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Effects Of Physicochemical Parameters On River Jakara Water Quality In Kano Metropolis, Nigeria

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Abstract
River Jakara is a major source of water for Kano city, and its pollution is of great concern due to the potential health and environmental consequences. The study therefore examined the effects of the physicochemical parameters on it. Eight sampling points that conveys wastewater to River Jakara were purposefully established and a total of 96 water samples were collected at different locations from June 2021 – April 2022 during wet and dry season. Using the Principal Components Analysis (PCA), 9 physicochemical parameters and 2 microbial colonies were chosen and subjected to laboratory analysis. The results showed that the wastewater contributed significantly to the river pollution for concentrations of all the pollutants exceeded the Nigeria discharge standards such as National Environmental Standard Regulatory Enforcement Agency (NESREA, 2011). Laboratory analysis recorded high concentrations of parameters: temperature 38˚C, pH 12, turbidity (TUR) 38NTU, electric conductivity (EC) 3861mg/L, total hardness (TH) 574mg/L, total dissolved solid (TDS) 3915mg/L, dissolved oxygen (DO) 7.5mg/L, biological oxygen demand (BOD) 185mg/L, nitrate (NO) 283.5mg/L, total coliform 395cfu/100ml and escherichia coli (E.coli) 452cfu/100ml in wet season. The T-test analysis indicated a strong significant variation between wastewater loads and the water quality parameters as well wet and dry season at P = .05. The results suggested that discharge of wastewater into the river had adversely affected its water quality and could pose a great risk to aquatic life and public health. Therefore, effective management strategies are needed to reduce wastewater loads and improve the water quality of River Jakara.

Keywords: *Pollution; Pollutant; Physicochemical parameter; Wastewater and Water quality*

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I. Introduction

It is gain saying that human beings depend on water for day to day activities and the byproducts or output generates wastewater (Mshelia and Bulama 2023) referred to wastewater as any kind of water which has been used and has outlived its usefulness or water that its quality has been altered as a result of the depositions or putting of some of substances, chemicals, organic matter or contaminates which makes it unfit for consumption. More still, water used for washing, cleaning, in the toilets at homes and industries where it becomes polluted in such a way that it is harmful when consumed or it cannot be used for other domestic uses is termed as wastewater (Joshua et al. 2021). What matter most in this case when the wastewater is generated is the ability of man to discharge it safely but most often reverse is the case as man disposes wastewater in the surrounding with impunity. In most cases, the wastewater is indiscriminately discharged into the environment through wall outlets, canals, sewerage and open drainage. However, such is not the case in many urban centres especially in the developing world (UNESCO, 2019; Mshelia, 2024; Jibrin, et al., 2018).

It is anticipated that fresh water meant for drinking and domestic uses should be free from physiochemical and microbial properties as well as heavy metals or above World Health Organisation (WHO) guidelines, National Standards for Drinking Water Quality (NSDWQ) standard and other permissible limits stipulated by other countries and international recognized water regulatory bodies. When other substances (soap, detergent, excreta) we use at homes and at industries or markets (chemicals, waste of different sorts) are discharged and gets into the water bodies (surface, sub surface or groundwater), the water becomes contaminated and unfit for drinking and other domestic uses as a result of some pharmaceutical and personal care products (PCP) (Michael, et al., 2019; Vuliet and Cren-Olive, 2011; UNEP, 2019).

Water bodies in urban and peri urban settings across Nigeria are being polluted on daily basis from on-site sanitation such as shallow wells and boreholes, industrial effluent discharges and nonpoint pollution sources by chemical and biological industrial discharges and by domestic septic tanks and sewerages (Royal and Parvez, 2015; Mshelia, 2022). These sources of wastewater serve as the major water supplies that recharge the rivers in major Nigerian cities, in Kano the wastewater sources recharge River Jakara and Challawa and other (Ince *et al.*, 2010).

