
Oxygen Impact Assessment in Liquid Pollution and Purification of Aquatic Biomes using Hydro Bio Interplay Functions

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ABSTRACT

Oxygen plays two vital hydro bio functions in liquid pollution, prior biochemically through biochemical oxygen demand, BOD, and biologically through dissolve oxygen, DO, both serving as measures of quantification for levels of pollution and purification of water respectively. Thus, appropriate hydro oxygen quantifications were deployed in acquisition of the impact contributed in liquid pollution and purification of the aquatic biome. Resultantly, it was conceived that, the pollution level was low with biochemical oxygen demand of 0.28 mg/L. The purification was high with dissolve oxygen of 8.19 mg/L. And, the river system had natural or self-purification adequate to combat liquid pollution in the aquatic biome, inditing the bio impacts played by oxygen in various forms.

Keywords: Liquid Pollution, Liquid Purification, Oxygen Interplay, Dissolve Oxygen, Biochemical Oxygen, Aquatic Biome

Introduction

Impact assessment refers to the process of evaluating impacts with respect to measurable quantities. Accurate measurements, reliable data, and proper interpretation are essential for the impact assessment of water bodies (Okolotu et al., 2024). Pollution in water bodies results from quality deterioration due to the entry of pollutants originating from agriculture, runoff carrying sediments, industrial activities, urbanization, and infrastructural development (Misman et al., 2023). The river under study relies on natural purification processes for the pollution it incurs, as no artificial sanitation measures are readily available, and its

eventual receiving body is the southern Atlantic Ocean. Hence, the pollution problem under study, as well as the location, is of global concern in the long term because, through transportation processes, the worldwide distribution of such liquid pollution is inevitable.

Liquid pollution is contamination associated to liquid or water pollutants. They are from liquid wastes existing in the form of materials that can pass through mini filter of 0.45 micron at differential pressure of 75 psi (Chowdhury, and Sarkar, 2023). They contaminate aquatic biomes, making the water unhealthy. They are harmful to humans upon direct ingestion of polluted water, consumption of food from or contaminated by polluted water, living near polluted water bodies, use in agriculture (e.g., irrigation), recreation, and application for industrial purposes (UIA, 2020). Liquid pollution causes aquatic habitats destruction as well as water - borne diseases which are the leading global cause of death (<https://doi.org/10.5281/zenodo.755105> Swathi, G. (2021). Pollution and its effects: A short note. *Journal of Pollution Effects & Control*, 9, " title="Swathi, 2021">Swathi, 2021). UNCTAD, (2025), emphasized that pollution contributes negatively to water systems, resulting to the endangerment of at least 2.2 billion persons worldwide. These endangerment impact elevate death rate globally. Water pollution and shortage kill 25,000 persons daily, and from 1980 statistics of third world countries, four in a five child mortality were associable to polluted water supply diseases (UIA, 2020). This entail that over 9 million people die annually due to liquid pollution.

Liquid purification refer to the pollution cleansing and recovery of damaged liquid quality to a desirable normal condition. About 80% of the population in developing countries lack sanitation facilities (UIA, 2020), making artificial purification inhibited in such areas. Modern sanitation techniques are used in various places depending on projected budget. For example, molecular distortion technology deployed by Pakistan in Asian continent, capable of purifying about 98% pollutants while enabling about 90% water re-use and maintaining energy efficacy using even integrable solar heating (UNCTAD, 2025). Natural purification otherwise self purification rely on natural mechanisms in the waterbodies processes. Self purification include physical modification (e.g., sedimentation of particulate matter to the bottom bed of waterbodies), chemical modification (e.g., organic matter oxidation, re - oxygenation from atmospheric air above, nitrate release, etc), and microbiological modification (e.g., organic matter oxidizing like growing aquatic micro - organisms decomposable upon death) (Alrumman *et al.*, 2016). Self purification is recommendable if the water is mildly polluted. This is because in a highly polluted circumstances, self purification process maybe uncertain or slow to remedy the pollution

