ISA Journal of Multidisciplinary (ISAJM)

Homepage: https://isapublisher.com/isajm/

Volume 3, Issue 3, May-Jun, 2026 ISSN: 3049-1851

Assessing the Impact of Natural Resource Exploitation on Environmental Degradation: A Case Study of the Pampana River, Sierra Leone

Esther Edith Kargbo[1]; Jusufu James[2]; Emman Chilambe[3]; Clara N. Kun[4]

[1]*Department of Aquaculture and Fisheries Management, School of Natural Resources Management, Njala University, Njala Campus, Kori Chiefdom, Moyamba, Sierra Leone*
[2]*Department of Physics and Computer Science, Njala University, Njala Campus, Kori Chiefdom, Moyamba, Sierra Leone*
[3]*Department of Ministry of Agriculture, The Copperbelt University, Kitwe, Zambia*
[4]*Department of Agriculture and Forestry, University of Liberia, Fendell, Montserrado, Monrovia, Liberia*

Received: 11.04.2026 | **Accepted:** 16.05.2026 | **Published:** 18.05.2026

***Corresponding Author:** Esther Edith Kargbo

DOI: *10.5281/zenodo.20266429*

Abstract **Original Research**

In many emerging nations, the exploitation of natural resources is a key factor in economic growth, but it also presents serious environmental problems. This study evaluates how Sierra Leone's Pampana River environmental degradation is affected by the exploitation of natural resources. Using structured questionnaires and interviews, 50 respondents provided primary data, which was supplemented by secondary data from pertinent literature. Looking at how resources get used, small-scale gold digging stands out at 40%, closely followed by sand extraction at 36%. Seventy percent of people surveyed describe clear harm to nature around them. Water quality has dropped sharply, according to nearly three-quarters of those asked. Damage shows up most clearly in broken habitats, over half report this issue. Fewer point to species loss, yet still more than one-third notice it happening. Polluted waterways come up less often but remain a concern for some. When rating overall damage, four out of five see mining effects as very serious. Health problems linked to these activities appear even more widespread, 84% say they're affected. Most people see little benefit from efforts like planting trees or educational outreach, yet nearly all favour tighter rules. Despite programs aimed at protection, six out of ten doubt their real-world impact. Stronger oversight gains broad approval. Damage to the Pampana River continues under current resource use patterns. Evidence points to lasting harm caused by unchecked extraction. Fixing it may depend on updated enforcement, responsible mining methods, together with local stewardship models.

Keywords: Natural resource exploitation, environmental degradation, Pampana River, artisanal mining, biodiversity loss, Sierra Leone.

1. Introduction

Water is a basic natural resource that is necessary to support life and preserve the equilibrium of ecosystems. Even while freshwater makes up around 70% of the Earth's surface, just 3% of its water resources are available for human consumption (Arimieari et al., 2014). Significant environmental deterioration has resulted from the tremendous strain that growing anthropogenic activities have placed on these finite resources (Usharani et al., 2010).

Natural resource extraction has boosted economic growth on a global scale, but unsustainable practices have led to environmental problems such soil erosion, water pollution, and biodiversity loss (Jin et al., 2020a; Whitehead et al., 2018). Because of lax regulatory enforcement and unofficial procedures, artisanal and small-scale mining (ASM) is a significant cause of environmental degradation in Sub-Saharan Africa (Hilson, 2002; Babut et al., 2003).

Minerals, forests, and water bodies are just a few of Sierra Leone's many natural resources. However, extensive environmental deterioration has resulted from the unsustainable exploitation of these resources (Allison, 2016). A significant river system in Sierra Leone, the Pampana River sustains residential water consumption, fishing, and agriculture. Mining, deforestation, and agricultural practices have had a greater impact on it in recent years (Kamara, 2019; Conteh, 2021).

Hazardous substances like cyanide and mercury, which contaminate water bodies and endanger aquatic ecosystems, are frequently used in artisanal mining operations (Hilson, 2002; Marcantonio., 2011). By increasing soil erosion and sedimentation, deforestation worsens environmental degradation by lowering water quality and changing river ecosystems (Kaimowitz and Angelsen, 1998; Nasi et al., 2011).

Human health and livelihoods are significantly impacted by the Pampana River's deterioration. Waterborne illnesses and other health issues are made more likely by exposure to contaminated water (WHO, 2020). The degree of environmental degradation in the Pampana River watershed has not been thoroughly studied empirically, despite these worries. By evaluating the effects of natural resource extraction and suggesting sustainable management techniques, this study seeks to close this gap.

2.0 Materials and Methods

2.1 Study Area

Flowing across northern and southern parts of Sierra Leone, the Pampana River stretches roughly 249 kilometres (155 miles), feeding a drainage zone near 7,500 square kilometres (2,900 square miles) (Clarke, 1969). Communities along its banks rely on farming, mineral extraction, or catching fish for survival.

