URBANIZATION AND SURFACE WATER QUALITY IN WARRI, SOUTHERN NIGERIA

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Abstract:

The study examines the impact of urbanization on surface water quality in Warri, Southern Nigeria. Warri is an urban centre in Nigeria, with a population of over 536,023 people, industrialized and drained by the Warri River. In carrying out this research, water samples were collected from two communities (Warri and Ovu) along the course of the Warri River. A total of 72 water samples were collected from January, 2018 to December, 2018 and analysed. The results showed that variation exist in the water quality in the urban centre of Warri when compared to the rural area. Also, most of the physiochemical and biological indices of water quality examined were influenced by storm water runoff paved surfaces and industrial discharges, resulting in high concentration of these parameters as against the WHO (2010) standard. The paper recommends the monitoring of all human activities along the course of the river including proper urban planning to check incidences of surface water pollution.

Keywords: Urbanization, water, quality, Warri, Impact

1. Introduction

The increase in population and growth of urban centres has a forceful impact on the hydrology of an area. Urbanization causes local but severe changes in the hydrological cycle (Ayoade, 1988) urbanization impairs the quality of water as urban water courses are often used to carry domestic and industrial effluents. This results in undesirable changes in the appearance of surface water. The rivers lose their attractiveness and become smelly and turbid. Many of the industrial effluent not only change the chemistry of the river water but also its physical characteristics such as colour and temperature. The water temperature is increased by effluent discharges from industries. The polluted rivers eventually lose much of their aquatic life. These ups and downs of the river result in the variation of the physiochemical characteristics (Egborge, 1991). This impedes its quality and leads to a substantial change in the ecosystem.

Spurred by the oil boom prosperity of the 1970s and the improvements in roads and other social infrastructure, Warri since 1991 has become increasingly urbanized. This is as a result of the influx of people from the rural areas into the urban centre of Warri. The area has growing manufacturing sectors including government service centres with great variety of small business enterprises. These attracted a lot of people to the area and an increase in population. This created pressure on the available surface water resources.

Drained by Forcados-Warri River basin, Warri is dissected by a network of the Warri River which continues upstream as the Olumesi River and empties into the Atlantic Ocean as the Forcados River (Odemerho & Jemeyovwi, 2007). Warri River stretches within latitudes 5°21 and 6°00 North of the equator and longitudes 5024 and 6°21 East of the Greenwich Meridian. The river is about 150 kilometers long and occupies an area of about 255 sqkm (NEDECO, 1961). The river flows through the settlements of Utagba-uno, Amai, Otorho-Abraka, Oviorie, Ovu, Agbarho, Otokutu, Ekakpamre, Iigbolokposo, Enerhen, lgbudu, Ovwian, Aladjaand Warri among other settlements. The inhabitants of these settlements depend on the water from the river for domestic, recreational, transportation, agricultural and industrial purposes (Egborge, 2001; and Omo-Irabor and Olobariiyi, 2007). However, the river water suffers from contamination caused by the use of detergents, solid waste disposal, effluent discharge, industrial waste and sewer leakages as a result of increasing urban population. Due to these impingements, water borne diseases such as diarrhoea, typhoid, dysentery and cholera are prevalent in the area (Federal Ministry of Water Resources (FMWR), 2000). It is therefore against this backdrop that this study assesses the quality of surface water in Warri, Southern Nigeria in the light of a growing population in order to safeguard human health for the present and future generations.

2. Prevailing Trend

A lot of progress has been made in the last 25 years to provide people with safer water and as at 2010, over 6 billion of the world's population has access to improved drinking water (Water Aid, 2012). Although it is commendable, 11 percent of the world population still lacks access to water that is safe for consumption. The figure rises to over 40 percent in sub-Saharan Africa. Moreover, in densely populated areas, the absence of proper sanitation facilities leads to massive pollution and contamination of the available surface water resources through improper disposal of industrial and faecal wastes. Unclean water poses serious health hazard to man, especially amongst the most vulnerable urban poor.

Thus, challenges related to water will magnify in the future due to an ever-growing city population that needs to share the already insufficient and poorly managed water resources. Urban water distribution systems are too often derelict and unable to cope with the growing population. Low income urban dwellers most often have to pay high prices for water. Assessing surface water quality is therefore crucial in the overall development and sustenance of man on the earth's surface especially in the developing countries of the world. This underscores the need for this study.

