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ASSESSMENT OF EFFLUENT DISCHARGE FROM FISHING ACTIVITIES IN ASEJIRE RESERVOIROYO STATE, SOUTHWEST NIGERIA

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ABSTRACT

The effect of the fish farming activities on the downstream section of the Asejire reservoir were evaluated by studying the changes in the water quality parameters from the upstream fish farm to the downstream of the fish farm. The study was carried out over the course of the two seasons synonymous with the Nigerian climate (dry and wet).The reservoir was divided into three sampling points, the upstream station situated upstream from the fish farm and the downstream station situated downstream from the fish farm. 6 samples were taken from each sampling station and a total of 12 samples were collected throughout the period of the study. Anthropogenic activities in the reservoir tends to affect the water quality of the reservoir. From this study, results showed that Dissolved oxygen and pH values decreased downstream while other parameters such as ammonia, nitrate, nitrite, phosphate, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Temperature, Chemical Oxygen Demand (COD), Total Colony Count (TCC), Coliform Organisms (CO) and Escheriachia Coli increased downstream most notably during the dry season. Dissolved Oxygen ranged from 6.93-6.46mg/L, Phosphate from 0.15-0.16mg/L, TCC from 91.33-108.66cfu/ml, CO from 35.66-67.33 and E.Coli from 13-24cfu/ml upstream and downstream respectively and fell outside the WHO guideline for drinking water. There is no significant variation in the values of the parameters upstream and downstream during the wet season but COD values of 250.66-242.66mg/L fell outside the WHO standard. From the results obtained, it was established that water from the Asejire reservoir is not fit for human consumption due to its high bacteriological loads.

Keywords: Pollution, fish farm, water quality

INTRODUCTION

Surface water is the most easily polluted due to the disposal of wastewater and pollutants either through natural occurrence or through man made activities (Murray *et al.,* 2010).

Spatio-temporal evaluation of water quality has been adopted by many researchers in establishing pollution sources and potential influences of both natural processes and human activities on the spatiotemporal variation in water quality (Pillsbury *et al.*, 2007).

According to Ravichandra (2003), some of the natural and anthropogenic activities that causes the degradation of surface water includes agricultural activities such as land use, sewage disposal into surface water, weathering, erosion, industrialization, global climate change, precipitation, hydrological cycle and human versed use of the available water resources.

Mirto, (2009) further confirmed fish farming to be a source of water pollution, it influences the water quality through various means such as remnants of uneaten food and fish faeces which all settles at the bottom of rivers and in return alters the organic matter concentration in the sediment which increases the oxygen consumption in such river and cause eutrophication of the water body.

The Study Area

Asejire Reservoir is in Oyo State in Southwestern Nigeria, created by the impoundment of River Osun. The reservoir was built in the late 1960s. It is found in between latitude 07˚21'45"N - 07˚36'25"N and longitude 04˚08'00"E - 04˚13'33"E. The Reservoir provides water to the Asejire and Osegere water treatment plants in Ibadan. It has a capacity of about 80 million litres per day, of which 80% is used for domestic purposes. The catchment area is 7,800 22km and the impounded area is 23.42 km (2,342 hectares). The reservoir has a normal pool elevation (water level) of 150 m and maximum flood elevation of 152.4 m. The surface area is 2about 24 km. (Oladipo, 2013)

Climate

The Asejire community experiences both dry season from the month of November to April and rainy season from May to October. There is an annual mean temperature of 27.3°C, annual mean humidity of 79% and an annual mean rainfall of 14.7mm (Ayoade, 2006)

Population

Asejire area is made up of five villages, which are: Olukeye-Asejire, Erinmi, Alabuke,Faleti, and AbaAlufa. From the 2006 Census result, Olukeye-Asejire(1,192) is the most densely populated, followed by Erinmi(566), Aba Alufa (324), Faleti (296) and Alabuke (201). The principal occupation of the people of the study area is farming and Fishing. From the fieldwork, it was discovered that 78.4 per cent of the sampled population were previously engaged in farming, although many of these people combine part-time activities

such as tailoring, hunting, palm-wine tapping and produce buying (Oyedotun, 2011).

Field equipment

The equipment used for the collection of the water samples are the following: five litres sampling bottles, sterile bottles, Geographical Positioning System (GPS) and measuring tape were used for taking samples at the upstream and downstream respectively.

