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THE IMPACT OF RIVER POLLUTION ON THE LEVEL OF HEALTH OF RIVER BASIN COMMUNITIES IN INDONESIA: A LITERATURE REVIEW

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Abstract

River pollution in the watershed area is a crucial issue that has a direct impact on public health. This study aims to analyze the relationship between river water pollution and the level of public health around the watershed. Case studies were conducted on Karang Mumus River in Samarinda and Cukir River in Jombang. The results showed that domestic and industrial waste caused a decline in water quality, characterized by high levels of Coliform bacteria, E. coli, and other harmful substances. As a result, the community experiences various diseases such as diarrhea, skin irritation, indigestion, and ISPA. Low environmental awareness and minimal sanitation facilities exacerbate the health impacts. This study emphasizes the importance of integrated watershed management through water quality monitoring, waste control, and community education and active participation to reduce the risk of disease due to river pollution.

***Keywords**: public health, river pollution, watershed.*

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INTRODUCTION

Water is an essential component needed by every living thing (Artajaya and Putri, 2021). Water sources can come from springs, lakes, swamps, aquifers, situ, reservoirs, estuaries, and rivers (Ministerial Decree, 2003). Water plays a role in fulfilling daily needs, such as industry, hospitals, agriculture, activities, and sanitation. The river is one of the water sources that is mostly used to meet the various needs of the community (Prasetya et al., 2023).

The important role of river water in meeting the needs of the community is inversely proportional to the quality of river water today. Rapid population growth and not balanced with environmental awareness in community activities can trigger environmental pollution, especially in river waters (Pramaningsih et al., 2023). The decline in river water quality can be influenced by various factors, one of which is due to activities carried out by residents in the watershed area (Soukotta et al., 2019). Other factors can also result in a decrease in river water quality, including industrial activities, domestic activities, and other activities that have a negative impact on rivers (Fitri, 2020). Pollution and contamination of river water have various negative impacts, one of which is public health problems in the river basin. This is because people who live along the river rely on river water for various daily needs, including bathing, washing, and defecating (Pramaningsih et al., 2017). Water pollution is not only detrimental to the people who live along the riverbanks, but like river water that flows from upstream to downstream, which means it also brings various negative impacts to other communities (Puspitasari, 2009).

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Based on these problems, it is important to conduct a study on the relationship between the lifestyle of the polluted river basin community and the level of health of the community around the river basin. With this study, it is expected to increase awareness of the importance of environmental protection, especially in river basins.

In addition to the previously mentioned factors, it is also important to highlight the weak enforcement of waste disposal regulations and the lack of environmental governance implementation. The imbalance between rapid urbanization and inadequate water resource management has accelerated the degradation of river quality. Public awareness regarding the importance of preserving river water quality remains low, which is evident from the widespread practice of dumping household waste directly into rivers. Moreover, the lack of sanitation infrastructure such as septic tanks and wastewater treatment plants (WWTPs) has worsened water pollution. Understanding the complexity of these issues is crucial for emphasizing the need for multi-sector collaboration in protecting river ecosystems and ensuring the health of the communities that depend on them.

In terms of governance, Indonesia still struggles with enforcing environmental regulations effectively. Although legal frameworks such as Law No. 32/2009 on Environmental Protection and Management exist, their implementation is hindered by weak institutional capacity, lack of monitoring mechanisms, and minimal public participation. Industries that discharge hazardous waste into rivers often go unpunished due to loopholes in regulatory oversight. Simultaneously, the development of wastewater treatment facilities and sanitation infrastructure has lagged behind urban growth, particularly in peri-urban and rural areas. Without adequate planning and investment, the pressure on river systems will continue to intensify.

Another critical factor contributing to worsening river pollution is climate change. Irregular rainfall patterns and extreme weather events exacerbate the spread of pollutants. Flooding, for example, can disperse contaminants from point-source pollution sites to wider areas, increasing the risk of outbreaks of diseases such as leptospirosis and cholera. Conversely, prolonged droughts can lead to a concentration of pollutants in low water volumes, magnifying their toxic effects. This interconnection between climate variability and waterborne hazards makes river pollution a multi-dimensional issue that intersects with public health, environmental sustainability, and climate resilience.