3. Aims, Objective and Hypothesis

The aim of the study is to assess the impact of urbanization on the quality of surface water in Warri, southern Nigeria. Therefore, the specific objectives are:

- Assess the quality of water from Warri River.
- Compare the variation in physico-chemical and biological indices of surface quality in urban and rural communities in the area.
- Suggest ways on how to check the impact of urbanization (if any) on surface water quality in the area.
- Ho: There is no significant variation in surface water quality in urban and rural communities in the area.

4. Study Area

The study area is Warri in Southern Nigeria. Warri is located within latitudes 5030 North and 5035 North of the Equator and longitudes 5029 East and 5°48 East of the Greenwich Meridian. Warri occupies a total land area of over lo0sqkm, with a total population of over 36,023 people in 2006. It is an industrial town with many manufacturing industries. It is also a transportation centre with air, land and sea routes.

5. Research Method

The study adopted both experimental and expost-facto designs. The experimental designs involve field survey and collection of water samples in settlements located along the course of Warri River and laboratory analysis of the water samples collected. While the expost-facto design draws a relationship between the physiochemical and biological parameters of the water and the effects of urbanization on the quality of water from the river.

The simple random sampling technique was used for choosing two settlements along the course of the river (Warri an urban settlement and Ovu, a rural settlement); while the systematic random sampling technique was adopted and used for the location of sites for the purpose of collection of water samples. The rationale for choosing these two settlements was to ascertain if urbanization has influence on surface water quality in the area, hence the choice of Warri an urban settlement and Ovu, a rural settlement

For the study, three (3) sampling points each (were taken at Warri and Ovu) along the course of Warri River were studied from January 2018 to December 2018. A total of seventy-two (72) water samples (three samples each from Warri and Ovu) were collected.

The method of data collection was through direct field collection of water samples from the surface and subsurface of the river. The water samples were collected early in the morning between the hours of 7am and l0am to reduce the effect of temperature on collected samples the water samples were collected sing sterilized 2-litre plastic cans fitted with information tags for identification. Collected water in plastic cans were securely corked and stored in ice packed containers before transporting them to the laboratory for analysis. This was done within six hours of collection.

Water quality parameters such as pH, electrical conductivity, temperature, TDS, DO, COD, nitrate, alkalinity, phosphate, HCO, chloride, sulphate, faecal, coliform, sodium, calcium and zinc were analysed using Atomic Absorption Spectrophotometer (AAS), Digital Meters, Standard Plate count in addition to filtration methods. The results obtained were compared with WHO (2010) standard for drinking water quality. The Kruskal Wallis H Test was used to test the posited hypothesis. This statistical tool was adopted because it gives accurate results. Efe (2002) used this statistical technique to determine the level of variation of physiochemical and biological indices of rainwater samples in the urban area of Warri and he achieved significant results. Ushurhe (2007, 2014) employed this statistical technique and he achieved significant results; hence its application in this study.

6. Results and Discussion

The results of the analysed water samples collected atWarri and Ovu along the course of Warri River from January 2018 to December 2018 are shown in Tables 1 & 2 and discussed.

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COD (mg/l)	THC (mg/l)	TOC (mg/l)	NO_2 N(mg/l)	NH_2 N(mg/l)	BOD (mg/l)	DO (mg/l)	Turb (NTU)	TSS (mg/l)	TDS (mg/l)	Salinity (%)	Temp. (°C)	Elec. Conduc. (us/cm)	pH	Field code	S/N
20.50	7.05	18.40	1.60	4.32	2.35	5.75	5.15	5.72	21.60	190.99	28.14	224.10	6.39	Jan	1
10.40	8.40	19.40	0.95	4.15	3.15	5.50	14.20	4.65	38.40	190.40	29.90	162.21	6.97	Feb	2
18.40	15.03	21.45	0.95	4.35	3.98	4.70	15.50	5.60	44.50	101.70	29.60	411.90	6.91	Mar	3
30.50	15.90	7.45	1.65	5.60	3.12	5.50	21.35	15.40	20.45	120.40	28.00	35.41	5.75	April	4
30.45	12.40	8.42	1.50	4.70	3.12	6.20	10.70	8.40	92.40	149.60	28.60	40.99	8.91	May	5
35.40	10.45	9.58	2.50	5.20	4.95	5.45	9.90	28.70	81.06	125.45	28.30	75.90	6.86	June	6
20.40	10.50	8.65	2.15	6.17	4.30	5.60	8.78	21.65	110.30	114.75	28.80	82.39	6.81	July	7
25.45	15.10	7.40	2.15	5.18	3.60	4.45	8.45	18.40	160.12	121.60	27.30	520.40	6.69	Aug	8
25.00	18.20	12.10	1.75	5.30	3.40	4.30	7.75	15.50	175.42	114.02	27.40	612.40	6.83	Sept	9
20.20	10.50	15.45	1.50	4.35	4.25	5.21	6.45	10.50	148.60	164.01	29.30	518.36	6.51	Oct	10
30.40	18.50	17.99	3.10	4.10	3.15	5.35	7.42	7.30	207.50	369.90	29.17	825.90	6.74	Nov	11
70.35	15.10	19.40	4.50	4.15	2.70	3.40	8.36	5.45	189.51	180.30	30.45	511.20	6.55	Dec	12
70.41	16.04	13.86	2.21	4.71	3.48	5.07	21.39	10.06	94.45	182.50	28.85	318.72	5.83	X	