Kano city comprises of residential, institutional and commercial landuse such as markets, hotels, restaurants, abattoirs, hospitals, prison, educational and commercial institutions. Landuse is the cultivation of crops along river banks especially the Jakara River where a length of about 7Km, where untreated sewages being discharged into river is used for irrigation of crops and vegetables such as tomatoes, lettuce, spinach and carrots among others (Amoo *et al*., 2017; Mshelia, 2024). In most parts of the country water resources which seem to be available in rivers, streams, ponds and underground is polluted and rendered unfit for drinking as a result of the presence of high concentrations of heavy metals and physicochemical parameters (Mshelia, *et al., 2020*). Therefore, knowledge of the contamination processes, environment and health risks is impressive in the management of wastewater and waste generally in Kano Metropolis

Several studies conducted on wastewater pollution such Ubuoh et al., (2023) studied effects of environmental pollution loads on the chemistry of surface water as well as ecological risks potentials of inland aquatic ecosystem in South-Eastern Nigeria. Similarly, Zhi-hua *et al.,* (2021) assessed the distribution and risk pollutants that are toxic in surface water of the lower Yellow River China. Mora *et al*., (2021) reported health issues as a result of the use of river water in the study review of the current environmental status and human health implications of one of the most polluted rivers of Mexico. Okolo *et al*., (2017) studied the effects of industrial effluents on water resources in Challawa, Kano metropolis and reported high concentrations of pH, temperature, turbidity, BOD, DO, EC, TDS, total suspended solids (TSS), NO, calcium and potassium in surface water. Similarly, Mshelia *et al.,* (2023) studied effects of wastewater on socioeconomic activities of people in Kano Metropolis, Nigeria and reported that wastewater let loose from homes pollute the environment and cause harm.

The results of most on the findings showed that the levels of most of the physicochemical parameters in wastewater exceeded the maximum permissible limits postulated by NESREA and that of WHO and the maximum contaminant levels (MCL). In some places, especially along the Jakara River the wastewater such as untreated sewages, grey and black waters from the Metropolis drains freely into river is used for irrigation and domestic activities without recourse. Based on the reviewed literatures, it is evident that there is the need for study of effects of wastewater on water quality in River Jakara, Kano Metropolis with a view of assessing concentration levels and effects on human, plants and aquatic ecosystem.

II. Materials And Methods

Location and Size

Kano Metropolis is located between latitudes 11˚ 55′ 23.93″N to 12˚ 3′ 53.10″N of the Equator and longitude 8˚ 27′ 42.26″E to 8˚ 3′ 41.62″E of the Greenwich Meridian (see Figure 1). It has total land coverage of 499Km^2 and consists of eight LGAs which are Nasarawa, Dala, Gwale, Fagge, KMC, Kumbotso, Ungogo and Tarauni. It is the most industrialized city in northern part of Nigeria with the industries concentrated in three areas namely: Bompai, Challawa and Sharada Industrial Layouts (Yahaya *et al*. 2016; Nagebu, 2010; Mshelia *et al.*, 2020).

The metropolis receives three to five months of rainfall from June – September which gives annual rainfall ranges from 700mm to 1,000mm, averagely about 690mm of precipitation per year and (NiMET, 2021). Kano Metropolis is often very hot almost throughout the year, though from December to February, the city is noticeably cooler. Nighttime temperatures are cool during the months of December, January and early February, with average low temperatures of 11°- 14 °C in some cases (NiMET, 2021).

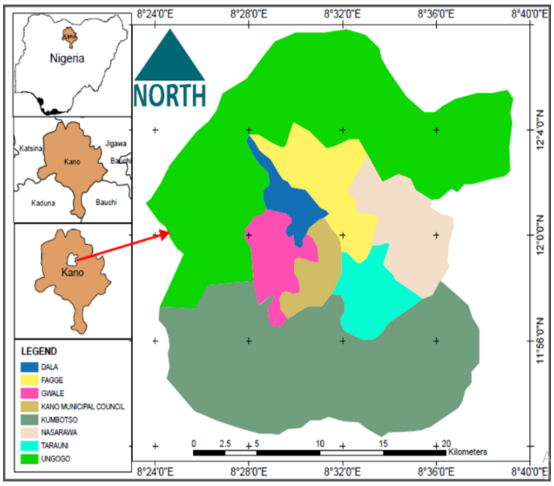

Figure 1: Kano Metropolis

Source: GIS Unit, Department of Geography, Federal University Gashua (2022).

Methods

The study was designed to conduct laboratory analysis of water quality parameters to assess the concentration effects of nine physicochemical parameters and two microbial (colonies) on River Jakara. The parameters were selected using the Principal Components Analysis (PCA) that reduced the large numbers of dataset to a sizeable number used for the study as shown on Table 1. River Jakara, River Jakara was chosen because it is the notable river in Kano Metropolis that receives domestic wastewater from different parts of the Metropolis and industrial effluents from Bombai, Kofar Wambai Tanneries and Kofar Mata. The study determined the concentration of the parameters or elements (physical, chemical and biological) in surface. Surface water from River Jakara was compared to NESREA's standard which regulates disposal of industrial effluents and sewages on land and surface water.