Considering the multifaceted nature of river pollution and its severe implications on community health, it becomes imperative to conduct focused research on this topic. Understanding the causal relationship between river pollution and the health of populations living in river basin areas will help provide evidence-based recommendations for policy and intervention. This study specifically explores two cases—Karang Mumus River in Samarinda and Cukir River in Jombang—as representative examples of the national issue. By analyzing the health conditions of communities exposed to polluted river environments, this research aims to contribute to the growing body of knowledge necessary to develop strategic, integrated, and participatory solutions to improve water quality and public health outcomes.

Ultimately, it is hoped that the findings of this study will raise awareness among policymakers, public health practitioners, environmental authorities, and the general public regarding the urgency of preserving river ecosystems. Effective river management must move beyond technical solutions and incorporate a holistic approach that includes education, infrastructure, regulation, and strong community engagement. Only through such collaborative and comprehensive efforts can we ensure the sustainability of rivers and safeguard the health of communities that rely on them every day.

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METHOD

This paper uses the literature review method as the main approach in data collection and analysis. This method is carried out by collecting, reviewing, and examining various relevant sources of information in the form of scientific articles, research reports, books, and official documents that discuss river water pollution and its impact on public health in the watershed area. The data collection process was carried out by searching for literature sources from various databases and trusted digital libraries, such as Google Scholar and university libraries. The literature selected was credible and up-to-date so that the study could describe the current condition of river pollution and its impact on public health.

This literature review was conducted systematically using a wide range of relevant academic sources, including national and international journals, institutional reports, and government documents. The selected literature focused on the issue of river pollution and its impact on public health, particularly in the context of Indonesian rivers. Inclusion criteria involved publications from the last ten years and studies that emphasized river areas in densely populated regions. A comparative approach was also adopted to identify variations in health impacts based on different pollution sources such as domestic, industrial, and agricultural waste. Therefore, the chosen method provides a comprehensive overview of the patterns linking river pollution and public health issues in Indonesia.

DISCUSSION

River Water Polution

The river is one of the containers where water gathers from an area. Surface water or runoff water flows by gravity to a lower place (Asdak, 1995). The quality of river water in an area is strongly influenced by various human activities, especially those around the river (Ibisch et al., 2009). If these activities are balanced by high public awareness in preserving the river environment, then river water quality will be relatively good. Vice versa, without awareness and active participation from the community, river water quality will also be poor.

Low or poor river water quality will have an impact on the decline in the number of river biota and in general will further reduce the quality of river water downstream which then empties into the sea (Yogafanny, 2015). Water pollution in many areas in Indonesia has resulted in a clean water crisis. Weak government supervision and reluctance to enforce the law properly have made the problem of water pollution even worse. The occurrence of water pollution has an influence on the lives of living things, such as the disruption of the water ecosystem and clean water used to fulfill life needs is difficult to obtain. The unavailability of clean water is generally caused by two factors, namely natural and human factors. Natural factors are caused by naturally occurring conditions such as geographical areas that lack water availability. Meanwhile, human factors are caused by human activities so that water becomes polluted (Puspitasari, 2009).

River pollution has a very serious impact on human health, especially for people who live around the river or who depend on the source of their water needs. Polluted rivers contain various hazardous materials such as bacteria, viruses, heavy metals (such as mercury, lead, and arsenic), and toxic chemical compounds from household, agricultural, and industrial waste. When this polluted river water is used for bathing, washing, cooking, or even consumed directly without a proper purification process, the risk of exposure to disease becomes very high.

Besides pollution from domestic and industrial waste, the phenomenon of eutrophication also warrants attention in the context of river pollution. Eutrophication occurs due to the excessive presence of nutrients such as phosphate and nitrogen from detergents and fertilizers, which stimulates the uncontrolled growth of algae (*algal bloom*). This leads to a decrease in

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dissolved oxygen levels and causes the mass death of aquatic life such as fish and plankton. In the long run, eutrophication disrupts the balance of the aquatic ecosystem and further deteriorates the quality of river water used by surrounding communities. This underlines the fact that river pollution has both direct and indirect effects on human health and environmental sustainability

Beyond the immediate health risks, river pollution also has far-reaching implications for economic stability and food security. Agriculture that relies on polluted river water for irrigation may lead to bioaccumulation of toxic substances in crops, posing indirect health risks through food consumption. Fish and other aquatic products contaminated by heavy metals and toxins are often still consumed by local populations, particularly in rural areas where monitoring is limited. This not only endangers health but also undermines trust in local food systems and reduces economic productivity in sectors reliant on clean water.

