.5%
Housewife	36	27.7%
Enterpreneur	29	22.3%
Laborer	21	16.2%
Others	3	2.3%
Total	130	100%

The ethnic diversity in riverside Mahakam communities dominated by Javanese (33.8%), Buginese (26.2%), and Kutai (20.0%). It is reflects the multicultural composition of many Indonesian urban and peri-urban communities. Cultural background often shapes environmental behavior and attitudes, influencing how communities engage with pollution management and health-related interventions. Pro environmental behavior is important implication with quality of life improvement (Purnama et al., 2025).

Educational attainment among respondents shows that 50% completed senior high school, while only 3.1% held a bachelor's degree. This indicates a relatively moderate level of education, which is crucial in shaping knowledge and awareness regarding environmental risks. Research has consistently shown that individuals with higher education levels tend to be more informed and proactive about environmental and sanitation issues (Meyer, 2015). However, the significant proportion of respondents with only basic education or no formal education (totaling nearly 47%) suggests a need for public health messaging to be delivered in simple and locally appropriate style.

In terms of occupation, most respondents were traders (31.5%) and housewives (27.7%), followed by entrepreneurs and laborers. Informal sector workers often face economic challenges that can limit their ability to engage in sustainable practices or invest in sanitation infrastructure. Both top-down and bottom-up strategies as well as interdisciplinary cooperation to provide appropriate water and sanitation policies for informal settlements (Sinharoy et al., 2019). Furthermore, housewives play a critical role in domestic water use and waste management, which are key factors in household-level environmental health (Crider & Ray, 2022). Therefore, empowering women through education and community involvement can be a catalyst for improved sanitation and pollution control. Behavioral change and community resilience (Yu et al., 2024) (Abbas and Haider, 2025).

3.2 Distribution of Respondents Knowledge, Attitude and Practice Level

As shown in Figure 2, about 62% of the respondents demonstrated high knowledge, indicating strong informational exposure or education regarding the environmental consequences of water pollution. However, this high level of knowledge was not proportionally reflected in behavior, as only 56.2% of respondents still exhibited poor environmental practices. This gap underscores a well-known issue in environmental psychology: knowledge alone does not always lead to behavioral change (Fischer et al., 2017). Self-control enables people to behave in a way that is consistent with their beliefs, indicating that it is an essential quality for preserving people's long-term environmental objectives (Wyss et al., 2022).

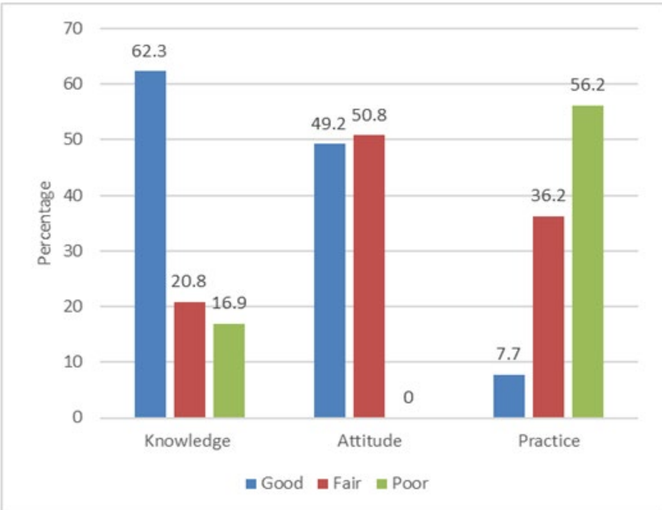

Figure 2: Respondents Knowledge, Attitude and Practice

There are 50.8% of the respondents have fair attitude level while 49.2% of them as good attitude. Although the public exhibits some level of concern, this has not yet resulted in a widespread commitment to environmentally responsible behavior. Community attitudes must be coupled with supportive infrastructure, social encouragement, and incentives to trigger lasting behavioral transformation (Kiran et al., 2023). The most successful way to address litter among inhabitants is with an integrated approach that includes empowerment, cognitive, social, and technological solutions (Ojedokun, 2011).

A majority of participants (56.2%) were classified as having poor environmental practices, with only 7.7% categorized as good, and 36.2% falling into the fair category. These findings underscore a persistent intention and behavior gap, where knowledge and even moderately positive attitudes fail to result in consistent pro-environmental actions. This is consistent with recent research showing that the weakness of the communities practice sanitation difficult to change are infrastructure inequality in accessing clean water and implementing healthy environmental sanitation; economic inequality/poverty; problems of education and public knowledge are still weak (Fitriyah et al., 2024).

