

Assessment of Solid Waste Pollution and Its Impact on Surface Water Quality in Atafu River, Enugu State

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ABSTRACT

This study evaluates the effects of indiscriminate dumping of solid waste on the water quality of Atafu River in Agbani, Enugu State. Employing physicochemical and microbial analysis, the research identifies pollutants and compares findings with WHO standards. Key results reveal significant degradation of water quality, rendering it unsuitable for human consumption. Recommendations include community re-orientation, waste segregation, and enforcement of sustainable waste management practices. The findings underscore the urgent need for integrated waste management systems to mitigate water pollution and safeguard public health.

Key Words: Physicochemical, pollutants, waste disposal, public health, WHO standard

INTRODUCTION

Background of the Study

Water is essential for life, serving critical domestic, agricultural, and industrial purposes (Mozie, 2010). However, its quality is increasingly compromised by anthropogenic activities, particularly in developing regions. In Nigeria, surface water bodies such as rivers and streams are often polluted by indiscriminate waste disposal, posing threats to ecosystems and human health (Ezenwaji, 2014).

Atafu River, a vital water source for the Agbani community, faces severe pollution challenges due to inadequate waste management. The river supports various activities, including drinking, domestic use, and agriculture. However, unchecked dumping of solid waste, coupled with a lack of regulatory oversight, has led to water quality deterioration, threatening both environmental integrity and public health (Chima, 2009).

Research Objectives

This study aims to:

1. Identify physicochemical and microbial pollutants in Atafu River.
2. Assess differences between control and experimental pollution values.
3. Compare pollution values with WHO standards for water quality.
4. Propose sustainable solutions to mitigate pollution.

Research Questions

- What are the key pollutants affecting Atafu River?
- How do pollution levels compare to WHO standards?
- What strategies can effectively address solid waste pollution in the study area?

LITERATURE REVIEW

Surface Water Pollution

Pollution of surface water is often linked to anthropogenic activities, including industrial discharge, agricultural runoff, and improper waste disposal (Meybeck et al., 1996). Studies have highlighted the correlation between solid waste mismanagement and the degradation of water quality, emphasizing the need for sustainable waste management systems (Seadon, 2010).

Municipal Solid Waste Management (MSWM)

The 3Rs (Reduce, Reuse, Recycle) and Life Cycle Assessment (LCA) are recognized as effective tools for waste management. These approaches minimize waste generation and promote resource recovery, reducing the environmental impact of waste disposal (McDougall et al., 2001).

RESEARCH GAPS

Despite extensive studies on surface water pollution, limited research focuses on the Atafu River. This study bridges this gap by providing comprehensive data on the river's water quality and offering actionable recommendations.

MATERIALS AND METHODS

Study Area

The study was conducted in Agbani, Enugu State, within latitudes 6°25'N and 6°40'N. Atafu River is a perennial river, culturally significant to the community, and a primary source of water for domestic and agricultural purposes (Ofomata, 2002).

Sampling Locations

Eight sampling points divided into (upstream and down stream) along Atafu River were selected based on dominant human activities, including refuse dumping, domestic water collection, and agricultural use.

Data Collection and Analysis

Water samples were collected using standard WHO procedures. Key parameters analyzed included:

- **Physicochemical:** pH, turbidity, total dissolved solids (TDS), and electrical conductivity (Nollet, 2000).
- **Microbial:** Coliform levels and biochemical oxygen demand (BOD) (Seadon, 2006).

Laboratory analysis was conducted within 24 hours of sample collection to ensure accuracy (Lee, 1996).

RESULTS AND DISCUSSION

Table 1: Physicochemical Parameters of The River Water Sample

Parameters	WHO Standards	A	B	C	D	E	F	G	H	P-Value
Temp (°)	Ambient	21.59	22.11	21.41	23.61	26.31	21.10	23.15	22.45	0.011