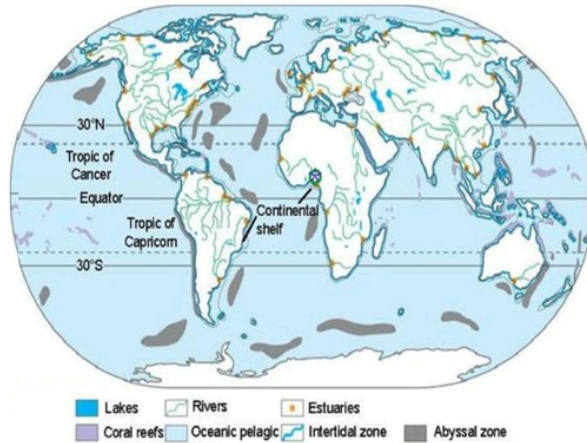
Oxygen interplay refers to the inter role functions played by the oxygen contained in water. Water chemically contains hydrogen and oxygen, possessing various properties applicable in different ways. The oxygen provides major functions in liquid pollution through its bio-chemical function in the area of pollution quantification attributively to biochemical oxygen demand, and biological functions in the area of purification attributively to dissolve oxygen. Biochemical oxygen demand is the amount of oxygen required aerobically for the decomposition of organic substances of mostly organic matter contained in water sample. Dissolve oxygen refers to the chemically melted oxygen contained in water required for necessary biological purification. Upon decomposition of excess materials of organic contents (like alga blooms) by aquatic microorganisms, anoxia otherwise no level of oxygen or hypoxia otherwise low oxygen levels may exist (EPA, 2025), in a waterbody. Reduction in oxygen level pose negative impacts like (1) production of toxic materials, flavor and odors through complete or partial anaerobic processes in the water, (2) production of flat taste due to oxygen removal, (3) production of organic matter due to deaths of aquatic animals resulting from water anaerobic conditioning, (4) high production of red blood worms and other unwanted organisms due to the absence of oxygen, (5) slower organic material decomposition due to oxygen absence resulting to slower purification processes, (6) accumulation of sediments rich in organic contents at the bottom bed of the waterbody (Alrumman *et al.*, 2016).

An aquatic biome is an identifiable geographical region known for the species (fish, plants, etc.) that live and dwell within it. An aquatic biome can contain many different aquatic ecosystems. It is broadly divided into saltwater biomes (seas and oceans, otherwise referred to as marine biomes) and freshwater biomes (rivers, streams, etc.). The ocean, which is the largest biome, occupies about three to four-fifths of the Earth's surface. It helps absorb large quantities of atmospheric carbon dioxide and, in return, provides a significant amount of oxygen globally through the activities of marine algae (UCMP, 2025). On the other hand, the river otherwise the largest freshwater biome plays its part in the ecosystem role globally. Nigeria possesses freshwater and coastal areas of about 1,076,730 ha, with the Niger Delta covering approximately 76,000 sq km. It hosts the largest mangrove ecosystem in Africa, spanning about 11,134 sq km, and ranks as the third largest in the world (Elekwachi *et al.*, 2021). During industrial revolution around 1700s, about

half areas of the earth was wilderness, but on present statistics about 13% of marine biomes and 23% land biomes out of the five major biomes (aquatic, forest, desert, grassland, and tundra) in our biosphere are untouched by man (UCAR, 2025). Typical examples of aquatic biomes are presented in figure one (1) below;



i. Nigeria aquatic biome map showing Asaba.



ii. World aquatic biome showing Nigeria, Africa

Figure 1: Aquatic biomes of Nigeria and the world

Materials

The selected study area was the "Otu Ogwu" section of the west African river Niger located in Asaba, Nigeria. Other materials used include: The water meter with flexible cord and steel sensing probe, computerized mobile digital set, satellite sensing software, etc.

Methods

Upon submersion of the steel sensing probe inside the river water, accompanied with necessary data recordings, documentation, and hydro evaluation for the selected periods, the water biochemical oxygen demand (used for pollution level quantification), and dissolve oxygen (used for purification level quantification) were deployed in assessing the bio role played by oxygen in the river liquid pollution and purification management.