Table 1: Samples and Parameters Analysed.

Sample	Physicochemical Parameter	Microbial Parameter
Surface/	Temperature	
Groundwater	Ph	Total Coliform
	Electric Conductivity (EC)	Count (TCC)
	Turbidity (TUR)	Escherichia Coli
	Total Dissolved Solids (TDS)	(E. coli)
	Total Hardness (TH)	
	Dissolved Oxygen (DO)	
	Biological Oxygen Demand (BOD)	
	Nitrate (NO3)	

Source: Field Survey (2022).

Samples Collection along River Jakara

In Kano Metroplis, River Jakara was purposefully selected as a result of land use patterns and its attribute as receptor and being recharged with wastewater from the Metropolis. Samples were randomly and purposefully collected at eight different points along River Jakara named Point (P)1 – 8 as shown on Table 2 and Figure 2 using composite sampling methods. The samples were collected six times at each location to get a reasonable mean between the hours of 0800 – 1100Hrs and 1600 – 1800Hrs from 24/06 – 22/08/2021 and 23/02 – 20/04/2022 during wet and dry seasons respectively using a pre-cleaned 2L bucket and emptied into pre-cleaned 0.75L labeled plastic bottle containers and conveyed to Laboratory and subjected analyses to determined physicochemical and microbial parameters in accordance to APHA (1998; 2005) as shown in Table 2. Similar method was also employed by Amoo, *et al* (2017) and Mshelia (2024) that established eight sample points along Jakara River.

Table 2: Sampled Sites along River Jakara

Sample Site	Location	Sampled Points
P1	12.005N 08.516E	Kofar ruwa junction receives wastewater from Kano city, Dala Hills into the Jakara.
P2	12.011N 08.522E	Junction where the effluent and domestic wastewater (sewage) from Mazugal abattoir and some communities in get into River Jakara.
P3	12.015N 08.525E	Kurna and Tudun Bojuwa junction where the traditional tanneries and dying pits within the old city release their wastewater into the river.
P4	12.028N 08.536E	River Jakara junction at Murtala Muhammad (MM) Road that receives Municipal waste, agricultural waste, runoff and Effluent.
P5	12.035N 08.536E	Junction along Zungeru roads which gets domestic sewage from Sabon and lubricants from mechanic workshops at Egbe Street and its environs.
P6	12.040N 08.541E	Kwana Hudu Bridge on the Getsi that receives effluents from the Bompai industrial Estate and another domestic wastewater.
P7	12.048N 08.548E	Kwakwachi junction which disposed wastewater from the metropolis and used for irrigation.
P8	12.055N 08.553E	Junction under the Airport Road Bridge which receives domestic wastewater and other waste from Noman's Land.

Source: Field Survey, (2023).

Table 3: Summary of Laboratory Analyses of Physicochemical and Microbial Parameters/Elements

S/N	Parameter	Unit	Methods	
1	Temperature	˚C	Thermometric APHA (2005)	
2	Ph	-	pH meter APHA (1998)	
3	Turbidity (Tur)	NTU	Nephelometric APHA (1998)	
4	Electrical Conductivity (EC)	µs/cm	Electrochemical Method APHA (2005)	

5	Total Hardness (TH)	mg/L	EDTA-Titrimetric AHPA (1998)	
6	Total Dissolved Solid (TDS)	mg/L	Standard Method 2540C (APHA, 1998)	
7	Nitrate (No)	mg/L	Cd Reduction Method (1998; 2005)	
8	Dissolved Oxygen (DO)	mg/L	Luminescent ASTM D888-12APHA (2005)	
9	Biological Oxygen Demand (BOD)	mg/L	5 Days incubation at 20 ^{0}C Titration of initial and final DO 5210B (APHA, 1998)	
10	TCC & E.Coli	cfu/100ml	Membrane Filter (MF) technique (HACH, 1996)	

Source: APHA (1998, 2005); APHA, AWWA, WEF (1995; 2012); Authors Compilations (2023)

