

EVALUATION OF EFFECTS OF WASTEWATER ON SOCIOECONOMIC ACTIVITIES OF RESIDENTS IN KANO METROPOLIS, KANO STATE, NIGERIA

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ABSTRACT

The paper assessed the effects of wastewater on socioeconomic activities of residents in Kano metropolis, Kano State, Nigeria. High population, poor drainage channels and lack of central wastewater sewerage and functional treatment plants have necessitated indiscriminate discharge of wastewater into the environment. Using Krejcie and Morgan (1970) table for determining sample size, a total of 384 population size was sampled and purposefully, systematically and randomly administered questionnaires in Likert Scale Format. Interviews were also conducted with stakeholders and community elders and direct field observation for elucidation of the socioeconomic effects of wastewater. Results were presented in tables and charts and further expressed in strength of associations using Spearman rho statistics analysis. Findings show that 89.75% of respondents are of the view that wastewater from households and commercial areas is let loose into the environment and affects land-use as well as domestic activities. It also shows that 88.5% reported that wastewater affects the means of livelihood of residents and 92.19% opined that economic cost of construction of drainage channels, embankment and sandbags while 92.5% strongly and agreed that wastewater affects the health of the residents and causes different kinds of diseases. The study further shows that wastewater has effect on businesses and recreations while making some places inaccessible and affecting their economic activities. The study therefore recommends public enlightenment, strong legislations and enforcement of principle of polluter pays, attitudinal change and population decongestion, centralized sewerages system should be implemented among others should strictly be adhered to harness to encourage socioeconomic activities.

Keywords: *Pollution, wastewater, indiscriminate, disposal, socioeconomic*

INTRODUCTION

Water is one of the most important resources found in the universe for living things depend on it for survival in virtually all aspect for their activities. The byproduct of water used at homes, industries, institutions and commercial centres is termed as wastewater (WHO, 2010; United Nation World Water Development Report, 2019; Audrey, 2019; Mshelia, *et al.* 2020). What then is this wastewater? Amoatey and Bani (2016) are of the view that any water whose chemical, biological and physical properties have been changed as a result of the introduction of substances (contaminants) which makes it unsafe for drinking and some domestic purposes such as bathing, washing and irrigation is referred to as wastewater. Corcoran *et al.*, (2010) called it sick water. It also makes people ill and cause tremendous damage to

water quality. The volume of wastewater produced by cities and towns increase on daily basis and can be ascribed to growth in population, urban sprawl, industrialization and globalization which have resulted to production of huge amount of pollutants being discarded on daily basis into water system and other parts of the environment and affects the environmental quality (UN-Water, 2013; Rafeay, 2013).

It is pertinent to note that Kano metropolis being the largest city in northern Nigeria in terms of population, industrial and commercial activities (Ahmed, 2012) is today facing water pollution problems as a result of the numerous activities of the small, medium and large scale industries that manufacture chemical, pharmaceuticals, cosmetics and consumable goods. Industrial, commercial, domestic and agricultural activities produce enormous wastewater. It is in this regard that Egwuonwu, *et al.* (2015) and Butu and Mshelia (2014) opine that enormous land pollution, surface water and groundwater pollutions in the metropolis occur as a result of unfortunate disposal of industrial effluent by the industries at Bompai, Challawa and Sharada as well as wastewater which comprises of sewerages (black and grey water) from residential areas, markets, offices, abattoirs, commercial and social institutions.

Similarly, the major wastewater problem in the metropolis is the absence of centralized sewerage system to collate wastewater and also functional wastewater treatment plants in which used water is treated prior to being discharge into the environment. There is no central sanitary facility or centralized and standard decentralized wastewater collection systems especially in the old city as well as functional wastewater treatment plant in the metropolis. Other problems are increased populations, poor planning and land-use patterns where houses, commercial centres in the city centres and peri urban settlements emerge without adherence to planning pattern. Similarly, most places in the urban centres such as ancestral *Birni*, *Gwale*, *Daaci*, *Fagge B*, *Gwammaga*, and *Danmarke* among others are either with poor or without adequate plans, bad and dilapidate drainage channels. These have left residents with little or no option but to discharge untreated wastewater or sewerages from households, offices, hospitals, abattoirs, small scale industries into ponds, shallow holes at the back or front of their houses, along slopes that convey it to streams and rivers in the metropolis (Bichi and Bello, 2014; Akan, *et al.* 2009; Yahaya *et al.* 2016). Hence, the call for the study to examine the wastewater effects on water quality in Kano metropolis with a view to key into the 2015 SDGs 6 and 11 which are provision of safe water and clean settlements as well as sustainable cities and communities by the year 2030.