Results

The results obtained are presented in tables one (1) to three (3) and figures two (2) to five (5) below;

Table 1: Results of the Dissolve Oxygen

SN	Month	Morning DO (mg/L)	Purification Level	Afternoon DO (mg/L)	Purification Level	Evening DO (mg/L)	Purification Level
1	January	8.50	Very high	7.72	High	7.58	High
2	February	8.84	Very high	7.58	High	7.44	High
3	March	8.50	Very high	7.58	High	8.02	Very high
4	April	8.33	Very high	8.02	Very high	8.02	Very high
5	May	8.67	Very high	8.50	Very high	8.67	Very high
6	June	8.67	Very high	8.33	Very high	7.87	High
7	July	8.84	Very high	8.02	Very high	8.18	Very high
8	August	8.84	Very high	7.72	High	7.72	High
9	September	8.67	Very high	7.16	High	7.30	High
10	October	8.67	Very high	8.67	Very high	8.84	Very high
11	November	8.33	Very high	8.33	Very high	8.84	Very high
12	December	8.84	Very high	7.16	High	7.72	High
Total	-	103.7	-	96.79	-	96.2	-
Average	-	8.64	Very high	7.90	High	8.02	Very high

Moreso, the dissolve oxygen, obtained at the earliest hours (~6am) were 8.84 mg/L.

Table 2: The Results of the Biochemical Oxygen Demand

SN	Month	Morning BOD (mg/L)	Pollution level	Afternoon BOD (mg/L)	Pollution level	Evening BOD (mg/L)	Pollution level
1	January	0.34 CW	Low	0.78cw	Low	0.14cw	Low
2	February	-	-	1.26cw	Low	0.14cw	Low
3	March	0.34 Cw	Low	0.92cw	Low	-	-
4	April	0.51cw	Low	0.31cw	Low	-	-
5	May	0.17cw	Low	0.17cw	Low	-	-
6	June	0.17cw	Low	0.34cw	Low	0.46cw	Low
7	July	-	-	0.82cw	Low	-	-
8	August	-	-	1.12cw	Low	-	-
9	September	0.17cw	Low	1.51cw	Low	-	-
10	October	0.17cw	Low	-	-	-	-
11	November	0.51cw	Low	-	-	-	-
12	December	-	-	1.68cw	Low	-	-
Total	-	2.38	-	8.91	-	0.74	-
Average	-	0.20	Low	0.74	Low	0.06	Low

Table 3: Results of dissolve oxygen, biochemical oxygen demand, pollution level and purification level of the river for all periods

SN	Month	Biochemical Oxygen Demand, BOD (mg/L)	River Liquid Pollution Level	Dissolved Oxygen Level, DO (mg/L)	River Purification level
1	January	0.42	Low	7.93	High
2	February	0.47	Low	7.95	High
3	March	0.42	Low	8.03	Very high
4	April	0.27	Low	8.12	Very high
5	May	0.11	Low	8.61	Very high
6	June	0.32	Low	8.29	Very high
7	July	0.27	Low	8.35	Very high
8	August	0.37	Low	8.09	Very high
9	September	0.56	Low	7.71	High
10	October	0.06	Low	8.73	Very high
11	November	0.17	Low	8.50	Very high
12	December	0.56	Low	7.91	High
Total	-	3.3	-	98.22	-
Average	-	0.28	Low	8.19	Very high

The biochemical oxygen demand and dissolve oxygen for morning hours are presented in figure two (2) below;