People may be aware of the negative effects of trash and river pollution, for example, yet continue to do so out of habit, convenience, or a lack of good alternatives. Provide the facilities of zero waste and increase community awareness in order to minimize pollution (Sulistyorini et al., 2025). Therefore, fostering better environmental practices in the Mahakam River community requires a shift from merely informing to empowering and enabling through behavioral modeling, incentives, and participatory action programs.

3.3 Interrelationship Among Awareness Components

Most respondents demonstrated high knowledge and fair attitudes, these have not yet fully translated into real-world practices. The relationships among awareness components (relationships knowledge with practice and relationships attitude with practice) are weak but statistically significant. This suggests that increasing public awareness about river pollution requires not only information dissemination but also deeper attitude internalization and the promotion of habitual actions.

Different levels of relationship between these components were found by statistical analysis utilizing the Chi-Square tests. It was discovered that there was no statistically significant correlation between knowledge and attitude, suggesting that a stronger environmental attitude is not always correlated with greater knowledge concerning river pollution. This implies that even while people may comprehend the effects of pollution on a cognitive level, emotional or value-driven engagement is not necessarily the result. It difference with other studied that knowledge and attitude have a significant correlation with the behaviour of river pollution. Nevertheless knowledge there is a more powerful influence on behaviour than attitude pollution (Alias, 2019). The private sphere's behavior was directly influenced by action- related environmental knowledge, which was associated with the ecological worldview (Liobikiene and Poskus, 2019).

However, the relationship between knowledge and practice showed a weak but significant positive correlation ($r = 0.217$; $p = 0.013$). This finding implies that individuals with greater knowledge are slightly more likely to engage in positive environmental behaviors, supporting prior research that knowledge can serve as a foundation for action, but only when accompanied by enabling factors such as infrastructure, support, and motivation. Knowledge gaps, the usefulness of applying habit theory to encourage environmentally friendly behavior, and how habit urban settings could be designed, altered, and constructed using architecture as a powerful leverage point (Linder et al., 2022).

Similarly, the correlation between attitude and practice was also weak but significant ($r = 0.206$; $p = 0.019$), emphasizing that a favorable attitude alone does not always result in behavioral change. Attitudes must be reinforced by behavioral reinforcement strategies, such as community programs, rewards, and public commitments, to become actionable. A Pro Environmental Habit (PEH) approach may be a successful means of advancing pro-environmental identities, attitudes, and cultures (Linder et al., 2022). Effective management of river water pollution requires behavioral change, with priority strategies focusing on active community participation supported by strong government regulations and law enforcement (Pramaningsih et al., 2018).

3.4 Water Quality of Mahakam River

Table 2 shows water quality parameters in the Mahakam River displaying signs of moderate to severe pollution, especially in urbanized segments such as Karang Mumus and PDAM intake areas. The analysis of water samples from various locations along the Mahakam River reveals several parameters exceeding national water quality standards, particularly in turbidity, COD, and pH values. These findings raise environmental and public health concerns, especially considering the river's importance for domestic and industrial use in Samarinda.

Table 2: Water Quality of Mahakam River

Parameters													
Sampling Location	**Location name**	**Turbidity (NTU)**	**Standard Turbidity (NTU)**	**BOD (mg/L)**	**Standard BOD (mg/L)**	**COD (mg/L)**	**Standard COD (mg/L)**	**Conductivity (µS/cm)**	**Standard Conductivity (µS/cm)**	**Salinity**	**Standard Salinity**	**pH**	**Standard pH**
A1	Intake PDAM	26.60	NA	1.54	2	28.02	10	39.14	NA	0	NA	5.0	6-9
A2	Mahakam Bridge	25.50	NA	2.30	2	18.68	10	35.25	NA	0	NA	5.1	6-9
B1	Karang Asam River	1.38	NA	1.92	2	30.27	10	298.4	NA	0	NA	5.6	6-9
A3	Pertamina	23.10	NA	1.36	2	22.04	10	35.12	NA	0	NA	5.1	6-9
B2	Muara Ijabah River	13.30	NA	2.82	2	25.03	10	96.45	NA	0	NA	5.3	6-9
A4	Ijabah	24.20	NA	1.40	2	19.80	10	34.92	NA	0	NA	5.2	6-9
A5	Tentara	23.90	NA	1.26	2	22.42	10	34.84	NA	0	NA	5.2	6-9
A6	Pelabuhan	24.90	NA	1.90	2	25.41	10	35.07	NA	0	NA	5.2	6-9
B3	Karang Mumus River	39.10	NA	1.96	2	25.03	10	754.7	NA	0	NA	5.8	6-9
A7	Selili	26.00	NA	2.58	2	24.29	10	34.75	NA	0	NA	5.2	6-9