2.2 Research Design and Sampling

Fifty respondents who worked in mining, farming, and fishing were chosen using a purposive sampling technique. Based on their familiarity and expertise with resource extraction, respondents were chosen.

2.3 Data Collection

During the process of collecting data from the respondents, the researcher uses three specific tools to harness the data presented in the next section of this work, as indicated below.

- Structured questionnaires
- Personal interviews
- Secondary sources (journals, reports, and publications)

2.4 Data Analysis

Descriptive statistical methods were employed to analyse the data. Results were presented using percentages, and charts.

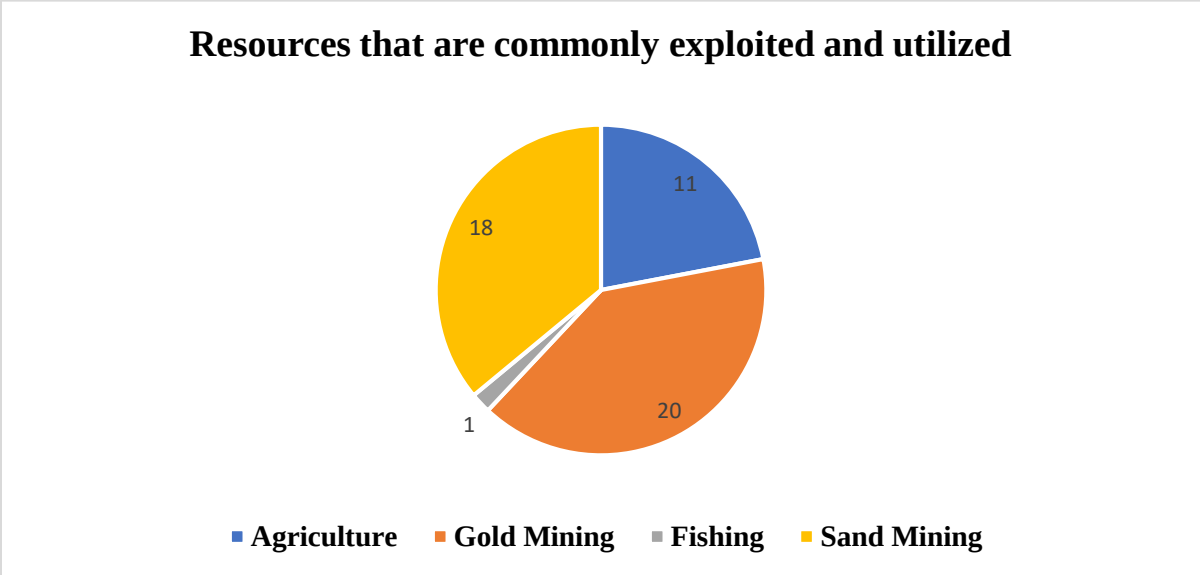
3. Results and Discussion

The data provided highlights several critical issues and perspectives regarding resource exploitation and its environmental impact on the Pampana River

region. The data includes details on age, gender, location, and type of employment, as well as how these relate to the use of natural resources, mining techniques, sources of income, and the results of resource management.

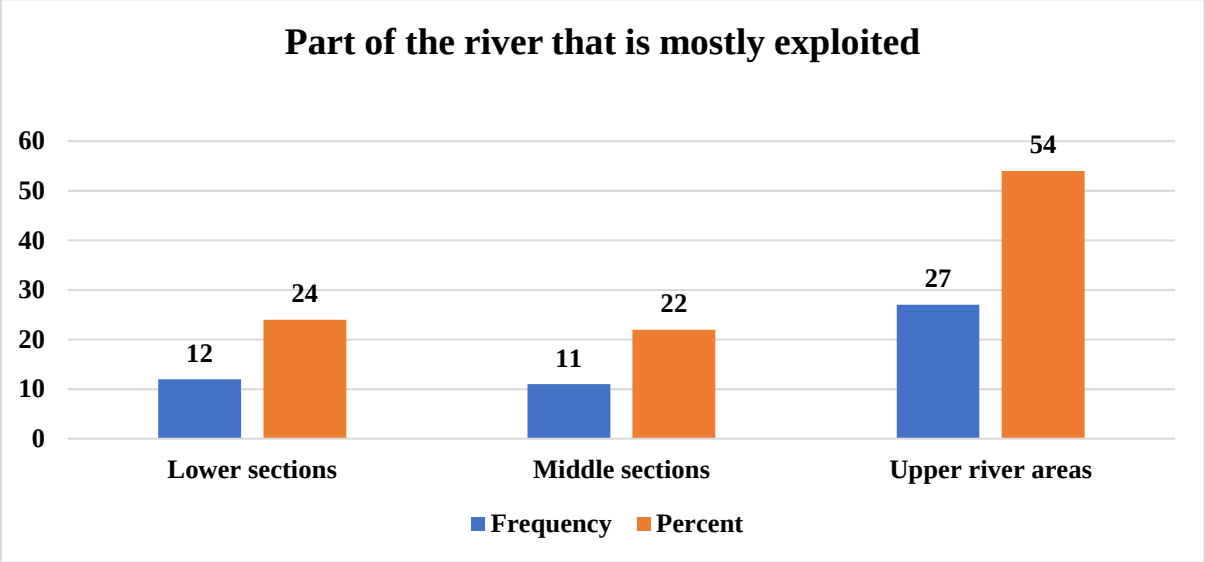
3.1 Types of Resource Exploitation

Gold mining takes up 40% of activity near the Pampana River, followed by sand extraction at 36%. Agriculture plays a smaller role, making up just over one-fifth of land use. Fishing barely registers, responsible for merely 2%. Clearly, most economic effort leans toward digging rather than growing or catching.