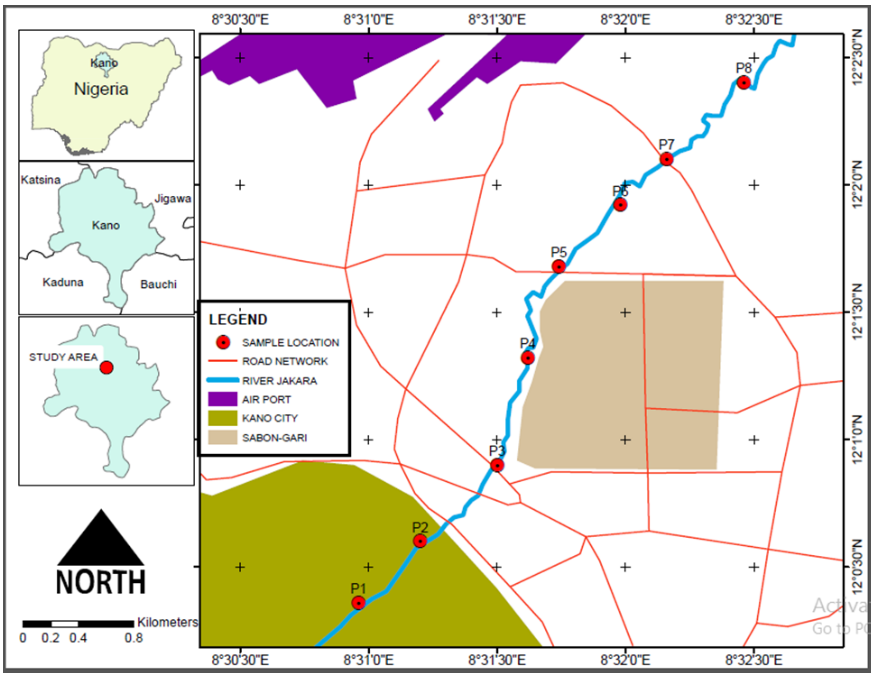

Figure 2: Sampled Points along River Jakara in Kano Metropolis.
Source: GIS Unit, Geography Department, Federal University Gashua, (2022).

III. Results And Discussion

Concentration and Comparison of Physicochemical Parameters along River Jakara

The concentrations of physicochemical parameters were investigated at eight different points along River Jakara that flows through the major parts of the metropolis (see Table 4). The values are compared to NESREA (2011) Standard permissible limit for disposal of wastewater using the student T-Test and statistically reported in Standard Alpha Level (SAL) format *(t (No of Parameters)* = Sig., *p< 0.05).*

Temperature (˚C): The mean value concentration of temperature ranges 28 – 33ºC during the wet season and 28 – 30ºC during the dry season with higher values recorded during the rainy period as shown in Table 4. All values fall within the permissible limit of <40^{0}C for disposal of wastewater by NESREA's (2011) as also observed by Ezeilo and Oba (2016) who investigated evaluation of water quality index of Orashi River, Rivers State, Nigeria and measured temperature of 27 - 32ºC. Paired samples T-test between the mean temperature concentration and the NESREA (2011) standard *(t (39) = 2.13, p < 0.05)* and *(t (39) = 2.21, p < 0.05)* during wet and dry seasons and showed no significant differences to the NESREA (2011) standard of >40ºC. This can be attributed to stability of the general environmental temperature during period of sample collections.

pH: Table 4 showed mean value of 5.5 – 12.0 during wet season and 4.2 – 11.5 during the dry period. Only P1 and 2 mean value of 5.5 and 6.9 respectively in wet season and P8 during dry season fall within the permissible set by NESREA (2011) of 6 – 9.5. Higher values resulting to the alkalinity of the water can be attributed to domestic wastewater from the abattoirs, institutions, commercial area and homes as also observed by Mshelia and Mbaya (2024) who studied seasonal variations of heavy metals and microbial parameters on well water quality in urban centre, effluent locations and non-effluent location of Kano Metropolis, Nigeria

. Furthermore, the paired T-test between pH value and the NESREA (2011) standard $(t\ (39) = 2.18, p < 0.05)$ and $(t\ (39) = 2.01, p < 0.05)$ showed significant differences.