Laboratory Equipment

The Laboratory equipment used are; pH meter, Flame Photometer, Dissolved Oxygen meter, Spectrophotometer and Atomic Adsorption Spectrophotometer (AAS).

Sample Collection

Samples were collected from two stations on the reservoir; the upstream station (located upstream from the fish farm facilities) and the downstream stations (effluent receiving water body located downstream of the fish farm facilities).The samples were taken during the wet and the dry season. Total of 12 samples were collected for the period of 2 months from the three sampling points of the reservoir.

The 3 sampling points used throughout the research for the upstream was tagged Upstream 1 (U1), Upstream 2 (U2), Upstream 3 (U3) and Downstream 1 (D1), Downstream 2 (D2), Downstream 3 (D3) for the downstream points to ensure consistency and to avoid mixing upstream samples with the ones from the downstream

Laboratory Analysis

Physical and chemical parameters used in the evaluation of the water quality includes; pHElectrical conductivity(EC) and Total dissolved solid(TDS)were measured using (Hanna combo Hi 98129 model) which is the Potentiometric method.Dissolved Oxygen was measured using a DO meter. Titrimetric method was used forPhosphate, Ammonia, Nitrite, Nitrate,Chemical Oxygen Demand(COD).

Bacteriological parameters analysed include; Colony count, E.coli organisms

and coliform organisms which was carried out in Water Resources Management and Environmental Management and Toxicology Laboratory. Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

Statistical Analysis

The data were analysed using the software package for Social Science (SPSS window version23)to statistically show the relationship between the obtained data for the wet and the dry season at Asejire Reservoir, using Descriptive Statistics which is used for the determination of the Mean, Standard deviation and Standard Error.

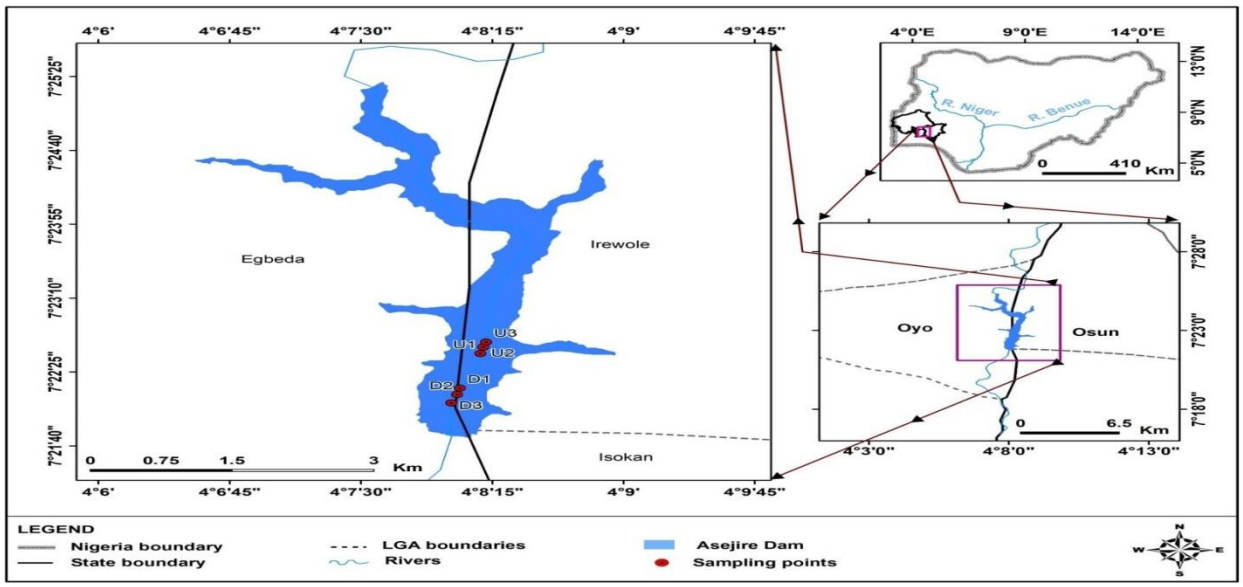

Figure 1: Map of Asejire reservoir showing the sampling points

RESULTS AND DISCUSSION

The pH value recorded during the dry season ranged from (7.23±0.05) at the upstream and (7.16±0.15) at the downstream with p value >0.05 pointing to no significant difference in the pH value. During the wet season the pH value at the upstream was (7.53±0.11) with a value of (7.66 ± 0.11)

downstream. The variation for both wet and dry season is statistically insignificant. This finding is in agreement with the results of (Bergheim and Selmer Olsen 1978) who also reported insignificant variation in the values ofpH.