Fe (ppm)	Zn (ppm)	Pb (ppm)	Ca (ppm)	Mg (ppm)	K (ppm)	Na (ppm)	Coliform (Count/100)	SO_4 (mg/l)	Cl-1 (mg/l)	HCO_2 (mg/l)	Total Phosporous	Alkali (mg/l)	S/N
0.95	1.20	0.001	9.25	4.80	3.50	7.15	58.40	3.30	0.35	13.00	1.65	40.15	1
0.95	1.00	0.001	10.30	3.90	4.15	8.10	50.40	2.65	6.20	16.90	0.59	40.16	2
0.65	0.91	0.001	11.15	3.90	3.90	7.40	28.00	1.70	0.30	17.30	1.53	40.40	3
0.30	0.45	0.001	7.35	4.00	5.20	7.41	25.00	0.96	0.30	10.10	3.37	36.00	4
0.25	0.15	0.001	7.30	4.00	5.65	6.40	18.20	1.14	0.15	12.40	2.45	35.14	5
1.05	0.50	0.001	8.75	4.20	6.35	5.40	15.20	1.02	0.20	15.50	3.60	33.40	6
2.02	0.42	0.001	8.30	5.20	5.15	5.42	25.20	0.90	0.15	16.40	2.45	29.40	7
1.05	0.25	0.001	7.75	5.40	4.30	6.15	25.00	0.70	0.07	20.00	1.68	30.21	8
0.92	0.16	0.001	7.40	5.41	3.60	7.40	30.20	0.22	0.10	25.00	1.60	50.91	9
0.75	1.32	0.001	7.39	25.00	3.40	7.80	40.32	4.25	0.29	27.80	0.95	58.20	10
0.81	1.43	0.001	30.85	26.15	3.10	8.00	36.10	4.30	0.45	43.50	1.09	54.00	11
0.70	1.25	0.001	20.40	30.25	3.10	7.70	41.90	4.10	0.30	42.00	0.99	65.33	12
2.01	1.42	0.001	7.24	13.26	6.41	4.18	58.46	5.16	0.36	3.58	3.61	43.08	

Table 1: Results of Physico-Chemical and Biological Analysis (Warri)
Source: Fieldwork, 2018