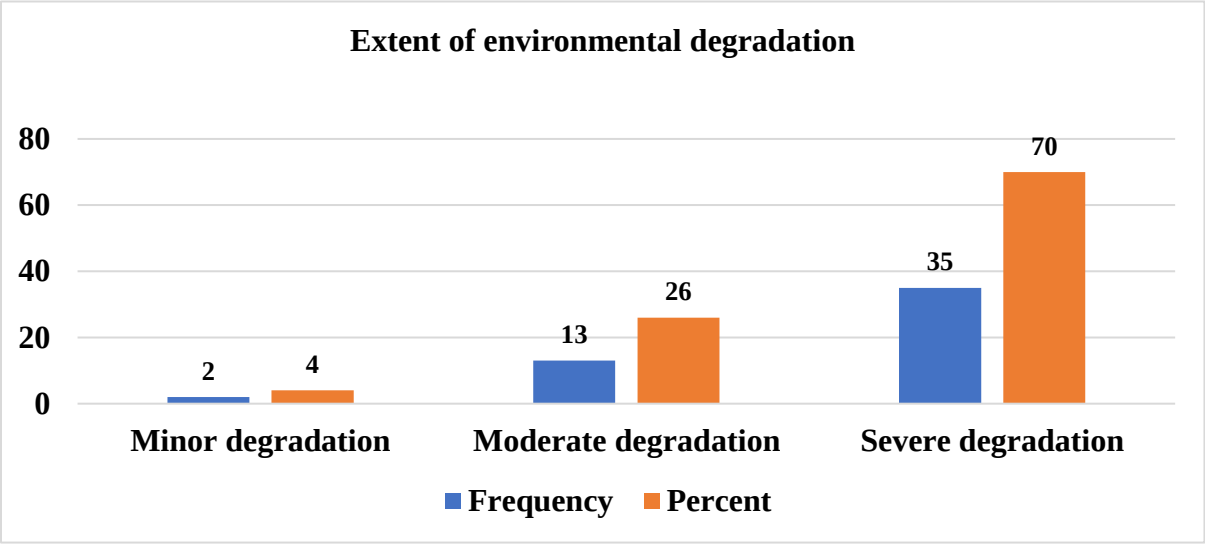
3.2 Parts of the Pampana River are used for resource exploitation

High levels of resource use appeared in the upper stretches, around 54%, probably because rich mineral deposits lie there along with simpler access for small-scale miners. Although lower zones saw only 24%, and midsections 22%, these spots might hold fewer resources or already face damage from past activity. Where digging and drilling pile up near the headwaters, problems grow. Steady removal could wear down habitats, taint water supplies, erode ecosystems slowly over time.