Turbidity (NTU)	5.0	2.85	4.25	3.63	6.14	32.15	34.33	13.63	6.32	0.021
Conductivity (µS)	1000	18.59	28.52	24.15	32.25	790.25	540.5	112.35	28.55	0.023
pH	7.0 – 8.5	6.52	6.81	6.61	6.52	5.93	6.84	6.41	6.42	0.012
TSS (mg/l)	200	1.32	7.12	4.31	5.23	601.15	520.20	368.24	116.32	0.023
TDS (mg/l)	500	9.05	10.33	10.35	11.12	35.59	20.41	18.92	16.33	0.013
TH (mg/l)	100	18.11	70.15	31.63	92.45	168.15	72.14	35.55	24.32	0.021
Ca (mg/l)	75	10.81	28.93	19.21	25.64	60.15	45.25	12.21	10.52	0.011
Mg (mg/l)	30-150	0.82	2.31	0.91	2.81	3.62	45.22	1.81	1.51	0.001
PO₄³⁻(mg/l)	5.0	0.21	8.12	5.21	7.33	10.41	9.22	6.32	0.42	0.022
Na (mg/l)	200	5.91	6.23	5.72	5.82	7.00	6.85	4.63	0.71	0.003
Fe (mg/l)	0.1	0.025	0.92	0.03	0.81	1.53	0.61	0.51	0.045	0.021
Cl⁻ (mg/l)	200	12.12	128.55	120.65	121.20	184.05	161.14	24.65	20.9	0.012
SO₄²⁻(mg/l)	500	27.41	86.32	31.23	94.61	103.75	102.63	50.11	42.62	0.022
NO₃⁻ (mg/l)	50	0.21	0.81	0.42	1.61	6.22	8.61	3.82	2.43	0.013
DO⁻ (mg/l)	3.0	15.07	14.04	14.23	13.52	4.42	6.81	8.92	10.13	0.001
BOD₅(mg/l)	5.0	3.84	7.15	5.33	15.24	37.93	28.20	11.35	5.81	0.012
COD(mg/l)	200	5.61	5.44	6.01	12.15	38.25	26.45	15.90	12.11	0.023

Upstream locations (A–D) served as the control (less impacted zone).

Downstream locations (E–H) as the impacted/experimental zone.

Upstream sampling points (A–D) were designated as control sites due to minimal anthropogenic interference, whereas downstream points (E–H) represented impacted sites influenced by solid waste dumping activities.”

Table (2) Upstream And Down Stream Mean Values Compared With (Who)

Parameters	WHO Standards	Upstream value	Downstream value	P-Value
Temp (°C)	Ambient	22.18	23.25	0.011
Turbidity (NTU)	5.0	4.21	21.60	0.021
Conductivity (µS/cm)	1000	25.87	21.60	0.023

pH	7.0 – 8.5	6.61	6.42	0.012
TSS (mg/L)	200	4.49	401.48	0.023
TDS (mg/L)	500	10.21	22.81	0.013
TH (mg/L)	100	53.08	75.04	0.021
Ca (mg/L)	75	21.15	32.03	0.011
Mg (mg/L)	30-150	1.81	13.04	0.001
PO₄³⁻(mg/L)	5.0	5.21	6.59	0.022
Na (mg/L)	200	5.92	4.79	0.003
Fe (mg/L)	0.1	0.44	0.67	0.021
Cl⁻ (mg/L)	200	95.63	97.68	0.012
SO₄²⁻(mg/L)	500	59.89	74.77	0.022
NO₃⁻ (mg/L)	50	0.76	5.27	0.013
DO(mg/L)	3.0	14.21	7.57	0.001
BOD₅(mg/L)	<5.0	7.89	20.82	0.012
COD(mg/L)	200	7.30	23.17	0.023

Upstream locations (A–D) were designated as control sites due to minimal anthropogenic disturbance, while downstream locations (E–H) represented impacted sites influenced by solid waste disposal. Statistical comparison using independent sample t-test revealed significant differences ($p < 0.05$) in turbidity, TSS, BOD₅, and DO between control and impacted zones.

Table 3: Microbiological Quality Of Water Samples From Atafu River

Parameters	WHO Standards	A	B	C	D	E	F	G	H	P-Value
Total Coliform (CFU/100ml)	0	<1.8	15	25	120	TNTC	TNTC	450	85	< 0.001
E.coli (CFU/100ml)	0	0	2	5	35	TNTC	280	110	20	< 0.001
Heterotrophic Plate Count(HPC) @37°C (CFU/ml)	< 100	12	55	110	420	>1000	>1000	880	305	0.015

CFU = Colony Forming Units;

TNTC = Too Numerous To Count (typically > 300 CFU/100ml for coliform tests).

P-values indicate a statistically significant difference between locations

The microbiological quality of the river water is presented in (table 3). The control site (A) showed no detectable E.coli and very low total coliform counts, indicating a lack of fecal contamination at the source. In stark contrast, all downstream samples (B-H) showed significant microbial contamination. Sites E and F, located adjacent to intense dumping activity, exhibited 'Too Numerous To Count' (TNTC) results for total coliforms and high counts of E.coli, confirming direct fecal pollution. These levels pose an extreme public health risk to the communities using the river for domestic purposes. Microbial analysis indicated elevated coliform counts exceeding WHO permissible limits (0 CFU/100 mL), confirming faecal contamination.

Physicochemical Parameters

The results of the physicochemical analyses of the water sample of the selected locations are represented in tables, graphs and figures. The table (1) above shows the summary of all the physicochemical parameter analyzed for the study. Figure 1 to 3 shows the graphical representation of the different physicochemical parameters of the selected boreholes with respect to each other.