Electrical Conductivity (EC): The result showed mean range of 1342µS/cm – 3861µS/cm and 1236 - 2275µS/cm during wet and dry seasons respectively. Only P1 and P 8 along River Jakara during dry period were found within the permissible level of 1500mg/L stated by NESREA's (2011) and shown in Table 4; with greater values recorded during the wet season. The paired samples T-test $(t(39)= 2.01, p < 0.05)$ during the wet season and $(t(39)= 2.12, p < 0.05)$ during the dry season showed significant variations. The values above the acceptable limit can be ascribed to the discharged wastewater which contains chemicals being used in dyeing of clothes and fabrics in the Metropolis as also reported by Shuaibu and Audu (2019) and Silva *et al*., (2017) who studied space time evolution of the trophic state of a subtropical lagoon in Lagoa da Conceição, Florianópolis Island of Santa Catarina, Brazil.

Turbidity: The mean values of turbidity during wet and dry seasons ranged from 32NTU – 38NTU and 34 – 53NTU respectively. All mean values reported well above the permissible level of 30mg/L stipulated by NESREA (2011). Similar values of 29 – 37NTU; 22 - 38.50 NTU were also observed by Ranjeet *et al*., (2017) who studied water quality of Damodar River in India and pollutants in wastewater. The paired samples T-test $(t(39)= 2.15, p < 0.05)$ and $(t(39)= 2.29, p < 0.05)$ showed that there were significant differences of turbidity values to NESREA (2011) and between wet and dry seasons.

Total Dissolved Solid (TDS): The mean concentration values ranged of TDS are 2009mg/L – 3915.3mg/L during the wet season and 1084 – 3995.5mg/L during dry season as shown in Table 4. All the established points recorded mean values of very high concentration above the 2000mg/L permissible limit stated by NESREA. The high values recorded during wet season were ascribed indiscriminate discharge of wastewater from homes, markets, mechanic workshops, other commercial centres and agricultural practice. Values fall within similar ranges were also recorded by Shawai *et al.*, (2019) and Mshelia, *et al*., (2023) who invested physicochemical parameters in wastewater samples along Jakara channels effects of wastewater on socioeconomic activities of the residents of Kano Metropolis respectively. Furthermore, the paired samples T-test $(t(39)= 2.01, p <0.05)$ in wet period and $(t(39)= 2.13, p <0.05)$ in dry period show significant differences to the NESREA (2011) standard.

Total Hardness (TH): The investigation shows mean range of 377.5mg/L to 574mg/L during wet season and 278 – 453mg/L during dry season as shown in Table 5.4. All the established points along the Jakara River channels recorded mean concentration values above the permissible limit stated by NESREA (2011) thresholds limit of 350mg/L except P8 during dry period. Concentrations within similar range were also recorded by Aremu *et al*., (2011) and Mshelia (2024) who studied physicochemical characteristics of stream. More still, the paired samples T-test $(t(39)= 2.22, p < 0.05)$ and $(t(39)= 2.30, p < 0.05)$ show significant difference during both seasons respectively. The values above the acceptable limit and the significant variations can be ascribed to the wastewater which contains high concentrations of calcium, magnesium and other chemicals being discharged into the river without treatment.

Dissolved Oxygen (DO): The study showed mean concentration mean ranges of 0.2mg/L – 7.5mg/L during wet period and 0.6 – 9.6mg/L during the dry season as shown in Table 4. The established locations recorded mean concentrations below the permissible level of 8mg/L stipulated by NESREA (2011) except P5 during dry season. This can be attributed to the impacts of temperature on the solubility of oxygen in water, high load of organic matter in water, use of fertilizers by farmers at the bank of the river and domestic sewages contributed to the low DO in water through breaking down of organic matter present by microorganisms the river in presence of oxygen as also reported by Chandne (2014) in Yavatmal District, Maharashtra (India) and also attributed to sewages from homes and commercial areas. It is on the basis of these findings that the paired samples T-test between the mean DO concentration value and the NESREA (2011) standard $(t(39)= 2.36, p < 0.05)$ during wet period and $(t(39)= 2.36, p < 0.05)$ shows high significant difference.

Biological Oxygen Demand (BOD): Table 4 shows BOD mean range of 124 mg/L to 381mg/L and 81 – 301mg/L during wet and dry seasons. All the established points along River Jakara recorded mean concentration well above the permissible limit of 30mg/L (NESREA, 2011). The paired sampled T-test between the mean BOD values and the NESREA's (2015) standard $(t(39)= 2.74, p < 0.05)$ and $(t(39)= -.65, p < 0.05)$ show significant differences during wet and dry season respectively where the BOD measures above the NESREA standard. Greater values can be linked to variations inorganic matter in different seasons that settles as residues in wastewater being discharged into the river (Ngang and Agbazue, 2016).