Temperature

During the dry season the weather is warmer and the water temperature values ranged from (26.23±0.11, 26.66±0.15^{o}C) and the wet season ranged from (25.96±0.15 and 26.00±0.10^{o}C respectively) at the upstream and downstream. The variation in temperature observed for both dry and wet season is minimal and fell within WHO standard for drinking water. The slight variation in the values of temperature upstream and downstream is similar to finding of (Ruiz *et al.,* 2009) who concluded that temperature and conductivity values does has no significant difference, and should be taken at either section of the water body due to close proximity.

Total Dissolved Solids (TDS)

The TDS values recorded for the dry season and wet season ranged from (124.66±6.11 - 135.33±22.74 mg/L) and (540.66±54.93-459.33±64.63mg/L) at the upstream and downstream. The TDS value is lower during the dry season and higher during the wet season, this can be attributed to higher dissolved salts that arises with the increased volume of inflow into the reservoir. The TDS values were within WHO set standard for TDS in drinking water.

Electrical Conductivity (EC)

EC values for both dry and wet season ranged from (210.66±18.14 - 227.33±36.11and 483.33±34.78:466.66±69.21µs/cm respectively) at the upstream and downstream. The EC values are higher during the wet season as a result of high erosion of streams flowing into the

reservoir. The higher EC values during the wet season is as a result of increase in the value of TDS in the reservoir during the wet season as EC has a direct relationship with TDS (Dagharaet *al*., 2019).

Dissolved Oxygen (DO)

The DO values obtained for the dry and wet season in the upstream and downstream section ranged from (6.93±0.32– 6.46± 0.20 and8.76±0.57 – 8.43±0.57mg/L respectively) for the dry and wet season. The DO values for wet season were higher than DO values for the dry season because of the low temperature that led to high rate of oxygen diffusion in water. This work agrees with the work of (Selong and Helfrich 1998).

Chemical Oxygen Demand (COD)

The mean value of COD is higher during the wet season. The COD values ranged from 4.09±0.72at the upstream to 6.28±0.89 mg/L at the downstream during the dry season. An increase in the value of COD is given as250.66±96.11mg/Lat the upstream and 242.66±84.03mg/L downstream during the wet season. The increase could be as a result of inflow into the reservoir carrying high concentration of suspended organic solids in agreement with the findings of (Silapajarn and Boyd, 2005).

Phosphate

The mean concentration of Phosphate ranged from ($0.15\pm4.5x10^{-3}$– $0.16\pm6\ x10^{-3}$ and $0.22\pm5.7\ x10^{-3}$ – 0.21±0.01mg/L) for dry and wet season respectively. The values obtained were higher than the WHO guideline for drinking water.

Higher value for phosphate was obtained during the wet season. This result is in conformity with the findings of (Correl 1998) who attributed this to high runoff washing domestic, municipal and agricultural waste into water bodies during heavy rainfall.

Nitrate, Nitrite and Ammonia

The nitrate values obtained for the dry and wet season in the upstream and downstream section ranged from (0.15±4.5x10^-3 - 0.16±6 x10^-3 and 0.22±5.7 x10^-3 - 0.21±0.01mg/L) while the Nitrite values ranged from (0.03±0.04 and 0.11±0.12) and Ammonia ranged from ($7x10^{-4}$ – $1.2x10^{-3}$: $5.3x10^{-3}$ – $5.7x10^{-3}$)for dry and wet season respectively. There was no significant difference between their values with $p>0.05$. This result agreed with the findings of (Amankwaah*et al.*, 2014) who reported insignificant difference in the values of these parameters upstream and downstream.