Temperature

The mean temperature values of different samples from the river ranged from 21.10°C - 26.31°C and are shown in table (1) above. The highest value for temperature was recorded at Point E along the river while the lowest value was recorded at point C as shown in the table (1) above. There is a significant difference in the temperature values of the different samples at 95% confidence and p value <0.05. The significant value of the different water samples is = 0.011.

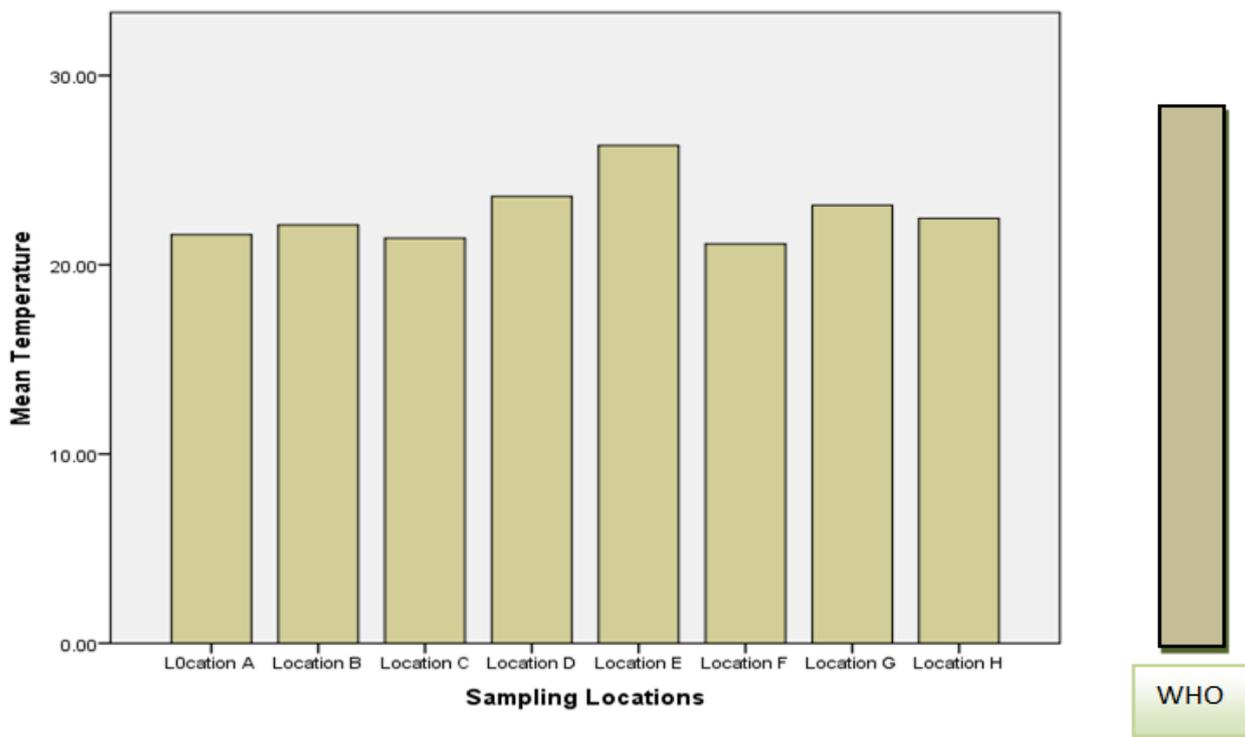
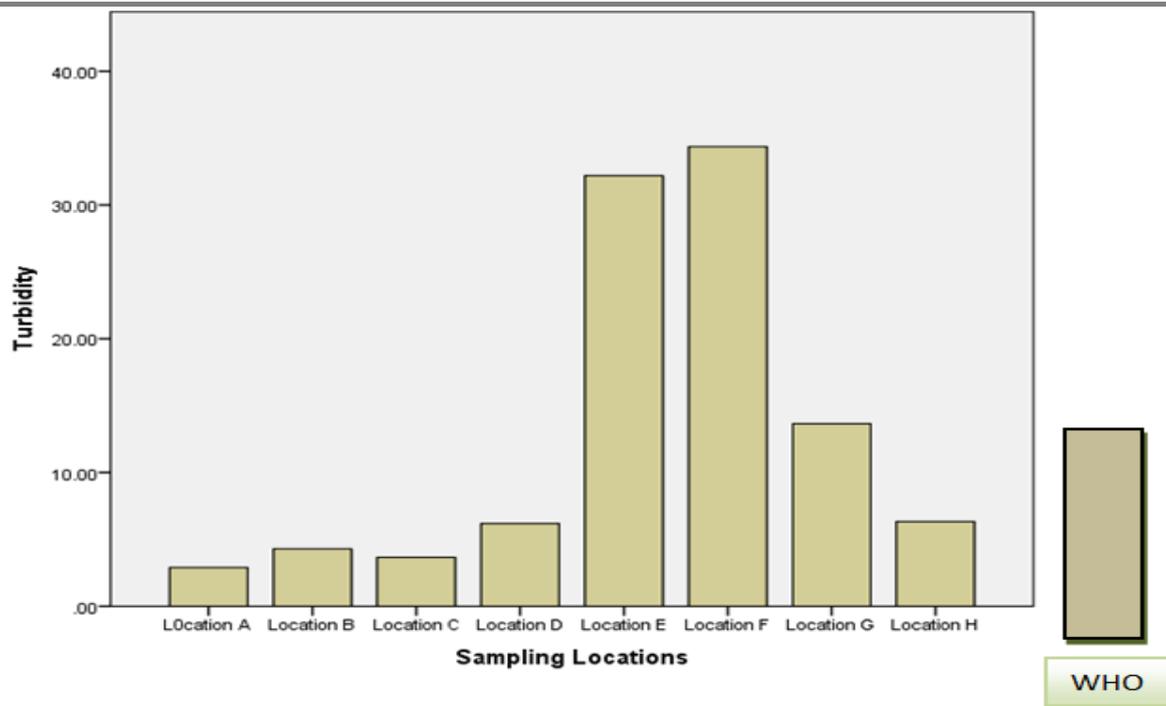