Table 4: Mean Concentration of Physicochemical Parameters along River Jakara in Wet and Dry Season

Location	P1	P2	P3	P4	P5	P6	P7	P8	NESREA (2011)
Wet Season River Jakara									
Latitude	12.005N	12.011N	12.015N	12.028N	12.035N	12.048N	12.048N	12.055N	
Longitude	08.516E	08.522E	08.525E	08.530E	08.536E	08.541E	08.549E	08.553E	
Temp(ºC)	29.5	30	32	31.5	32	29.5	32	28	40
pH	5.5	6.9	10.6	12	12	9.6	10.5	10	6-9.5
EC(μS/cm	1873	2042	2075	3861	2010.5	2218	3221	2185	1500
Turbidity (NTU)	32.4	32.5	35	33.1	34.6	37	32	38	20
TDS (mg/L)	2932	3103.4	3915.3	2009	3342	3220	3182	3119	2000
TH (mg/L)	377.5	378.5	377	460	436	452	574	470	350
DO (mg/L)	1.6	1.8	0.6	0.9	2.5	0.2	3.2	7.5	08
BOD (mg/L)	145	151	185	168.5	180	381	212	124	30
Nitrate (mg/L)	102	283.5	242	202	140	198	156	121	20
Jakara Dry Season									
Temp(ºC)	29.5	29.5	31.5	30.5	29	30	30	30	40
pH	9.6	9.7	10.5	11.5	11	9.8	9.9	8.5	6-9.5
EC(μS/cm	1236	2169.1	2075	2275	1753.4	2098	2006	1257	1500
Turbidity (NTU)	45.6	47.6	49	53	52	40	42	34	20
TDS (mg/L)	1084	2115	2101	1432	2115	3995.5	2567	1564	2000
TH (mg/L)	356	367	380	440	453	411	439	278	350
DO (mg/L)	1.6	1.8	0.6	0.9	9.6	1.8	5.6	3.7	8
BOD (mg/L)	145	151	310	168.5	160	256	81	105	30
Nitrate (mg/L)	121.5	220.7	203.4	202.7	256	203	234	156	20

P1 – P8 = Point 1 –Point 8

Source: Field Survey, (2021**).**

Nitrate: Table 4 showed mean range value of 102 – 283.5mg/L in wet season and 121.5 – 256mg/L in dry season well above the permissible limit of 20mg/L given by NESREA (2011). Higher values were measured during the wet season and could be ascribed to high concentrations of anions nitrates from small scale industries, wastewater from commercial centres and farming activities on the bank of the river. More still, the T-test statistical analysis paired between nitrate and NEREA (2011) standard reported; *($t(39)= 4.24$, $p < 0.05$)* and *($t(39)= 2.02$, $p < 0.05$)* during the wet and dry seasons respectively show significant variations with NESREA standard. The elevated values can also be as a result of the constituents of the pollutants at homes, institutions, abattoirs and other commercial centres that the wastewater, sewerages flows into River Jakara as similarly reported by Audu and Idowu (2015). The values fall within similar range as also recorded by Chandne (2014) in Yavatmal District, Maharashtra (India) and recorded Ni mean value of 152 –223mg/L.

Concentrations and Comparisons of Microbial Parameters along River Jakara

The concentrations of microbial parameters of Total Coliform (TC) and Escherichia Coliform (E. coli) were investigated at eight different points along River Jakara and concentrations compared to NESREA (2011) Standard (see Table 5)

Total Coliform (TC): The study showed mean concentration of TC ranged from 202cfu/100ml – 395cfu/100ml during wet season and 125 – 355mg/L in dry season extremely high when compared with 20cfu/100ml NESREA (2011) permissible limit for disposal of wastewater on land and river. The three TC highest values (cfu/100ml) of P4 395, P3 354 and P 431 recorded in wet season were obtained from (P4) Murtala Muhammad (MM) Road wastewater canal that drains municipal wastewater, agricultural runoff and other effluent from the town to River Jakara, (3) at Kurna and Tudun Bojuwa junction where the traditional tanneries and dying pits within the old city release their wastewater into the river and at Kwakwachi junction which disposes wastewater from the metropolis which is used for irrigation despite its high microbial concentrations.