Total Colony Count (TCC), Coliform Organism Count (CC) and Escherichia Coliform (E.Coli) Count

The values of TCC dry and wet season for the upstream and downstream section ranged from (91.33±28.57- 108.66±8.50 and 235.00±51.73 – 281.33±29.70cfu/ml). The values obtained for the Colony Countalso ranged from (35.66±4.50 – 67.33±23.35 and46.00±46.35 –43.66±9.29cfu/ml) and that of E.Coliranged from (13.33±1.52 – 24.00±4.35 and 8.66 ± 3.51 – 16.66±8.73). These parameters were higher for both wet and dry season but a higher mean concentration was recorded during the wet season as the stream inflow during this season carries a higher level of bacteriological pollutants as a result of erosion. The values obtained were higher than the WHO guideline for drinking water. This work agreed with the findings of (Bedwell and Goulder, 1997)

Statistical Analysis

The data were analysed using the software Package for Social Sciences (version 23) to statistically show the relationship between the obtained data. Descriptive Statistics was used and One- way ANOVA was also used for the separation of means.

Parameters	Unit	Upstream	Downstream	P value	WHO (2017)
pH		7.23±0.05	7.16±0.15	**0.51	6.5-8.5
Temperature	˚C	26.23±0.11	26.66±0.15	*0.01	35-40
EC	µs/cm	210.66±18.14	227.33±36.11	**0.51	1250

Table 1. Result of the Physical, Chemical and Bacteriological analyses of water Samples from Asejire Reservoir Oyo State Nigeria 2021 during the dry season.

TDS	Mg/l	124.66±6.11	135.33±22.74	**0.47	500
Dissolved Oxygen	Mg/l	6.93±0.32	6.46± 0.20	**0.10	2
COD	Mg/l	4.09±0.72	6.28±0.89	*0.03	20
Nitrate	Mg/l	0.05±0.01	0.06±0.01	**0.13	1
Phosphate	Mg/l	0.15±4.5x10^-3	0.16±6 x10^-3	**0.08	0.05
Nitrite	Mg/l	0.03±9 x10^-3	0.0413±6.6 x10^-3	**0.51	10
Ammonia	Mg/l	7 x10^-4±2.1 x10^-4	1.2 x10^-3±1.5 x10^-4	*0.02	1.5
Colony Count	MPN/100ml	91.33±28.57	108.6667±8.50	**0.37	Not detectable in 100ml of sample
Coliform Organisms	MPN/100ml	35.66±4.50	67.33±23.35	**0.08	Not detectable in 100ml of sample
E. coli Count	MPN/100ml	13.33±1.52	24.00±4.35	*0.01	Not detectable in 100ml of sample

***Significant; p< 0.05 "The readings at the upstream and downstream level are not similar"**

****Not Significant; p > 0.05 "The readings at the upstream and downstream level are similar.**

Table 2: Results of the Physical, Chemical and Bacteriological analyses of water samples from Asejire Reservoir Oyo State, Nigeria 2021 during the wet season

Parameters	Unit	Upstream	Downstream	P value	WHO (2017)
pH		7.60 ±0.11	7.53±0.11	**0.23	6.5-8.5
Temperature	˚C	25.96 ±0.15	26.00±0.10	**0.76	35-40
EC	µs/cm	483.33 ±34.78	466.66 ±69.21	**0.72	1250
TDS	Mg/l	540.66 ±54.93	459.33 ±64.63	**0.17	500
Dissolved Oxygen (DO)	Mg/l	8.76 ±0.57	8.43 ±0.57	**0.51	2
COD	Mg/l	250.66 ±96.11	242.66 ±84.03	**0.91	20
Nitrate	Mg/l	0.19 ±0.01	0.21±0.09	**0.84	1
Phosphate	Mg/l	0.22 ±5.7 $x10^{-3}$	0.21±0.01	**0.49	0.05
Nitrite	Mg/l	0.11 ±9.1 $x10^{-3}$	0.12±0.05	**0.84	10
Ammonia	Mg/l	5.3 $x10^{-3}$ ± 5.8 $x10^{-4}$	5.7 $x10^{-3}$±2.5 $x10^{-3}$	**0.83	1.5
Colony Count	MPN/100ml	235.00 ± 51.73	281.33±29.70	**0.25	Not detectable in 100ml of sample
Coliform Organisms	MPN/100ml	46.00 ± 46.35	43.66±9.29	**0.93	Not detectable in 100ml of sample
E. coli Count	MPN/100ml	8.66 ± 3.51	16.66±8.73	**0.21	Not detectable in 100ml of sample