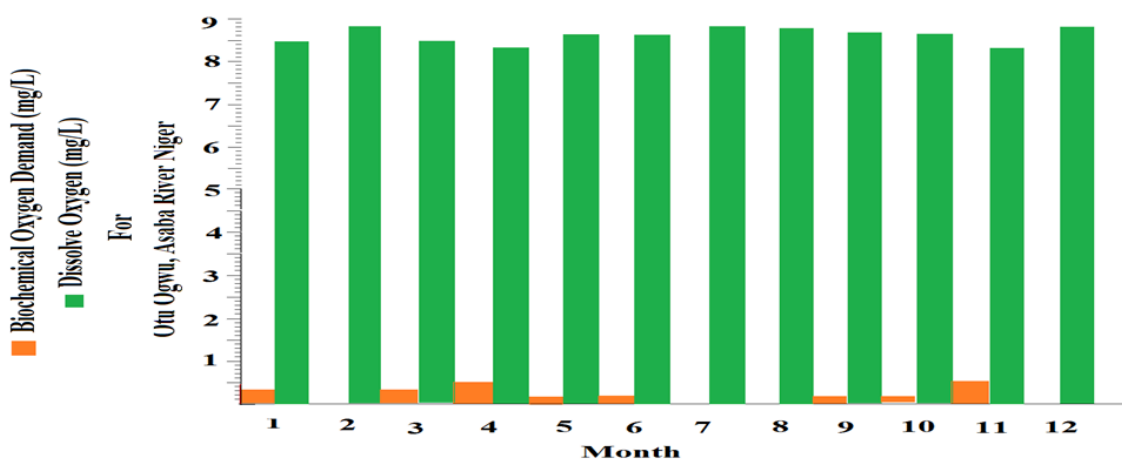


Figure 2: Biochemical oxygen demand and dissolve oxygen for morning hours

The biochemical oxygen demand and dissolve oxygen for afternoon hours are presented in figure three (3) below;

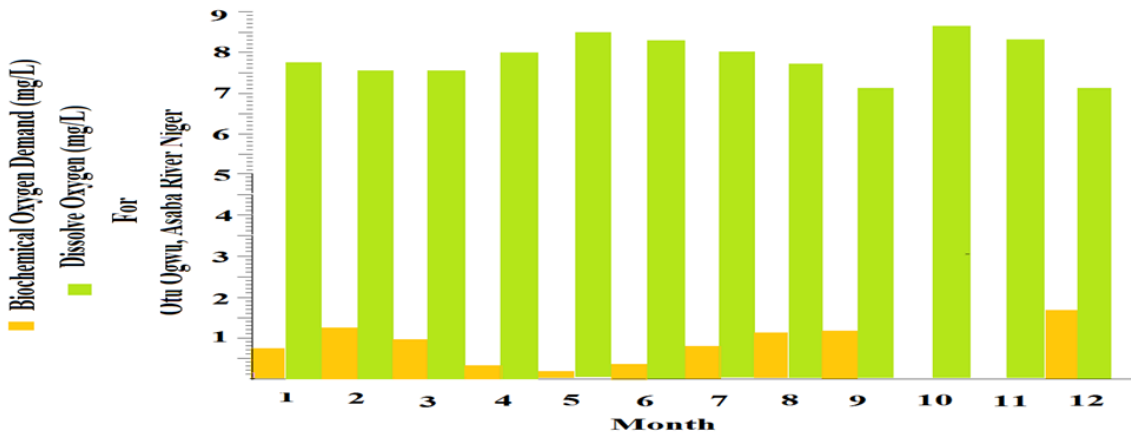


Figure 3: Biochemical oxygen demand and dissolve oxygen for afternoon hours

The biochemical oxygen demand and dissolve oxygen for evening hours are presented in figure four (4) below;

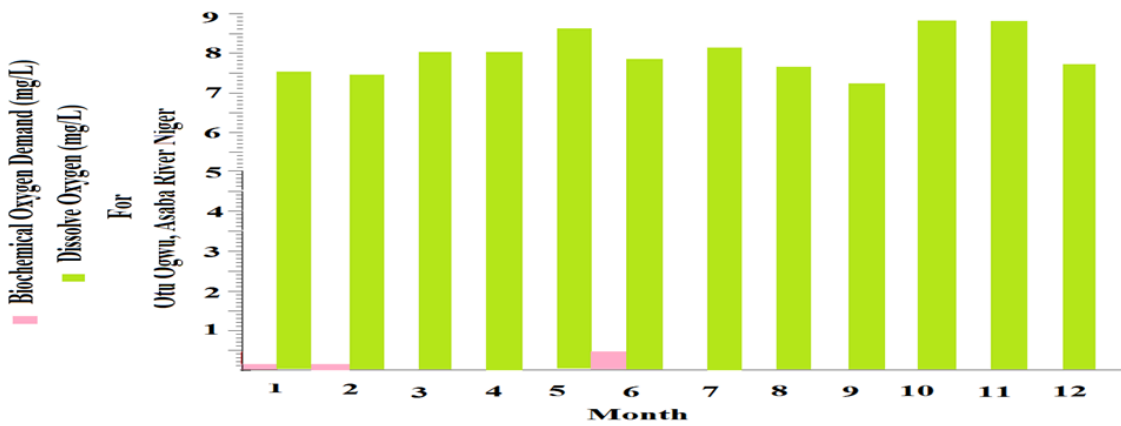


Figure 4: Biochemical oxygen demand and dissolve oxygen for evening hours

The average biochemical oxygen demand and dissolve oxygen are presented in figure five (5) below;