MATERIALS AND METHODS

This section deals with the materials and methods employed for the study as well as the study area.

Location

Kano Metropolis the capital of Kano State in Nigeria is located between latitudes 11° 55' 23.93"N and 12° 3' 53.10"N of the Equator and longitude 8° 27' 42.26"E and 8° 36' 41.62"E of the

Greenwich Meridian (Figure 1). It is one of the fastest growing cities in Nigeria and the most populated in the northern part of the country (Mohammad *et al.* 2017). It covers a land mass of 499km² and comprises of eight (8) local government areas; Dala, Fagge, Gwale, Kano Municipal Council, Kumbotso, Nasarawa, Tarauni and Ungogo local governments. It is arguably the second most industrialised city in Nigeria after Lagos having the many of the industries concentrated in three industrial estates namely: Bompai, Challawa and Sharada (Ahmed, 2012; Nagebu, 2010).

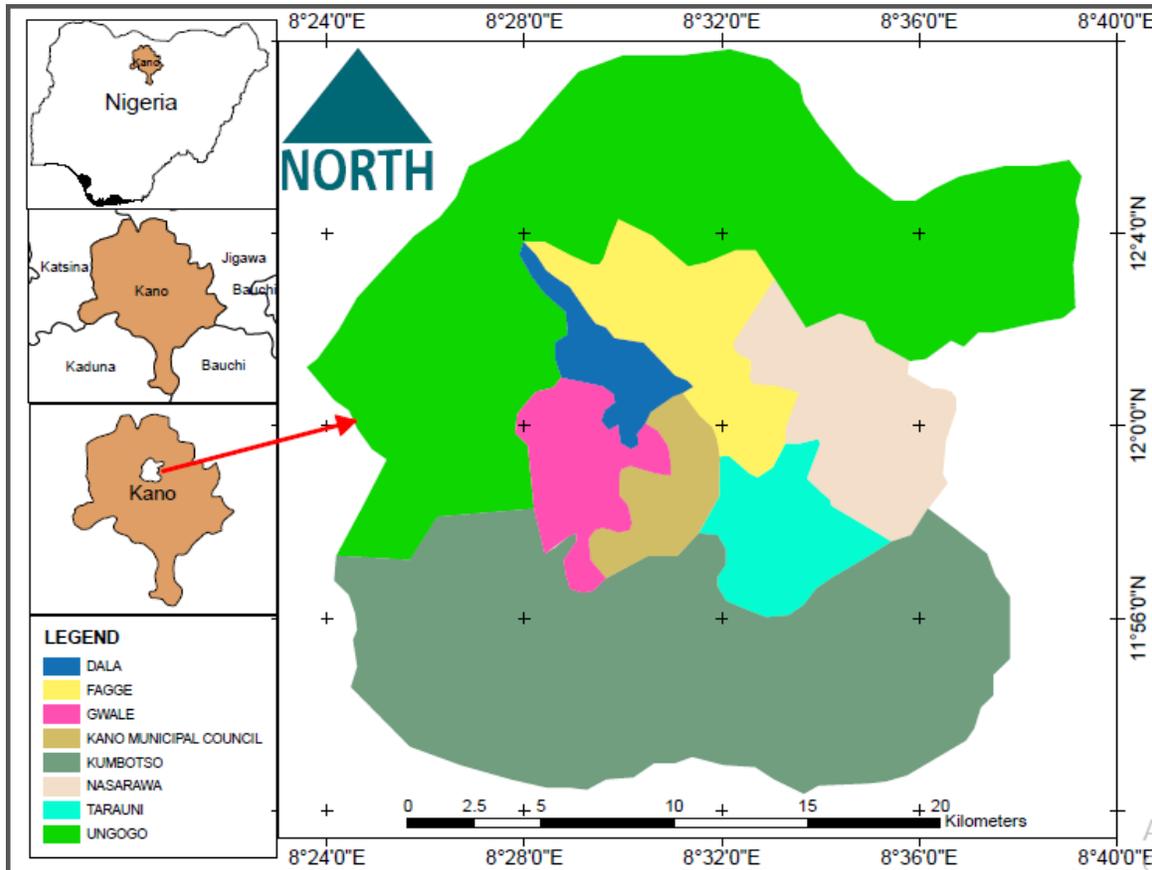


Figure 1: Kano Metropolis
 Source: Cartography and GIS Unit Kaduna Polytechnic (2019).