Figure (1): Mean Temperature of Water Samples in the Sampling Locations

Turbidity

Table (1) above shows the results of the different mean concentrations of turbidity values amongst river water sample. The highest value for the samples collected was recorded at Location F with value 34.33 NTU while the lowest mean value was recorded at Location A with value 2.85 NTU. The turbidity value amongst the water samples studied showed high turbidity with values far above the WHO standards for drinking water. There was a significance difference in the turbidity values of the different water samples with p value = 0.021 at 95% confidence level which is less than 0.05.



Figure(2): Mean Turbidity of Water Samples in the Sampling Locations

Water Quality Parameters

- **Physicochemical Analysis:** High TDS, turbidity, and electrical conductivity were observed in downstream samples.
- **Microbial Analysis:** Elevated coliform counts exceeded WHO permissible limits, indicating significant contamination

Comparison with WHO Standards

- Most parameters fell outside acceptable ranges, confirming the unsuitability of Atafu River for human consumption.

Statistical Analysis

Significant differences were noted between control and experimental pollution values ($p < 0.05$).

Statistical Tools

Chi-square models were employed to assess the significance of pollution levels. Comparisons were made against WHO standards for drinking water quality (WHO, 1998)

DISCUSSION

Implications of Findings

The study confirms that solid waste pollution significantly impacts Atafu River's water quality, jeopardizing public health and ecosystem balance. The presence of coliforms and elevated BOD levels highlights the urgent need for intervention (Nkwocha et al., 2014).

RECOMMENDED STRATEGIES

1. **Community Awareness:** Educating residents on the dangers of indiscriminate waste disposal.

2. **Integrated Waste Management:** Implementing the 3Rs and encouraging community participation (Seadon, 2010).
3. **Policy Enforcement:** Strengthening regulations on waste disposal and water quality monitoring.
4. **Technological Solutions:** Introducing low-cost water treatment options for affected communities (McDougall et al., 2001).

CONCLUSION

This study provides critical insights into the impact of solid waste pollution on Atafu River. Findings highlight the urgent need for sustainable waste management and water quality preservation strategies. Future research should focus on advanced treatment technologies and long-term monitoring to ensure the river's restoration and sustainability.

REFERENCES

1. Chima, J. N. (2009). Challenges in solid waste management. *Journal of Environmental Sciences*.
2. Ezenwaji, E. E. (2014). Urban rivers and pollution: A case study of Enugu, Nigeria. *Water Resources Management*.
3. Lee, G. F. (1996). Guidelines for water sample collection. *Environmental Monitoring*.
4. McDougall, F., et al. (2001). Integrated solid waste management: A life cycle inventory. *Waste Management Series*.
5. Meybeck, M., et al. (1996). Surface water quality: Global perspectives. *Journal of Hydrology*.
6. Mozie, A. T. (2010). Water resources in developing regions. *Geography Review*.
7. Nkwocha, E., et al. (2014). Impacts of waste dump on surface water quality. *African Journal of Environmental Science and Technology*.
8. Nollet, L. M. (2000). *Handbook of water analysis*. CRC Press.
9. Ofomata, G. E. K. (2002). *Geography of Enugu State*. Nigeria Publishers.
10. Seadon, J. K. (2010). Sustainable waste management strategies. *Environmental Development*.
11. WHO. (1998). *Guidelines for drinking water quality*. World Health Organization.