THC (mg/l)	TOC (mg/l)	NO_2 N(mg/l)	NH_2 N(mg/l)	BOD (mg/l)	DO (mg/l)	Turb (NTU)	TSS (mg/l)	TDS (mg/l)	Salinity (%)	Temp. (°C)	Elec. Conduc. (us/cm)	pH	Field code	S/N
7.50	18.40	1.60	4.50	2.40	5.50	5.12	6.40	16.94	15.60	16.95	6.80	6.40	Jan	1
8.45	18.55	0.95	4.20	3.15	5.20	12.14	4.30	25.95	115.10	18.90	10.95	6.80	Feb	2
15.10	20.10	0.96	4.40	3.50	4.10	13.40	5.00	24.00	125.10	20.88	20.50	6.95	Mar	3
15.04	7.30	1.40	5.10	3.20	5.10	20.93	2.45	75.95	130.25	25.30	41.50	5.60	April	4
15.12	8.10	1.50	4.35	4.00	8.00	7.95	25.70	85.90	11.20	20.10	50.60	9.95	May	5
9.00	9.40	2.00	4.10	4.10	5.45	8.00	20.00	95.90	151.30	25.10	45.50	6.40	June	6
8.40	8.50	1.95	5.30	3.60	5.02	9.15	17.45	91.90	158.10	30.25	45.80	6.10	July	7
9.00	7.40	2.00	6.17	3.35	4.00	8.25	14.45	95.10	180.10	25.10	60.80	5.50	Aug	8
8.15	11.90	1.45	6.10	4.20	4.00	15.35	10.25	110.10	150.10	25.10	60.70	4.30	Sept	9
8.35	13.30	1.40	5.50	2.80	5.10	15.30	8.75	110.05	181.50	50.45	50.45	4.50	Oct	10
4.70	17.80	2.95	6.15	4.10	5.13	40.30	6.73	120.05	185.10	45.35	45.00	5.60	Nov	11
8.50	18.40	4.10	3.48	3.65	8.21	4.30	6.75	115.20	190.12	10.35	48.90	6.70	Dec	12
8.42	12.15	2.16	5.22	4.50	5.29	8.75	10.15	76.40	121.61	28.69	82.45	6.85	X	

Table 2: Results of Physico-Chemical and Biological Analysis (Ovu)
Source: Fieldwork, 2018

Fe (ppm)	Zn (ppm)	Pb (ppm)	Ca (ppm)	Mg (ppm)	K (ppm)	Na (ppm)	Coliform (Count/100)	SO_4 (mg/l)	Cl-1 (mg/l)	HCO_2 (mg/l)	Total Phosporous	Alkali (mg/l)	COD (mg/l)	S/N
1.10	1.19	0.001	8.00	8.95	3.00	6.95	50.01	3.30	0.18	15.00	1.65	40.15	19.50	1
0.95	1.00	0.001	8.41	2.98	4.10	8.00	48.10	2.50	0.21	14.92	0.50	41.60	10.15	2
0.45	0.80	0.001	10.10	3.60	3.50	8.45	25.40	1.59	0.15	15.45	1.45	38.10	14.45	3
0.95	0.21	0.001	8.25	4.00	4.50	7.00	21.45	0.90	0.20	10.05	3.30	35.10	29.50	4
1.85	0.15	0.001	6.10	3.95	5.00	6.10	18.41	1.10	1.50	12.00	2.40	31.16	30.10	5
1.05	0.12	0.001	6.75	4.01	6.01	5.00	16.35	1.00	1.58	12.50	3.50	32.45	32.41	6
1.05	0.18	0.001	8.10	5.00	4.10	5.19	15.45	0.85	0.58	14.00	2.40	25.46	19.50	7
0.95	0.85	0.001	5.00	5.00	5.01	7.10	23.50	0.50	0.10	15.42	1.50	18.40	22.40	8
0.82	0.17	0.001	20.11	21.05	4.10	6.06	40.10	0.10	0.24	18.14	1.45	15.50	21.40	9
0.76	0.85	0.001	21.19	21.18	3.71	4.90	36.14	3.58	0.18	25.82	0.95	18.58	16.40	10
1.05	0.88	0.001	25.10	20.75	3.10	4.85	38.10	4.90	0.50	40.58	1.10	19.20	25.42	11
0.98	0.21	0.001	25.15	46.10	2.95	4.90	40.50	0.10	1.00	40.18	0.85	25.80	41.50	12
2.01	0.42	0.001	5.52	5.40	4.56	5.42	25.50	0.92	0.16	14.52	2.48	29.40	20.50	

Parameters	Warri	Ovu	WHO STD (2010)
pH	5.83	6.85	6.5-8.5
EC	318.72	82.45	100
Temperature (°C)	28.85	28.69	-
Salinity	182.50	121.61	-
TDS	94.45	76.40	500
TSS	10.06	10.15	5.00
Turbidity	21.39	8.75	5.00
DO	5.07	5.29	5.00
BOD	3.48	4.50	3.00
NH_3N	4.71	5.22	1.50
NO_3N	2.21	2.16	10
TOC	13.86	12.15	5.00
THC	16.04	8.42	0.00
COD	70.41	20.50	100
Alkalinity	43.08	29.40	50
Total phosphate	3.61	2.48	1.00
HCO_3	43.58	14.52	50
CL	0.36	0.16	250
SO_4	5.16	0.92	200
Fecal coliform	58.46	25.50	10
Na	4.18	5.42	200
K	6.41	4.56	NA
Mg	13.26	5.40	0.20
Ca	7.24	5.52	75
Pb	0.001	0.001	0.01
Zn	1.42	0.42	3.00
Fe	2.01	2.01	0.30