Weather and Climate

Kano metropolis is found with the tropics having divergent seasons that fluctuates between cool to hot dry and from humid to wet. It has an annual average temperature of 27°C but sometimes daily temperatures record reaches 38 - 42 °C especially in March - June (Nigerian Meteorological Agency, NiMET, 2021). The area is characterized by wet and dry seasons (May -September and October – April) respectively. Yearly precipitations ranged between 700mm and 1000mm averagely about 690 mm per annum. The wet period usually lasts for three to five months with August and September most often experience the highest rainfall (NiMET, 2019). It is no doubt, elements of weather and climates play significant role on wastewater as it influences the environment. For instance, during the rainy period, the heat and humidity being experienced usually makes the wastewater to be more turgid and increases the concentrations of pollutants as a result of increase in

seepages, infiltrations and high inflow of run offs. Similarly, in the dry season the wastewater becomes stagnant and produce foul odour, breeding place of mosquitoes and other form of bacteria (Imam, 2012; Mshelia *et al.* 2021).

Data for the study were obtained through primary observation of phenomena, photographs, administration of structured questionnaires and field interviews of the major stakeholders; Households, Private and Government agencies on the socioeconomic effects of wastewater in Kano metropolis. The study made use of purposive, systematic and random sampling techniques in the collection of samples and data from two wards in each of the eight LGAs that formed Kano metropolis. They are Gwale, Kwombotso, Kano Municipal, Tarauni, Nasarawa, Fagge, Ungogo and Dala. The sample size of 384 recommended by Krejcie and Morgan (1970) in the table for determining sample size from a given population equal to or greater than 100,000 was used

for administration of questionnaires. The population of each local government was divided by the total population in the metropolis by the sample size and determined the number of questionnaires administered each of the eight LGAs (Mshelia, *et al.* 2021). Secondary data were generated from desk reviews of useful books, literatures and journals. Data were analysed using descriptive and inferential statistical analyses and presented in forms of charts, simple arithmetic mean, frequency and Spearman's Rho Correlations.

RESULTS AND DISCUSSION

Wastewater Disposal in the Metropolis

The highest percentage of 65.5% and 24.25% strongly agreed and agreed which gives a total of 89.75% that wastewater flows freely from outlet of most homes and takes to any available space between households, streets, roads, ponds, shallow pits, behind buildings as shown on Plate 1 and 2. No response reported 4.5%, disagreed and strongly disagreed recorded 3.75% and 2% respectively as shown on Figure 2. This indicates that wastewater from houses and commercial areas is let loose that flows in the environment and pollute both surface and ground water, affects land-use as well as water for domestic activities. Wastewater from industries when discharged into rivers increase the concentrations of heavy metals level therein, affects, living organisms in the water such as fish by depleting the dissolved oxygen therein and results to poor yields. This makes farmers lose money, food shortages and hence affect the economic status.



Plate 1: Wastewater between Buildings Danmarke behind NNPC Depot
 Source: Field Survey, (2021).

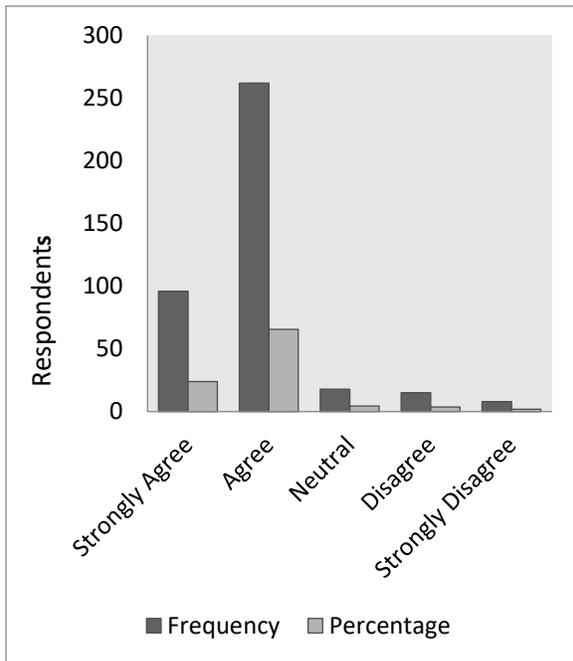


Figure 2: Wastewater Disposal in the Metropolis
 Source: Field Survey, (2021)



Plate 2: Wastewater from Tannery and Leather Works at Kofar Wambai Kano
 Source: Field Survey, (2021).