***Significant; p< 0.05 "The readings at the upstream and downstream level are not similar"**

****Not Significant; p > 0.05 "The readings at the upstream and downstream level are similar**

Table 3: Comparison of dry and wet season results from the Asejire reservoir Oyo State, Nigeria, 2021

		DRY				WET		
Parameters	**Unit**	**Upstream**	**Downstream**	**P value**	**Upstream**	**Downstream**	**P value**	**WHO (2017)**
pH		7.23±0.05	7.16±0.15	0.51**	7.60±0.11	7.53±0.11	0.23**	6.5-8.5
Temperature	˚C	26.23±0.11	26.66±0.15	0.01*	25.96±0.15	26.00±0.10	0.76**	35-40
EC	µs/cm	210.66±18.14	227.33±36.11	0.50**	483.33±34.78	466.66±69.21	0.72**	1250
TDS	Mg/l	124.66±6.11	227.33±36.11	0.22**	540.66±54.93	459.33±64.63	0.17**	500
DO	Mg/l	6.93±0.32	6.46± 0.20	0.10**	8.76±0.57	8.43±0.57	0.51**	2
COD	Mg/l	4.09±0.72	6.28±0.89	0.03*	250.66±96.11	242.66±84.03	0.91**	20
Nitrate	Mg/l	0.05±0.01	0.06±0.01	0.13**	0.19±0.01	0.21±0.09	0.84**	1
Phosphate	Mg/l	$0.15\pm4.5x10^{-3}$	$0.16\pm6\ x10^{-3}$	0.08**	$0.22\pm5.7\ x10^{-3}$	0.21±0.01	0.49**	0.05
Nitrite	Mg/l	$0.03\pm9\ x10^{-3}$	$0.04\pm6.6\ x10^{-3}$	0.51**	$0.11\pm9.1\ x10^{-3}$	0.12±0.05	0.84**	10
Ammonia	Mg/l	$7\ x10^{-4}\pm2.1\ x10^{-4}$	$1.2\ x10^{-3}\pm1.5\ x10^{-4}$	0.02*	$5.3\ x10^{-3}\pm5.8\ x10^{-4}$	$5.7\ x10^{-3}\pm2.5\ x10^{-3}$	0.83**	1.5
Colony Count	MPN/100ml	91.33±28.57	108.66±8.50	0.37**	235.00±51.73	281.33±29.70	0.25**	Not detectable in 100ml of sample
Coliform Organisms	MPN/100ml	35.66±4.50	67.33±23.35	0.08**	46.00±46.35	43.66±9.29	0.93**	Not detectable in 100ml of sample
E. coli Count	MPN/100ml	13.33±1.52	24.00±4.35	0.016*	8.66±3.51	16.66±8.73	0.21**	Not detectable in 100ml of sample

***Significant; p< 0.05 "The readings at the upstream and downstream level are not similar"**

****Not Significant; p > 0.05 "The readings at the upstream and downstream level are similar**

CONCLUSION

The results of this study showed that the water quality parameters of the Asejire reservoir were influenced by the activities of the fish farm majorly during the dry season, and less significant influence on the water quality parameters during the wet season pointing to a seasonal variation in the effect of the fish farming on the water water quality of the Asejire reservoir. The effect was due to high level of inundation from rainfall, which rendered the anthropogenic effect on the reservoir highly insignificant during wet season (ie. increased dilution).

This study characterized the physical, chemical and biological quality of the upstream and downstream section of the Asejire reservoir. It revealed that the average concentration of phosphate, Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total colony count, coliform count and *E.coli*analyzed were above the WHO guideline for drinking water.

It was also discovered that parameters such as Phosphate, Total Colony Count, Coliform Organism Count, and *E. coli* increased downstream during the dry and wet season as a result of the fishing activities.

From the results obtained, it was established that water from the Asejire reservoir is not fit for human consumption without adequate treatment due to its high bacteriological loads.

RECOMMENDATION

Effluents discharged into upstream rivers that flow into the reservoir should be regularly monitored by regulatory bodies.

More research work should be carried out on Fish farming activities in the reservoir.

Intensity of fish farming should be reduced to avoid deposition of waste to the river body as a result of the farming activities.

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