***Table 3:* Mean Values of Physiochemical and Biological Indices of Water Quality at Warri and Ovu on Warri River**

Parameters	Warri	Ovu
pH	26	28
Ec	54	50
Temperature	43	42
Salinity	53	52
TDS	51	49
TSS	32	32
Turbidity	40	31
DO	19	22
BOD	13	16
NH_3N	18	21
NO_3N	11	10
TOC	36	34
THC	38	30
COD	48	39
Alkalinity	45	44
Total phosphate	14	12
HCO_3	46	37
CL	4	3
SO_4	20	6
Fecal Coliform	47	41
Na	15	24
K	27	17
Mg	35	23
Ca	29	25
Pb	0.5	0.5
Zn	7	5
Fe	8.5	8.5
	R1=780	R2=702

***Table 4:* Ranked Values of Physiochemical and Biological Indices of Water Quality at Warri and Ovu on Warri River**

As shown in Tables 1 and 2, a mean pH, value of 5.83 and 6.85 was recorded for Warri and Ovu respectively. Electrical conductivity recorded a mean value of 318 l2us/cm at Warri and 82 45us/cm at Ovu while temperature recorded a mean value of 28.85°c at Warri and 28.69°c at Ovu. A mean value of 182.50% and 121.61% salinity value was recorded for Warri and Ovu respectively. Total dissolved solids recorded a mean value of 94.45mg/L at Warri and 76.4Omg/L at Ovu. Total suspended solids and turbidity values recorded at Warri were 10.06mg/l and 21.39NTU respectively. At Ovu, 10.15mg/I and 8.75 NTU were recorded for total suspended solids and turbidity respectively. DO (5M7mg/l), ROD (3.48mg/I) and ammonia (4.71mg/i), were recorded at Warri respectively. At Ovu, DO (5.29mgL), BOD (4.5Omg/L) and ammonia (5.22mg/L) were recorded. Nitrate recorded a mean value of 2.21 mg/L at Warri while at Ovu, a mean value of 2.l6mg/L was recorded. Also, at Warri, TOC mean value was 13.6 mg/L while a mean value of 12.l5mg/L was recorded at Ovu. Hydrocarbon (160.O4mg/L) was recorded at Warri and 8.42mg/L recorded at Ovu.

From Tables 1, 2 and 3, mean COD value of 70.4lmg/L was recorded at Warri and 20.50mg/L at Ovu. Alkalinity, total phosphate and bicarbonate recorded mean values of 43.08 mg/I, 3.61mg/I and 43.58mg/L respectively at Warri; while mean values of 29.40mg/I, 2.48mg/L and 14.52mg/I were recorded at Ovu respectively. Chloride and Sulphate recorded a mean value of 0.36mg/L and 5.l6mg/L respectively at Warri. However, mean values of 0.16mg/I and 0.92mg/I were recorded for chloride and sulphate respectively at Ovu. A high mean value of 58.46cfu/100 was recorded for fecal coliform at Warri and 25.50cfu/100 at Ovu.

Sodium, potassium, and magnesium had mean values of 4.l8ppm, 6.4lppm, and 3.26ppm at Warri respectively; while at Ovu, mean values of 5.42pm (sodium), 4.56ppm (potassium) and 5.4oppm (magnesium) were recorded. Calcium, lead, zinc and iron recorded mean values of 7.24ppm, 0.000lppm, 1.42ppm and 2.0lppm respectively at Warri. At Ovu, mean values of 5.52ppm (calcium). 0.00lppm (lead), 0.42ppm (zinc) and 2.0lppm (iron) were recorded.

Thus, low value of pH and high values of EC, TSS, turbidity, BOD, NH_3N, TOC, THC, faecal coliform, Mg, and Fe were recorded at Warri. These values are above the WHO (2010) standard for drinking water quality. Thus, lower values of pH recorded in the area are indications of high acidity, which is caused by the deposition of acid forming substances on the surface water. Changes in the pH can be indicative of an industrial pollutant, photosynthesis or the respiration of algae that is feeding on a contaminant (Warrick. 2003).

