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Evaluation of the Impact of Effurun Market Activities on Water Quality and Aquatic Sentinels in Warri River, Delta state

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Abstract: *The impact of activities in the market affect water quality is a major problem for surface water, aquatic organisms and humans in the environment. the study shows the effects of Effurun Market activities on the water quality of the Warri River and its aquatic sentinels. Water samples were collected from upstream, midstream, and downstream sections and analyzed for physicochemical parameters, heavy metals, and microbial contamination and aquatic organisms (fish and water hyacinth) were collected .the results obtained for some parameters are pH ranging from 5.4-6.8, DO from 3.2 to 7.1, COD from 32.0 -309.33, feaecal coliform from 5.3-12.7. The results show elevated pollution levels, with lead, phosphate, and biochemical oxygen demand exceeding permissible limits. The findings underscore the need for better waste management strategies and policy interventions to reduce pollution in the Warri River.*

Keywords: *Water Pollution, Warri River, Heavy Metals, Aquatic Sentinels, Environmental Impact*

INTRODUCTION

Water is an essential resource for human survival, economic development, and ecosystem sustainability. However, increased anthropogenic activities, including improper waste disposal from markets, contribute to water pollution. Effurun Market, a major commercial hub in Delta State, generates significant waste, which is often deposited into the Warri River. According to Kılıç (2020), water pollution is a pressing global issue that affects both developed and developing nations, leading to ecosystem degradation and health risks. Mishra (2023) emphasizes that surface water contamination is particularly concerning due to its direct interaction with human activities and its vital role in sustaining biodiversity. The contamination of water bodies by human activities, including waste disposal from markets, has long been recognized as a severe environmental challenge (Akhtar *et al.,* 2021). Market activities introduce various pollutants such as organic waste, heavy metals, and chemicals, which can alter the physicochemical composition of water, affecting aquatic life (Patil & Ramakrishna, 2020). The Warri River, which receives significant waste inflows from Effurun Market, is at risk of ecological degradation, similar to findings in other industrial and commercial areas worldwide (Chen *et al.,* 2020). According to Aghoghovwia (2023), the Effurun Market's slaughter

activities contribute significantly to the pollution of the Warri River, introducing blood, animal waste, and other organic contaminants that deplete dissolved oxygen levels and increase biochemical oxygen demand.

The assessment of water quality and aquatic life in polluted environments is crucial for determining the extent of environmental damage and formulating mitigation strategies. Onojake *et al.* (2011) found that continuous waste discharge into water bodies leads to increased concentrations of toxicants, which affect aquatic organisms at multiple trophic levels. Additionally, Babaniyi *et al.* (2022) noted that water contamination from market waste runoff can contribute to health risks for populations relying on these water sources for domestic and economic activities. It is in light of these reviews that this study aims to evaluate the impact of Effurun Market activities on the Warri River's water quality and its aquatic sentinels, providing critical insights for environmental management and policy formulation.

MATERIALS AND METHODS

2.1 Study Area

Effurun Market is located in Uvwie Local Government Area, Delta State, adjacent to the Warri River. The market hosts various commercial activities, including abattoirs, which contribute organic and chemical waste to the river. The river is an important water body used for multiple purposes, including fishing, washing, and domestic activities, making its pollution a major concern for the surrounding communities.