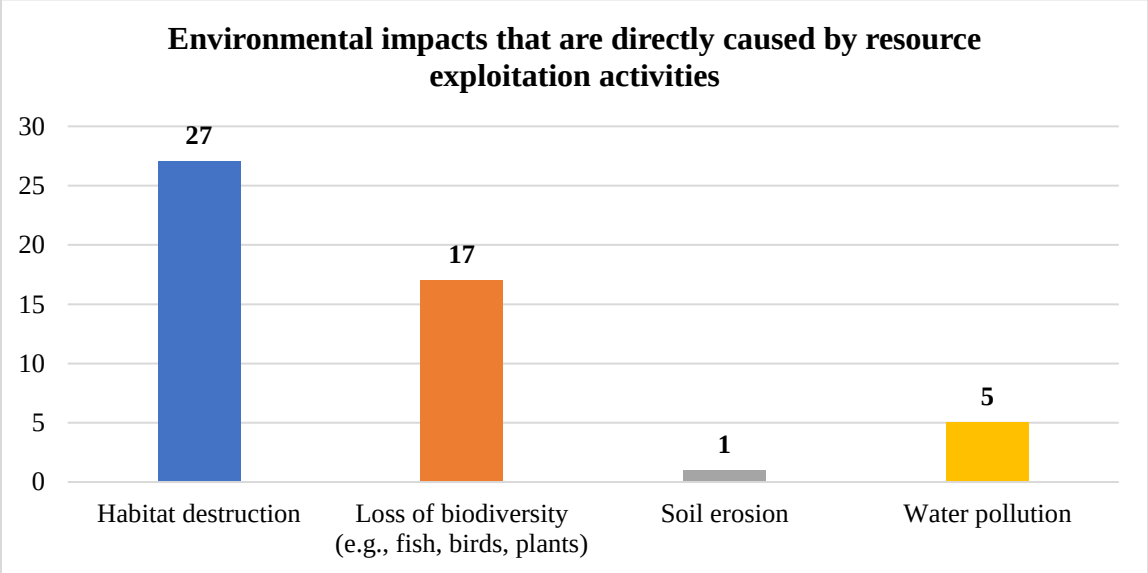
3.3 Extent of Environmental Degradation

Most people surveyed, 70 percent noted serious harm to the environment, whereas a quarter saw noticeable but less intense damage. Just four out of every hundred noticed only slight changes. A rise in pollution levels was seen by nearly three-quarters of those asked. Nearly everyone who took part pointed to worsening conditions in nearby water sources. Earlier research matches these results, showing farming alongside extraction work heavily affects water quality through contamination and silt buildup (Hasan et al., 2019; Uddin and Jeong, 2021).



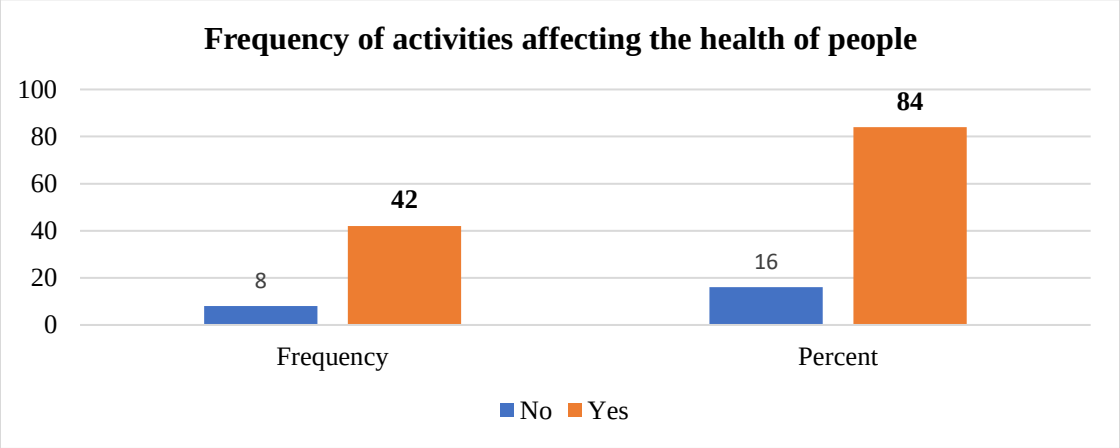
3.4 Environmental Impacts

The majority of respondents believe habitat destruction (54%) is the primary environmental impact. A significant proportion identified biodiversity loss (34%) as a major concern. While less frequently cited, water pollution is a critical issue. Mining activities (10%) often lead to the release of harmful chemicals (e.g., mercury, cyanide) and sedimentation, degrading water quality and impacting aquatic life and human water resources. Soil erosion (2%), though minimally highlighted, is a known consequence of deforestation and mining. It leads to reduced land fertility, siltation of water bodies, and the loss of arable land. Findings in other river systems impacted by mining and deforestation are consistent with habitat damage and biodiversity loss (Nasi et al., 2011; Leh et al., 2013).