Efforts to mitigate river pollution must adopt an integrated, multi-sectoral approach. Firstly, regulatory enforcement must be strengthened to ensure that industrial and domestic effluents are treated before being discharged. Environmental agencies should employ real-time monitoring systems using digital sensors and Geographic Information Systems (GIS) to track pollution sources and trends more effectively. Public health departments must collaborate with environmental scientists to identify disease clusters linked to water quality, enabling targeted interventions.

Secondly, community involvement is essential. Local populations need to be empowered through environmental education, participatory river monitoring programs, and access to clean technology. For instance, the use of eco-sanitation systems, bioremediation methods, and community-based waste treatment facilities can provide low-cost and sustainable solutions to the pollution problem. Civil society organizations can play a mediating role in bridging communities and policymakers, advocating for inclusive environmental governance.

Thirdly, investment in green infrastructure should be prioritized. Urban wetlands, vegetative buffer zones, and constructed wetlands act as natural filters that absorb pollutants and improve water quality. Reforestation of watershed areas can stabilize soil, reduce runoff, and improve infiltration, helping restore the hydrological cycle and reduce sediment loads in rivers.

In conclusion, river water pollution is a multi-dimensional issue that intertwines environmental degradation, public health risk, economic loss, and social injustice. Addressing it requires a long-term commitment from all stakeholders—government, industries, scientists, and the public alike. By acknowledging the interconnectedness of these impacts and implementing comprehensive, science-based, and community-oriented strategies, the vision of clean, sustainable river systems can still be realized in Indonesia and beyond

Environmental Health

Environmental health is an ecological balance that must exist between humans and the environment in order to ensure the healthy state of humans (WHO, 2021). The Association of Environmental Health Experts (HAKLI) defines environmental health as an environmental condition that is able to sustain a dynamic ecological balance between humans and their environment to support the achievement of a healthy and happy quality of human life (Islam, 2021). Climate change impacts human life and health in a variety of ways. It threatens the essential elements of good health, clean air, safe drinking water, nutritious food supply and space. River pollution has a major impact on the overall health of the environment. Rivers polluted by domestic, industrial and agricultural effluents lead to disruption of the balance of the aquatic ecosystem. Hazardous chemicals and organic waste entering the river cause a

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decline in water quality, the death of aquatic life such as fish, plankton, and aquatic plants, and disrupt the natural food chain. In addition, inorganic waste such as plastics and heavy metals not only pollute the water, but also contaminate the land around the river when flooding or sedimentation occurs.

Environmental conditions polluted by dirty river water also have an impact on human life. A poor environment can become a hotbed of disease, increasing the population of vectors such as mosquitoes and flies that spread infectious diseases. The unpleasant odor from polluted river water also reduces air quality and the comfort of living for the surrounding community. In the long run, this pollution can lead to widespread environmental degradation, such as the destruction of agricultural land due to irrigation from unsuitable river water, as well as the reduction of clean water sources for local communities. Therefore, keeping rivers clean is essential to ensure the sustainability of ecosystems and the health of the human environment.

Moreover, children, pregnant women, and the elderly within these populations are disproportionately affected by river pollution. Children are more susceptible to gastrointestinal infections and developmental impairments from exposure to lead and arsenic, while pregnant women face increased risks of miscarriage, premature birth, and birth defects. Elderly individuals, whose immune systems are often weakened, are also more prone to respiratory and gastrointestinal diseases stemming from poor water and air quality. Addressing these disparities requires an environmental justice framework that ensures equitable access to safe water and health-promoting environments.

From a policy perspective, the integration of environmental and public health approaches is essential. Pollution control measures must go beyond environmental regulations to include proactive public health interventions. For example, environmental health officers should work alongside community health centers to conduct health risk assessments, water quality monitoring, and health education campaigns. Government programs that promote the construction of community-based sanitation systems, rainwater harvesting, and low-cost water purification technologies can help reduce the dependence on polluted rivers.

Furthermore, multi-sectoral coordination is vital. Ministries of environment, health, public works, and education must collaborate to develop policies that are coherent, enforceable, and community-centered. Urban planning should include buffer zones to prevent settlements along highly polluted riverbanks, and zoning regulations must be updated to protect water bodies from industrial encroachment. Investment in green infrastructure—such as bioswales, wetlands, and vegetated riparian corridors—should be prioritized as part of both environmental restoration and public health strategies.