Wastewater Affects the means of Livelihood of Residents

Figure 3 shows that 25.5% strongly agreed that wastewater has significantly affected the business activities and 63% that is 88.5% hold similar view that wastewater affects the means of livelihood of residents. Neutral recorded 2.5% while disagree and disagree reported 9%. The study shows that wastewater from factories, medium and small-scale industries in the metropolis pollute water and affects fishing activities in River Jakara and Challawa.

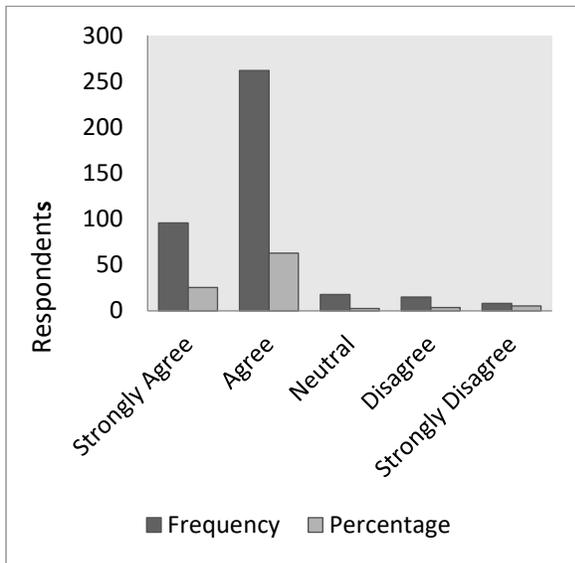


Figure 3: Wastewater effects on the means of Livelihood of Residents in Kano metropolis
 Source: Field Survey, (2021).

The concentrations of heavy metals, physicochemical and microbial parameters in the wastewater is usually above the permissible limits stipulated by National Environmental Standard and Regulation Enforcement Agency (NESREA) making living things survival vary rare. The absence of fish to catch and sale to get money is hampered by wastewater as also observed by Sheikh (2008). Plate 3 is a large body of water which houses Challawa industrial effluent but it is not economically buoyant for crop cultivation and fishing purposes. Similarly, social activities such as learning, ceremonies, festivals and games are often hampered where wastewater in ward, community or town overflows especially during wet season.



Plate 3: Challawa Industrial Effluent
 Source: Field Survey, (2021).

Economic Cost of Construction of Drainage Channels, Embankment and Sandbags

Of the 384 respondents, 25% strongly agreed and 67.19% agreed (a total of 92.19%) are of the view that residents spend money in constructions of drainage channels and embankment in their residential areas or communities' collectively as shown on Figure 4. Those that showed no response and disagreed recorded 1.04% respondents while the view strongly disagrees measured only 0.52%.

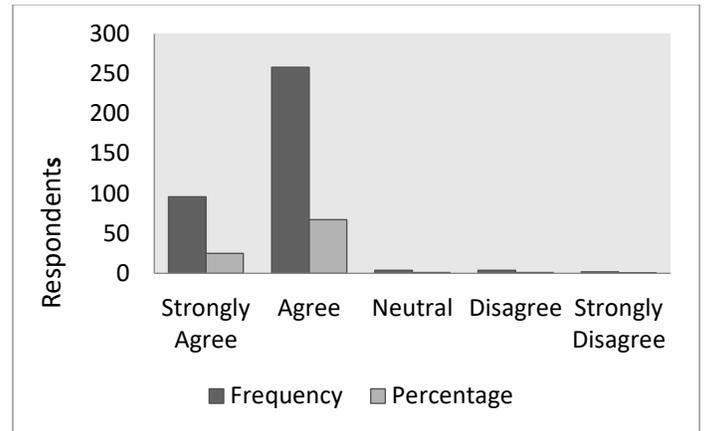


Figure 4: Economic Cost of Construction of Drainage Channels, Embankment and Sandbags
 Source: Field Survey, (2021).

The result shows that most of the residents, especially those that live in in unplanned and slum areas use to spend some amount of money in constructions of drainages and embankments to prevent floods or wastewater spillages in the metropolis. Bichi and Bello (2014) who studied water pollution in Kano Metropolis also reported that most communities and individuals provide drainages and embankment in their environment to prevent their houses and soakaways from being submerged in water during raining season as shown on Plate 4 and 5 as a result of insufficient wastewater management facilities.



Plate 4: Black, Murky, Grey or Viscously Turbid Wastewater Hawar Wanki in Gwale Kano
 Source: Field Survey, (2021).