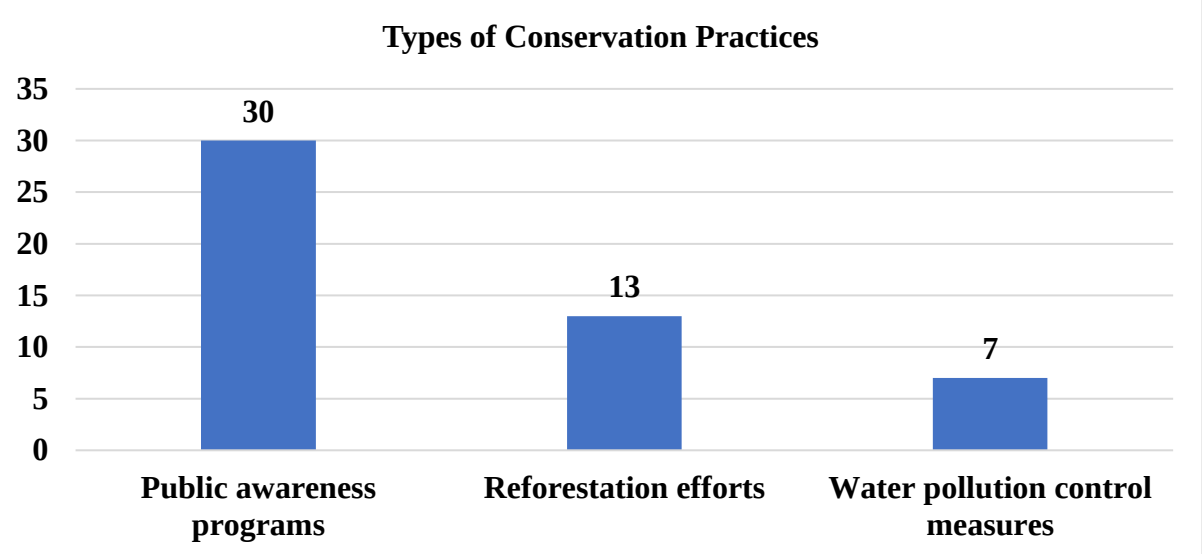
3.5 Socioeconomic and Health Impacts

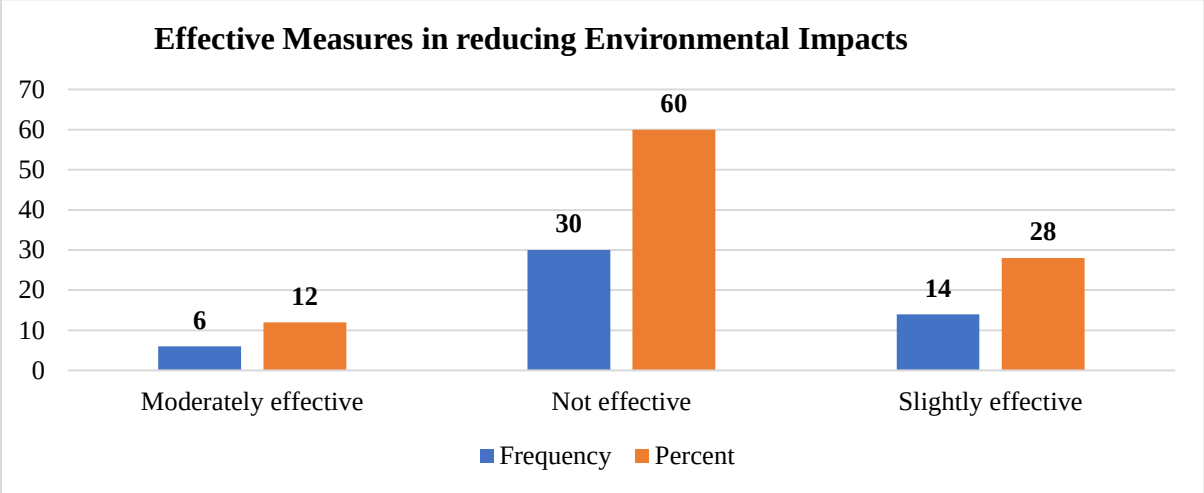
A large proportion of respondents (84%) reported that environmental degradation has negatively affected human health. This is consistent with studies linking polluted water to increased incidence of waterborne diseases (WHO, 2016). Additionally, 16% reported a decline in fish populations, indicating ecological imbalance and reduced biodiversity.



3.6 Effectiveness of Conservation Measures

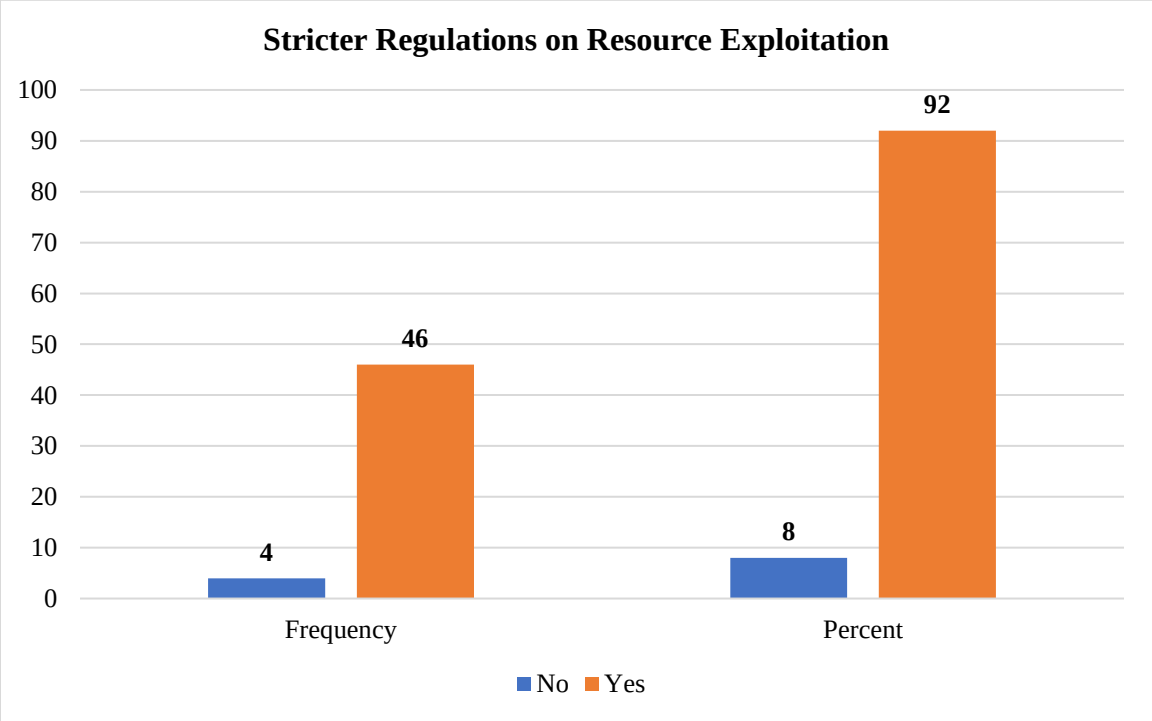
Despite the existence of conservation strategies including public awareness campaigns (28%) and reforestation (26%), 60% of respondents believe they are ineffective. This implies that better implementation and oversight are required.