Similarly, during dry season, 355, 286, 235 (cfu/100ml) were recorded at P4, P7 and P8 respectively. The study agrees with Adeola (2017); Sharma and Walia, (2016) and Mshelia (2024) who reported similar mean values of 265cfu/100ml - 347cfu/100ml; 241 – 410cfu/100ml and 258 – 338cfu/100mlin Ibadan, India and Kona respectively. The T-test statistical analysis showed that there was significant variations between the measured vales to NESREA (2011) standard and between wet and dry season at *(t(1)= -1.21, p < 0.05)* and (T(4)= -2.21, *p* < 0.05). The contamination of the River Jakara water is attributed to disposal of wastewater, open defecations which the wastes are transported downstream and discharged into the river during wet season. Other factors are blackwater from toilets; soak away and grey water are also directly released into the water bodies.

Escherichia Coliform (E. coli): The laboratory analysis showed mean concentration of E.coli ranged from 253 – 452cfu/100ml and 192 – 389cfu/100ml during wet and dry seasons respectively; attributable to enormous domestic wastes of all sorts (sewages, feacea urines, open defecation, wastewater from different institutions) in the Metropolis transported down slopes to the river. Highest values of 452cfu/100ml in wet period and 389cfu/100ml during dry season were both recorded at P8: junction under the Airport Road Bridge which receives domestic wastewater, small scale industrial effluent and other wastes from Noman's Land.

Table 5.6: Mean Concentration of Microbial Parameters along River Jakara during Wet and Dry Seasons

Parameters	P1	P2	P3	P4	P5	P6	P7	P8	NESREA (2011)
Wet Season									
Latitude	12.005N	12.011N	12.015N	12.028N	12.035N	12.048N	12.048N	12.055N	
Longitude	08.516E	08.522E	08.525E	08.530E	08.536E	08.541E	08.549E	08.553E	
TCC (cfu/100ml)	202	285	354	395	285	247	341	248	20
E-coli (cfu/100ml)	253	312	345	402	433	310	422	452	00
Dry Season									
TCC (cfu/100ml)	125	207	226	355	205	201	286	285	20
E-coli (cfu/100ml)	192	255	285	370	388	295	370	389	00

P1 – P8= Pont 1 to Point 8; TCC+ Total Coliform count; E.coli= Escherichia
Source: Field Survey, (2020).

The paired samples T-test between the mean E.coli value and the NESREA (2011) standard *(t(1)= -1.20, p < 0.05)* during wet period and (T(4)= -1.14, *p* < 0.05) in dry season showed that there were significant differences; where the E.coli measured above the NESREA Standard and also higher during the wet season. The presence of E.coli in the river can be ascribed to effluent from industries, home and institutions as observed by Yahaya *et al.* (2016) who reported that 89.5% of the sampled water had indicator bacteria presence above WHO and NSDWQ limits. One interesting finding from the study is the increase in concentrations of TC and E.Coli from P1 – P8 as the wastewater from different sources enters the River Jakara. However, few variance (see Table 4) were obtained but values continue to increase as the wastewater loads increase from one point to the other.

IV. Conclusion

Wastewater is any water that has been unfavourably affected in quality, mostly by anthropogenic influence. It comprises of liquid waste discharge by industries, residences, agricultural activities or commercial properties, and can include a wide range of potential contaminants and concentration. In the most common usage, it refers to the municipal wastewater that contains abroad spectrum of contaminants resulting from the mixing of unwanted and used water from different sources. Wastewater from industries and homes has also contributed to high concentrations of contaminants in surface water different locations of urban centres and industrial towns like Kano. River water quality and quantity is a major issue for this region, and wastewater loads are a major contributor of pollutants, which can have both short-term and long-term effects on aquatic life. In order to assess the effects, samples were collected from River Jakara, and analyzed for various physicochemical parameters. The study concluded that the river water was contaminated by wastewater discharges that the physicochemical and microbial parameters like temperature, pH, TDS. TH, BOD, DO, EC, NO, turbidity, TC and E.coli were measured to be above the NESREA's permissible limit for the discharge of wastewater The results suggested that discharge of wastewater into the river had adversely affected its water quality and could pose a great risk to aquatic life and public health. Therefore, effective management strategies are needed to reduce wastewater loads and improve the water quality of River Jakara.

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