Plate 5: Bad Soakaway Releasing Wastewater at Unguwan Dacci
 Source: Field Survey, (2021)

Wastewater Affects the Health of Residents

The study on Figure 5 shows that 32% strongly agreed and 60% agreed which gave 92% of the respondents are of the view that wastewater affects the health of residents. In addition, 5% did not show response while 1% and 2% disagreed and strongly disagreed with the view attributable to ignorance of the health effects of wastewater by these respondents.

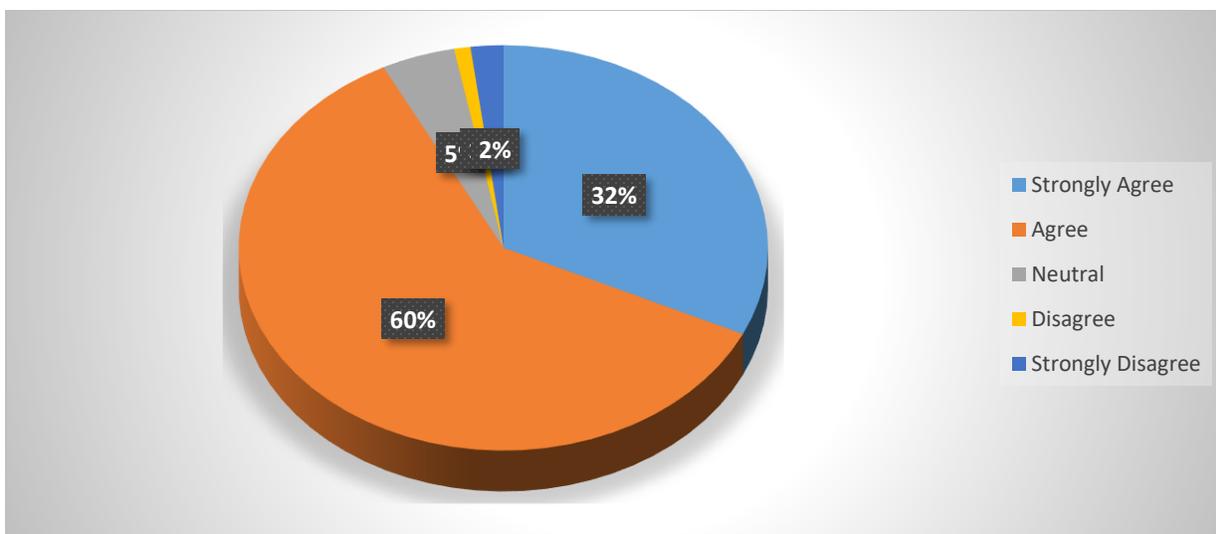


Figure 5: Wastewater Affects the Health of Residents
 Source: Field Survey, (2020).

Furthermore, investigations through the review of relevant literatures published by Akpan and Ajayi (2016); Mshelia *et al.* (2020 and 2021) and UN-Water, 2013 also asserted that exposure to wastewater or sewage-infested water having high concentrations of water quality parameters during swimming, bathing and use of stream water for cooking, drinking and

agricultural lead to environmental and health hazards such as heart problems, nausea, cholera, typhoid, dysentery, polio, gastrointestinal disorder and infectious hepatitis. Summary of the potential health and environmental effects which in variably affects socioeconomic activities.

Table 1: Summary of the Potential Health and Environmental Effects of high Concentration of Physicochemical, Heavy Metals and Microbiological in Water

Parameter	Units	Potential Health/Environmental Effects
Temperature	°C	None
pH		Acidic: Aesthetic problems
Electrical Conductivity (EC)	µS/cm	Hinders nutrients uptake
Turbidity	NTU	Accelerate microbial pollution
Total Hardness (TH)	mg/L	Affects soap to produce foam or lather and film like of residue on the body
Total Dissolved Solids (TDS)	mg/L	Excess leads to scaling in boiling ring, water heaters and pipes
Total Suspended Solids (TSS)	mg/L	Filthy, cloudy
Dissolved Oxygen (DO)	mg/L	Affects water taste, death of organisms