While urbanized areas contribute large amount of turbidity, EC, ammonia to nearby water, through storm water pollution from paved surfaces such as roads, bridges and parking lots (USEPA, 2005). The main made sources of TSS such as industrial discharges contributed to the high concentration of TSS in the water. High values of hydrocarbon, faecal coliform, magnesium and iron recorded in Warri can be attributed to industrial discharges, discharge of sewage and abattoir activities (Aisien, Gbegbaje- Das and Aisien, 2010), laundry and wastewater flow into the river.

7. Test of Hypothesis

The Kruskal Wallis H test statistical technique was adopted and used to test the posited hypothesis which states that, 'there is no significant variation in surface water quality in urban and rural communities in the area'. The data for this test were re-arranged and ranked to satisfy the Kruskal Wallis H test (Table 4).

The hypothesis posited as follows

Ho = $\mu 2$ = $\mu 2$

H1 $\neq \mu 1 \; = \mu 2$

H = $\frac{12}{\mu(N+1)} \sum \frac{R1}{ni} - 3\ (N+1)$

Where:

N = Total number of individuals in all the samples

R = The sum of the ranks within a sample

Nn = Number of individuals in the sample

Thus: n = 54

Nn = 27

R1 = 780

R2 = 702

H = $\frac{12}{54(54+1)} \sum \left(\frac{(780)2}{27} + \frac{(702)2}{27}\right)$- 3 (54 + 1)

H = $\frac{12}{54(55)} \sum \left(\frac{608400}{27} + \frac{492804}{27}\right) - 3(55)$

H = $\frac{12}{2970}\ (22533.3333 + 18252) - 165$

H = 164.78906066532 — 165

H = 0.21093933468

Conclusively, p — value (-0.2109) is less than the cut-off value (0.05). therefore, the null hypothesis is rejected and the alternative hypothesis accepted, which implies that variation exists in surface water quality between urban and rural communities. This variation is observed in the high amount of E, TSS, turbidity, BOD, ammonia, TOC, hydrocarbon, total phosphate, fecal coliform, Mg and iron recorded at Warri along the course of Warri River.

8. Findings

The study of the impact of urbanization on surface water quality in Warri, Southern Nigeria revealed that:

- There is significant variation in surface water quality in the urban area of Warri located along the course of Warri River.
- Most of the physiochemical and biological indices examined such as turbidity, electrical conductivity, ammonia, TSS, hydrocarbon, faecal coilform, Mg and Fe were influenced by storm-water run-off, paved surfaces, industrial discharges such as wasteful, oil spills, sewage, caused by urbanization were Identified as factors responsible for the high concentration of these parameters on the surface water in the area.
- Some of the parameters examined were above the WHO (2010) threshold for drinking water quality.
- The result of the Kruskal Wallis H test on the posited hypothesis shows that H cal (-0.2109) < (0.05), which implies that variation exists in the surface water quality at Warri as against other locations along the course of the river.

9. Recommendations

Urbanization affects the quality of surface water by changing the rate of recharge through overland flow and run-off capacities. An assessment of the quality of surface water needs to take account of the recharge and discharge pressures, especially of all human activities in the catchment area. It is on this premise that this paper recommends:

- The monitoring of all human activities along the course of the river.
- Government should introduce legislation on surface water protection zones, under which housing, industrial and certain agricultural activities should be excluded from certain parts of the catchment area.
- Proper urban planning should be intensified and carried out to check improper waste disposal and waste water generation.
- Adequate solid waste disposal methods should e put in place; while phasing out open dumps and reckless dumping of solid waste on surface water bodies.
- The people should be sensitized on the need to protect the surface water, hence improve household and urban sanitation in the area.
- Surface water should be tested from time to time to identify impairments and to ascertain whether the physiochemical and biological indices of water quality are increasing or decreasing in line with approval water quality standard.

10. Conclusion

The study examined the effects of urbanization of surface water quality in Warri, Southern Nigeria. The water from the river showed significant variation in some of the parameters examined as against the WHO (2010) threshold for drinking water quality in the area. Thus, the quality of water from the rivers is influenced by the high population through run-offs from paved surfaces, waste water generation from households and industries, improper solid waste disposal, leading to high concentration of ammonia, iron, hydrocarbon and faecal coliform in the surface water. However, with improved planning, monitoring and sensitization, we can rise up to the challenge of urbanization and control of surface water, hence safeguarding human health in Nigeria and the world in general.

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