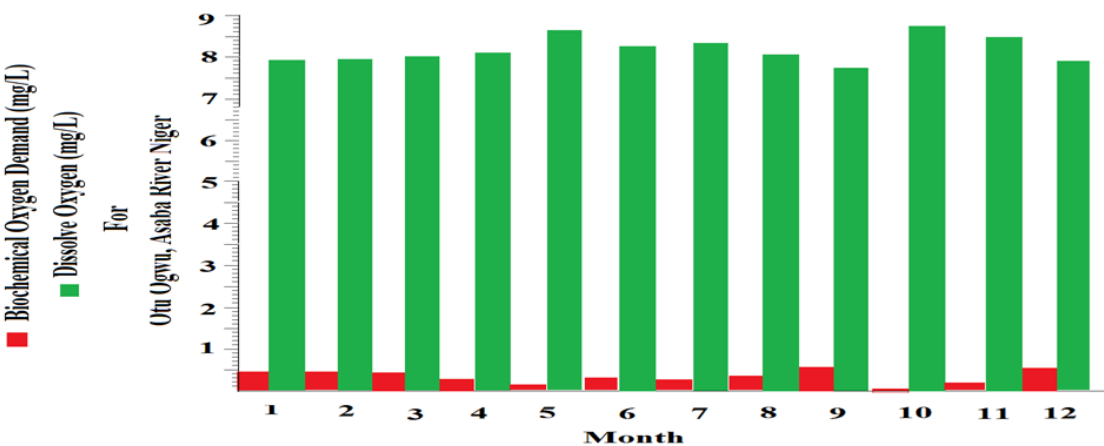


Figure 5: Average biochemical oxygen demand and dissolve oxygen

Discussion

From results obtained, 8.84 mg/L of dissolve oxygen were recorded to be associated with the earliest hours of the morning. This significantly points that the adequate oxygen at that periods maybe related to the fact that the river system were undergoing its peak purification over the night hours, resulting to little or no purification in the morning due to less liquid pollution remnants pointing on little or no biochemical oxygen demand function in the aquatic biome at such morning periods expected to have less human activities.

From figures two (2) to four (4) above, figure three differentiatedly showed higher biochemical oxygen demand levels which indicatively implied that more pollution occurred during that afternoon periods. This may have been fueled by human actions in the waterways which extend to infusion of decomposable waste materials from people living nearby or using the river, drainage, floods, *etc.*, depending on momentary prevailing circumstances.

From figure five (5) above, the river purification was higher during may (8.61 mg/L, dissolve oxygen), July (8.35 mg/L, dissolve oxygen), October (8.73 mg/L, dissolve oxygen), and November (8.50 mg/L, dissolve oxygen), during which significant rain fell, implying that river recharge after and during rain settlements increase the carrying capacity of the water ways to transport off materials that would have been deposited if inadequate pressure for transportation is provided. However, November is excludable to rainy month due season, but as the beginning of dry season, some rainfall occurs in the month, and also some yet non-transported water accumulated during raining months use the November discharge window to maintain equilibrium.

Conclusion

From results obtained, it was concluded that on the average, the river system pollution level was low with biochemical oxygen demand of 0.28 mg/L, while purification was high with dissolve oxygen of 8.19 mg/L, featuring adequate natural or self-purification. Also, that oxygen played dual functions adequately in the river liquid pollution quantification and purification management. It was also concluded that, in dynamic flowing waterbodies with human actions, the biochemical oxygen demand levels tend higher with more pollution occurrence during the afternoon periods. Conversely, the purification tends to be higher from evening hours and minimal during the morning periods.

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