In summary, river pollution has become a significant driver of environmental health decline, particularly in densely populated and economically disadvantaged regions. Its impact spans physical health, ecological integrity, and social equity. Addressing this issue requires a paradigm shift from reactive remediation to proactive prevention through inclusive, integrated, and sustained environmental health planning. Protecting rivers is not merely an ecological concern—it is a public health imperative that directly determines the quality of life for millions of people.

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Impact of River Water Pollution on Public Health in Several Rivers in Indonesia Karang Musmus River, Samarinda, East Kalimantan

The data obtained based on the results of community interviews on the banks of the Karang Mumus River, shows that there are three types of diseases that are often suffered by the community, namely diarrhea, dysentery and skin irritation. The most common type of disease suffered by the community is skin irritation with 45 people, followed by diarrhea with 15 people. Diarrhea is thought to be caused by the use of river water to wash various eating utensils. Based on several other sources, Karang Mumus river water is polluted with Coliform bacteria. The presence of fecal coliform will have a health impact on the community if they consume polluted water or use river water to wash tableware. Communities along the Karang Mumus river do not have latrines equipped with septic tanks so that feces go directly into the river. The presence of human waste causes an increase in the concentration of fecal coliform bacteria which is a source of disease. Household waste management, waste management, and fecal management are related to the bacteriological quality of Escherichia coli (E. coli) in river water, as well as the onset of diarrhea symptoms in communities living around the river. Coliform and Escherichia coli bacteria are found in clean water sources, namely in borehole water, dug well water and even PDAM water, putting them at risk of transmitting waterborne diseases. In this case, water quality monitoring efforts are very important to improve public health.

As a further example, the Citarum River in West Java represents an extreme case of pollution and its impact on public health. It is considered one of the most polluted rivers in the world, contaminated by industrial waste from textile factories, heavy metals, and synthetic dyes. Studies by international agencies have found that children living near the Citarum River exhibit lead levels in their blood that exceed WHO safety thresholds. This condition puts them at risk of impaired growth and cognitive development. The Citarum case highlights that river pollution is not just an environmental concern but also a public health crisis that demands urgent, systemic, and collaborative responses

Cukir Village River, Jombang District, East Java

The river of Cukir Village in Jombang District, East Java is plagued by sugar factory effluents. Sugar mill effluents, when discharged into the environment, pose a serious health hazard to rural and semi-urban residents who use the river and its waters for agricultural and domestic purposes (Baruah et al., 1993). River pollution can have an impact on the health of the surrounding community, such as diarrhea, Upper Respiratory Tract Infection (URTI), dyspepsia (indigestion), dermatitis (skin disorders). The data obtained shows that 36.4% of respondents or around 12 people out of 33 respondents chose diarrhea as the most commonly encountered disease as a result of factory waste discharges. This can happen, because the community around the river consumes water that has been contaminated with wastewater that contains many microbes and has a negative impact on the digestive system.

CONCLUSIONS

River pollution in watershed areas has been shown to have a significant impact on the health of people living in the vicinity. Based on studies in Karang Mumus River (Samarinda) and Cukir Village River (Jombang), pollution from domestic and industrial waste has caused various diseases such as diarrhea, skin irritation, ARI, and digestive disorders. This is caused by low water quality polluted by pathogenic bacteria, heavy metals, and harmful chemicals. The community's dependence on river water for daily activities such as washing, bathing and consumption, without proper treatment, increases the health risks. Lack of adequate sanitation facilities and low environmental awareness exacerbate this condition. Thus, the link between

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river water pollution and public health conditions is very real and needs to be a serious concern in sustainable watershed management.

The findings of this study confirm that river pollution in watershed areas poses direct and serious health threats to nearby communities. To mitigate these risks, multi-sector interventions are needed—not only to improve water quality but also to raise public awareness, expand sanitation infrastructure, and enforce environmental regulations. Local governments must promote community participation in waste management and monitor industrial effluents more strictly. Community-based interventions such as communal toilet construction and routine environmental health education by local health centers can serve as initial steps. Thus, improving river water quality must go hand in hand with sustainable public health development.

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