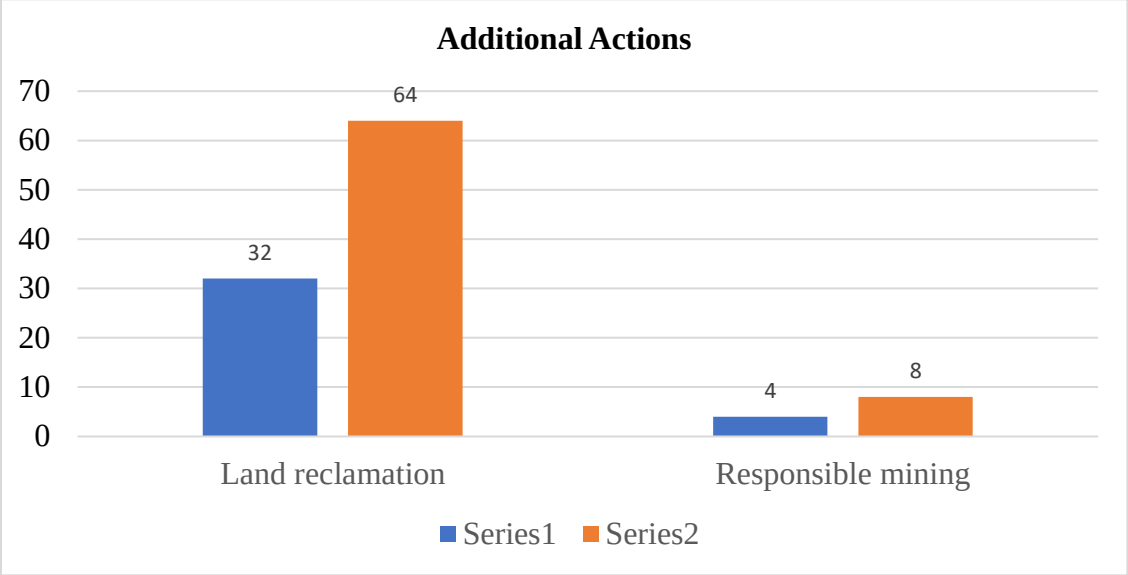




3.7 Community Perception and Policy Implications

92% of respondents are in favour of more stringent environmental laws. The most popular alternative was found to be land reclamation (64%), which was followed by reforestation and sustainable mining methods.





3.8 Impact of industrial and artisanal gold and sand mining

Near villages along the Pampana River in Sierra Leone, small-scale and large-scale mining, especially for gold and sand, endanger both nature and people's well-being. This waterway supports daily life, providing for household needs, animals, and food gathering (Akagi et al., 1995). Yet pollutants enter its flow when waste fluid and leftover rock from mines release toxic elements into it, undermining underwater habitats as well as community safety. Fish tainted with mercury, once eaten, may lead to brain and movement disorders, damage to hearing, physical immobility, or fatal outcomes during extreme exposure (WHO, 2016). Most small-scale gold mining operates outside oversight, weak penalties allowing harm to grow (Funoh, 2014). Where building needs drive intense removal of sediment, water edges weaken, river floors sink, shorelines recede, habitats shrink, species vanish, worsened by shifting weather patterns (Choi-Ben, 1978).