2.2 Sample Collection and Analysis

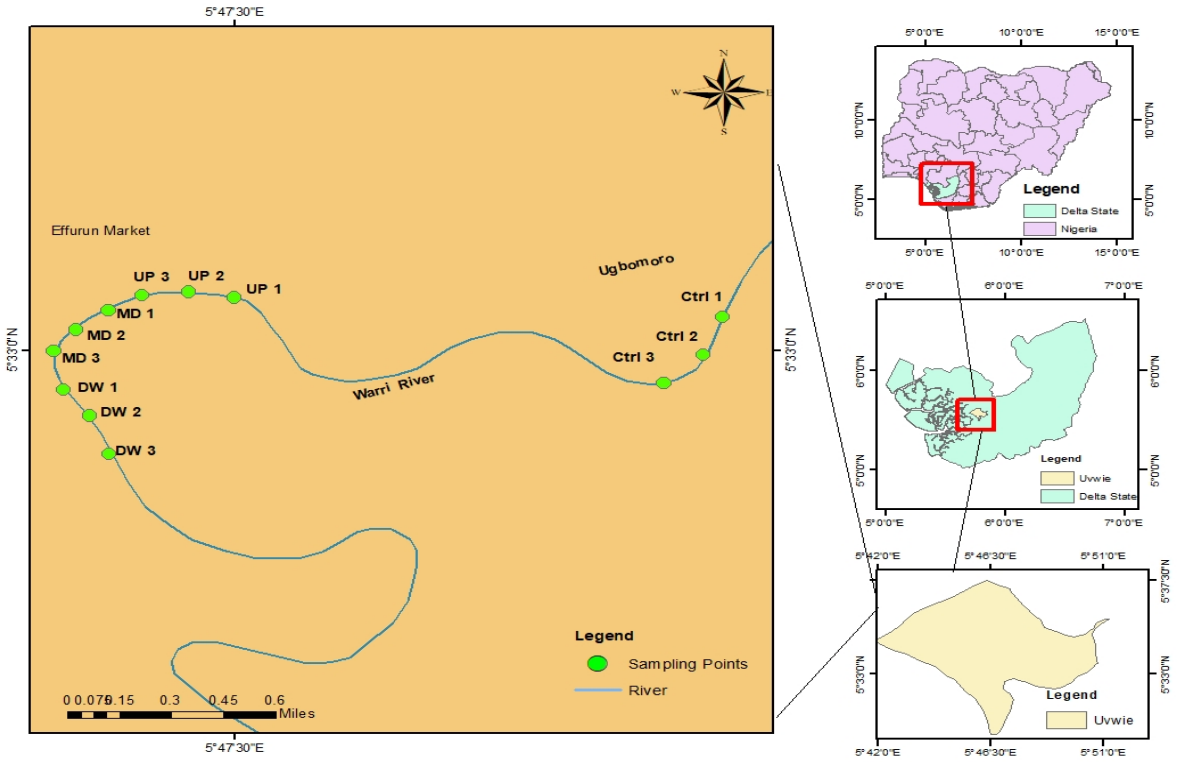

Fig. 1. Schematic map of the study area

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Water samples were collected from three locations: upstream (less disturbed), midstream (discharge point), and downstream (high human activity). Samples were collected in pre-cleaned polyethylene bottles, ensuring minimal contamination. Physicochemical parameters, including pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), turbidity, and heavy metals (Pb, Fe, Cd), were analyzed using standard methods prescribed by the American Public Health Association (APHA, 2017). For microbial contamination, fecal coliforms were analyzed using the most probable number (MPN) method. Water samples were incubated in selective culture media, and bacterial colonies were counted and recorded. Heavy metal concentrations were determined using Atomic Absorption Spectrophotometry (AAS), while pH and conductivity were measured using a digital multiparameter probe. The water quality index (WQI) was also computed to assess overall pollution levels and categorize water quality. Fish (Oreochromis niloticus) and water hyacinth (Eichhornia crassipes) were collected as biological indicators. Fish samples were weighed, measured, and dissected for tissue analysis of metal accumulation. Plant samples were rinsed with distilled water, dried, and subjected to acid digestion before AAS analysis. Samples were all collected during the dry season.

2.3 Quality Control and Assurance

For accuracy and reliability, samples were collected in triplicates, and standard reference materials were used for calibration. Blank samples were included in each batch analysis to check for contamination. Data validation was performed by cross-checking results against environmental quality standards set by WHO and Nigerian regulatory bodies.