Note: A = Mahakam River B = Tributary

Turbidity, measured in NTU, exceeded the common surface water standard of 5 NTU (for sea water) at 8 out of 9 sampling points, with the highest value recorded at Karang Mumus River (B3) with 39.10 NTU. Elevated turbidity levels are typically associated with suspended solids, organic matter, and potential pathogen presence, which can interfere with disinfection processes and reduce light penetration, affecting aquatic ecosystems. Increases in turbidity are strongly correlated with rainfall intensity, with the impact of agricultural activities on river water clarity largely governed by rainfall patterns (Chi Wo et al., 2023). Increased turbidity in water leads to an extended period for sediment deposition (Azis et al., 2015).

Biochemical Oxygen Demand (BOD), an indicator of organic pollution, remained below the standard threshold of 2 mg/L in most locations except A2 (2.30 mg/L), B2 (2.82 mg/L) and A7 (2.58 mg/L). Add reasons why these locations exceeded BOD. Any pollution sources lead to this. BOD serves as a key indicator of organic pollution in freshwater ecosystems and is linked to microbiological contamination. Elevated BOD levels decrease dissolved oxygen, disrupt aquatic habitats and biodiversity, and limit the usability of water resources. The primary contributors to high BOD in freshwater are anthropogenic activities, including domestic and livestock waste, industrial discharges, and combined sewer overflows (Vigiak et al., 2019).

All the sampling locations recorded COD concentrations significantly above the 10 mg/L standard, with B1 (30.27 mg/L) and B3 (25.03 mg/L). Chemical Oxygen Demand (COD) is a critical parameter in waste management, especially for tracking bioprocesses like anaerobic digestion. It plays an important role in assessing the biodegradability of waste and in determining both mass and energy balances within the overall process (Cazaudehore et al., 2019). High COD levels indicate the presence of oxidizable pollutants such as industrial effluents or decaying organic matter, chicken farm which pose a threat to aquatic life by reducing available dissolved oxygen (Abdullahi et al., 2021). High COD levels in Mahakam River communities are largely driven by multiple pollution sources along the riverbanks, including untreated household wastewater from bathing, washing, and leaking septic tanks; organic waste from traditional markets; livestock and poultry farms where manure and wash water flow directly into drainage channels; agricultural runoff carrying organic residues and fertilizers; oil and fuel leakage from river transport and tugboats; and the natural decomposition of accumulated biomass and solid waste along stagnant river sections.

Conductivity varied widely, with Karang Mumus River (754.7 µS/cm) showing extreme ion content, suggesting possible urban runoff, saline intrusion, or chemical waste accumulation. Such high conductivity can affect freshwater species and may be linked to unregulated land-use practices. The pH levels across all sampling points were slightly acidic, ranging from 5.0 to 5.8, falling below the standard range of 6–9. Low pH can increase metal solubility and toxicity, endangering aquatic organisms and signaling acidification from upstream mining, industrial discharge, or acid rain. Influence of pH on the Mobilization of Heavy Metals from Polluted Sediments by a leaching (Zhang et al., 2018).

4. Conclusions

The study reveals a clear gap between environmental awareness and actual behavior among communities along the Mahakam River. Although most respondents possess high knowledge and positive attitudes, more than half still demonstrate poor environmental practices. Statistical analysis confirms weak but significant links between knowledge, attitude, and practice, indicating that awareness alone is insufficient to drive sustainable actions. Water quality data further reflect this behavioral / practise gap, showing high levels of turbidity and COD, as well as acidic pH across several sites. These findings demonstrate ongoing pollution and environmental degradation. An integrated approach, combining environmental education, community empowerment, adequate infrastructure, and strong regulatory enforcement is urgently needed to improve public behavior and protect the Mahakam River's ecosystem and public health. Future studies should examine socio-economic and cultural factors affecting community behavior, evaluate policy and education effectiveness, and apply long term monitoring to support sustainable river management.

Author Contributions

Vita Pramaningsih: Corresponding author, writing, Conceptualization, Analysis data; Sarva Mangala Praveena: Grammar and scientific writing, design research instrument; Deny Kurniawan: Sampling, Collect data

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