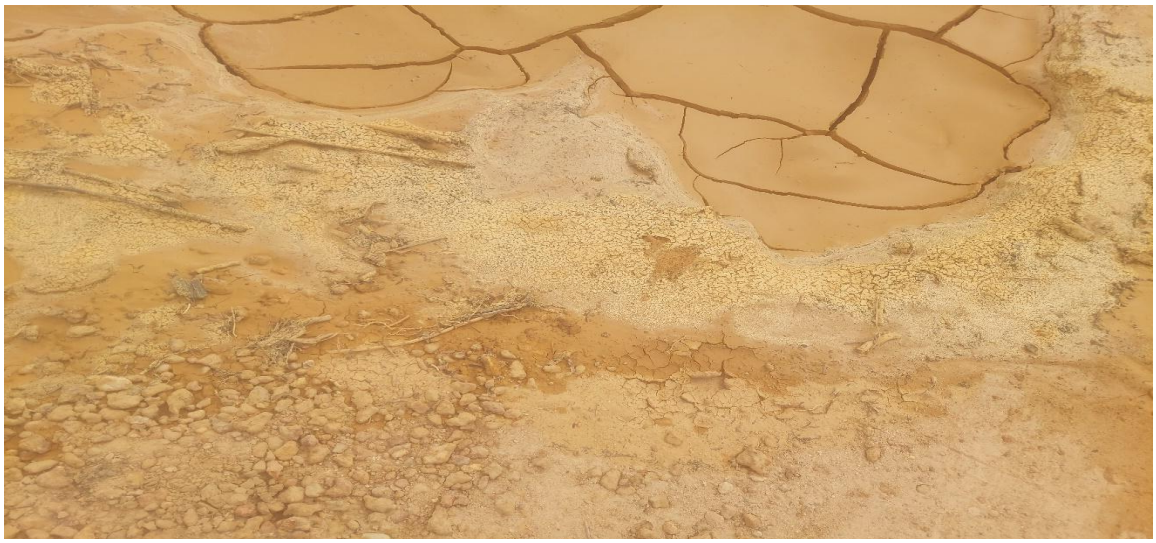


Plate 1: Gold mining pit

Plate 2: Machine used for gold mining

Plate 3: Sand mining

3.9 The impact of Man's activities on the river

3.9.1 Reasons for change in color and ways for improving the quality of River Pampana

Color shifts in the Pampana River trace back to sand and gold extraction, according to local accounts. Clear water once flowed here, people recall it distinctly - but that changed as digging increased. Instead of "and," actions like dredging and sluicing now dominate the banks. Though some propose halting operations or offering new jobs, others doubt recovery is realistic. Their reasons were, livelihoods are tied too closely to the trade. Daily routines involving fish harvests, bathing, or washing clothes have vanished from riverside life. What remains is a stream altered beyond familiar use.

4.0 Conclusion and Recommendations

4.1 Conclusion

Despite its small scale, artisanal mining pushes much of the environmental harm seen across the Pampana River basin. Habitat damage runs deep, species vanish rapidly, while rivers carry growing contamination, signs pointing to immediate response. Though often overlooked, these activities reshape entire ecosystems through steady pressure. Without measures taking effect soon, recovery grows less likely each year.

What stands out is how closely damaged ecosystems tie to rising health threats. Even where protection measures are in place, weak results point toward deeper issues in oversight. Stronger rules could make a difference, paired with smarter use of natural assets. Without firmer follow through, gains remain fragile.

4.2 Recommendation

- Strengthen environmental regulations and enforcement
- Promote sustainable mining practices
- Implement land reclamation programs

- Establish water quality monitoring systems
- Enhance community awareness and participation
- Provide alternative livelihoods

Acknowledgments

Appreciation goes first to the Department of Natural Resources Management at Njala University, Sierra Leone, for steady backing during every stage of this work. Supervisors, lecturers, and field staff each played a role, guiding ideas, sharing insight, lending hands when needed. Along the Pampana River, people opened their homes; without such willingness, gathering data would have been difficult, maybe impossible. Responses shared there shaped much of what follows here. Encouragement arrived in quiet ways too from family, from friends offering strength through long stretches of effort. In many forms, help came. It made a difference.

References

Akabzaa, T., & Darimani, A. (2001). *Impact of mining sector investment in Ghana: A study of the Tarkwa mining region*. Third World Network.

Akagi, H., Malm, O., Branches, F. J. P., Kinjo, Y., Kashima, Y., Guimarães, J. R. D., Oliveira, R. B., Haraguchi, K., Pfeiffer, W. C., Takizawa, Y., & Kato, H. (1995). Human exposure to mercury due to gold mining in the Tapajos River Basin, Amazon, Brazil: Speciation of mercury in human hair, blood and urine. *Water, Air, and Soil Pollution, 80*(1–4), 85–94. https://doi.org/10.1007/BF01189656

Allison, E. H. (2016). Environmental impacts of mining in Sierra Leone. *Journal of Environmental Studies, 15*(4), 345–367.

Amarendra, S. (2017). *Mining and environmental degradation*. Environmental Research Publications.

Arimieari L.W, Sangodoyin A.Y, & Ereoforiokuma N.S. (2014). Assessment of Surface Water Quality in Port Harcourt, Nigeria. Journal of Engineering and Technology. PP.1146-1151

Arimieari, L. W., Nwankwoala, H. O., & Amadi, A. N. (2014). Freshwater resources and sustainability challenges. *International Journal of Water Resources and Environmental Engineering, 6*(3), 95–102.

Ashraf, M. A., Maah, M. J., & Yusoff, I. (2010). Sand mining effects, causes and concerns: A case study from Bestari Jaya, Selangor Peninsula, Malaysia. *Scientific Research and Essays, 5*(11), 1216–1231.