RESULT AND DISCUSSION

The results indicate significant variations in water quality parameters across sampling points. Downstream sections exhibited higher pollution levels, with lead concentrations exceeding 4.36 mg/L at the midstream discharge point. BOD values ranged from 2.33 to 3.13 mg/L, while COD was highest upstream (309.33 mg/L), reducing midstream (32.00 mg/L) and slightly increasing downstream (277.33 mg/L). Fecal coliform contamination was highest downstream (12.70 MPN/100mL), indicating sewage intrusion. Table-1 shows the results of some water quality parameters from the water sample analyzed.

Table-1 Summary of water quality parameters across sampling points

Parameter	Upstream	Midstream	Downstream
pH	6.8	5.9	5.4
DO (mg/L)	7.1	4.5	3.2
BOD (mg/L)	2.33	3.13	3.50
COD (mg/L)	309.33	32.00	277.33
Lead (mg/L)	0.75	4.36	2.88
Fecal Coliform (MPN/100mL)	5.3	9.1	12.7

These findings suggest that market-related activities, particularly waste disposal and abattoir runoff, contribute significantly to river pollution. The higher pollution levels observed downstream indicate that contaminants accumulate and disperse along the river's flow direction. Additionally, the analysis of aquatic sentinels (Oreochromis niloticus and Eichhornia crassipes) showed bioaccumulation of heavy metals, particularly lead and cadmium, in their tissues. The presence of high fecal coliform counts further confirms microbial contamination, which could pose significant health risks to communities relying on the river for domestic use. The results highlight the detrimental impact of Effurun Market activities on the Warri River's ecosystem. The elevated levels of COD, BOD, and fecal coliform suggest high organic pollution, likely due to the uncontrolled discharge of waste from the

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market and abattoirs. This is consistent with previous studies (Onojake *et al.*, 2011; Aghoghovwia, 2023) that reported similar pollution patterns in urban waterways affected by market and industrial activities. The decrease in dissolved oxygen levels downstream is a critical concern, as it negatively affects aquatic life. DO levels below 4.0 mg/L, as recorded in the downstream section, can lead to hypoxic conditions, stressing or even killing fish and other aquatic organisms (Babaniyi *et al.*, 2022). The high BOD and COD values suggest that microbial degradation of organic pollutants is depleting oxygen levels, further exacerbating water quality issues. The presence of heavy metals, particularly lead and cadmium, is alarming. These metals have been linked to bioaccumulation in aquatic organisms, leading to potential health risks for humans who consume fish from the river. The high lead concentration of 4.36 mg/L in midstream samples far exceeds the WHO permissible limit of 0.01 mg/L for drinking water (WHO, 2022). Continuous exposure to such contamination can result in neurological and developmental health issues. Moreover, the high levels of fecal coliform downstream indicate contamination from human and animal waste. This poses a significant health risk, particularly for residents using the river for bathing and domestic purposes. Previous studies have shown that waterborne pathogens can spread rapidly in such environments, leading to outbreaks of gastrointestinal diseases (Patil & Ramakrishna, 2020). Overall, these findings underline the urgent need for intervention measures to mitigate the pollution of the Warri River and ensure its sustainability for ecological and human use.

CONCLUSION

The present study confirms that Effurun Market activities contribute significantly to water pollution in the Warri River. The presence of elevated heavy metals, organic pollutants, and microbial contaminants highlights the need for stringent waste management practices. Immediate measures should include improved waste management by enforcing proper disposal practices, including designated waste collection points and scheduled waste removal. Regulation of abattoir waste should be enforced by prohibiting the direct discharge of animal waste into the river and implementing alternative waste management strategies. Public awareness campaigns should be conducted to educate traders, residents, and market operators on the impact of improper waste disposal and the importance of responsible waste management practices. Regular water quality monitoring should be established to track pollution levels and ensure compliance with environmental standards. Additionally, the government should implement stricter environmental regulations with penalties for violators contributing to river pollution. By implementing these measures, the degradation of the Warri River can be mitigated, protecting both aquatic life and human populations that rely on the river as a critical resource.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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