Babut, M., Sekyi, R., Rambaud, A., Potin-Gautier, M., Tellier, S., Bannerman, W., & Beinhoff, C. (2003). Improving the environmental management of small-scale gold mining in Ghana: A case study of Dumasi. *Journal of Cleaner Production, 11*(2), 215–221. https://doi.org/10.1016/S0959-6526(02)00043-4

Brandt, M. J., Johnson, K. M., Elphinston, A. J., & Ratnayaka, D. D. (2016). Twort's water supply. Butterworth-Heinemann.

Clarke, J. (1969). *Hydrology of Sierra Leone rivers*. Government Printing Press.

Conteh, A. (2021). Mining pollution and environmental degradation in Sierra Leone. *African Environmental Review, 18*(2), 56–70.

Edokpayi, J. N., Odiyo, J. O., & Durowoju, O. S. (2019). Impact of wastewater on surface water quality in developing countries: A review. *Water Quality*, 401–416. https://doi.org/10.5772/intechopen.79196

Fiedler, H. (1997). Water pollution and ecosystem health. *Environmental Toxicology and Water Quality, 12*(1), 9–17.

Food and Agriculture Organization (FAO). (2020). *Agricultural impacts on water systems*. FAO Publications.

Hasan, M.K. Shahriar, A. Jim, K.U. (2019). Water pollution in Bangladesh and its impact on public health Heliyon. Article e02145, 10.1016/Heliyon. 2019.e02145

Hilson, G. (2002). Small-scale mining and its socio-economic impact in developing countries. *Natural Resources Forum, 26*(1), 3–13. https://doi.org/10.1111/1477- 8947.00002

Islam, M. S., Han, S., Ahmed, M. K., & Masunaga, S. (2019). Assessment of trace metal contamination in water and sediment of some rivers in Bangladesh. *Journal of Water and Health, 17*(2), 283–298. https://doi.org/10.2166/wh.2019.250

Jin, Q., Tang, S., Wang, P., Lu, B., Li, K., Jin, W., & He, X. (2021). From source to sink: Review and prospects of microplastics in wetland ecosystems. *Science of the Total Environment, 758*, 143633. https://doi.org/10.1016/j.scitotenv.2020.143633

Kaimowitz, D., & Angelsen, A. (1998). *Economic models of tropical deforestation: A review*. Center for International Forestry Research.

Kamara, A. (2019). Mining activities and environmental degradation in Sierra Leone. *Sierra Leone Environmental Journal, 7*(1), 25–39.

Karikar, R. (2004). Water pollution sources and management strategies. *Environmental Protection Review, 10*(2), 44–58.

Leh, M., Bajwa, S., & Chaubey, I. (2013). Impact of land use change on erosion risk: An integrated remote sensing, geographic information system and modelling methodology. *Land Degradation & Development, 24*(5), 409–421. https://doi.org/10.1002/ldr.1137

Marcantonio, R. A., Field, S. P., Sesay, P. B., & Lamberti, G. A. (2021). Identifying human health risks from precious metal mining in Sierra Leone. *Regional Environmental Change, 21*(1), 1–14. https://doi.org/10.1007/s10113-020-01731-5

Nasi, R., Billand, A., & van Vliet, N. (2011). Managing for timber and biodiversity in the Congo Basin. *Forest Ecology and Management, 268*, 103–111. https://doi.org/10.1016/j.foreco.2011.04.005

Ochieng, G. M., Seanego, E. S., & Nkwonta, O. I. (2010). Impacts of mining on water resources in South Africa: A review. *Scientific Research and Essays, 5*(22), 3351– 3357.

Samuel, P. (2019). Water use and agricultural sustainability in developing countries. *Journal of Agricultural Development, 8*(3), 112–120.

Uddin, M. G., & Jeong, Y. (2021). Urban river pollution in developing countries: Water quality assessment. *Environmental Challenges, 5*, 100344. https://doi.org/10.1016/j.envc.2021.100344

Usharani, K., Umarani, K., Ayyasamy, P. M., & Shanthi, K. (2010). Physico-chemical and bacteriological characteristics of Noyyal River and groundwater quality of Perur, India. *Journal of Applied Sciences and Environmental Management, 14*(2), 29–35.

Vega, M., Pardo, R., Barrado, E., & Debán, L. (1998). Assessment of seasonal and polluting effects on the quality of river water by exploratory data analysis. *Water Research, 32*(12), 3581–3592. https://doi.org/10.1016/S0043-1354(98)00138-9

Whitehead, P. G., et al. (2018). Wastewater impacts on river water quality under climate change. *Science of the Total Environment, 640–641*, 1144–1158. https://doi.org/10.1016/j.scitotenv.2018.05.356

World Health Organization (WHO). (2016). *Mercury and health*. World Health Organization.

World Health Organization (WHO). (2020). *Water quality and public health*. World Health Organization.