Biological Oxygen Demand (BOD)	mg/L	Insufficient oxygen for aerobic activities
Nitrate (NO ₃)	mg/L	Cyanosis, and asphyxia (blue - baby Syndrome) in infants under 3 months
Phosphate (PO ₄ ³⁻)	mg/L	Eutrophication
Chloride (Cl ⁻)	mg/L	Increase in heart beat which consequently leads to hypertension, stroke risk, asthma and renal stones
Lead (Pb)	mg/L	Nervous system disorder, cancer, Infants mental development problem
Copper (Cu)	mg/L	Gastrointestinal disorder
Cadmium (Cd)	mg/L	Toxic to kidney
Nickel (Ni)	mg/L	Possible Carcinogenic
Zinc (Zn)	mg/L	Retard growth, decrease body resistance to diseases in children
Iron (Fe)	mg/L	Liver and heart problems, diabetes, fatigue
Mercury (Hg)	mg/L	Affects the kidney and central nervous system
Chromium (Cr)	mg/L	Liver, kidney, circulatory disorders
Arsenic (As)	mg/L	Cancer
Manganese (Mn)	mg/L	Neurological disorder
Total Coliforms Count (TCC)	cfu/100ml	Indication of faecal contamination
Escherichia Coli (E.coli)	cfu/100ml	Urinary tract infections, bacteraemia, meningitis, diarrhea, (one of the main cause of morbidity and mortality)

Source: Akpan and Ajayi (2016); Corcoran, *et al.* (2010); Mshelia, *et al.* (2020 and 2021) and UN-Water, (2013); Authors Compilation (2020)

Spearman's Rho Correlation of Effects of Wastewater on Socioeconomic Activities on Residents in Kano Metropolis

To further elucidate the perceptions of the residents on the various views of the socioeconomic effects of wastewater on the residents in Kano metropolis. Using the Spearman's Rho Correlation, the variables were correlated to investigate the level of significance and relationships between one variable numbered A - D representing each of variables statistically analysed as follows:

- A. Wastewater disposal problem in the metropolis
- B. Wastewater affects the means of livelihood of residents
- C. Economic cost of construction of drainages and embankment
- D. Wastewater affects the health of residents

Spearman's Rho Correlations on Socioeconomic Effects of Wastewater in Kano metropolis

		A	B	C	D
A	Correlation Coefficient	1.000	0.661**	0.881**	0.921**
	Sig.(2-tailed)		0.000	0.000	0.000
	N	384	384	384	384
B	Correlation Coefficient	0.661**	1.000	0.893**	0.749**
	Sig. (2-tailed)	0.000		0.000	0.000
	N	384	384	384	384
C	Correlation Coefficient	0.881**	0.958**	1.000	0.719**
	Sig. (2-tailed)	0.000	0.000		0.000
	N	384	384	384	384
D	Correlation Coefficient	0.921**	0.706**	0.815**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	384	384	384	384

Field Survey, (2020).

The Spearman's rho correlation coefficient statistical analysis shows that there were high significant positive association between A that wastewater disposal has effects on the socioeconomic

activities of the residents and B that wastewater has effects the means of livelihood of residents ($r_s(384) = 0.66, p < 0.01$ shows strong positive significant relationship; A and C that wastewater results to economic cost of construction of drainages and

embankment among others, $(rs(400) = 0.88, p < 0.01$ shows very strong positive significant relationship; A and D that wastewater causes various diseases and affects the health of residents, $(rs(400) = 0.92, p < 0.01$ shows there was a very strong positive associations between the variables and further gives insight into various wastewater being generated and disposed in the environment. The findings show that there were strong association between variables (A – B) which shows that they wastewater significantly has effects on socioeconomic activities in Kano metropolis.

CONCLUSION AND RECOMMENDATION

The inability of most of the underdeveloped countries such as Nigeria to manage wastewater properly has created rooms whereby generated wastewater is freely discharged into rivers, ponds, on road and any available space. These practices are not environmentally friendly due to the facts that they greatly contribute to pollutions. Most towns and cities in developing nations such as Kano are witnessing unprecedented population growth, industrialization, globalization and urbanization which have resulted to poor centralized and even the decentralized wastewater or sewage collection systems and wastewater treatment plants. In addition, anthropogenic activities of man such as disposal of industrial effluents, dumping of wastes in the environment especially in the drainage channels, streams, rivers, on the soil, market places and dumpsites located near water source as well as the use of agricultural chemicals, land-use and cover changes especially in Kano metropolis greatly devalue water quality and affects socioeconomic activities of the residents. The study shows that wastewater has greatly affects businesses, over flow during wet season and make residents to relocates, build water channels and embankment. It also produces bad odour and cause different kinds of diseases such as gastro-intestinal disorder, heart problems, nausea, cholera, typhoid, dysentery and polio among others. The study therefore recommends that:

- a. The residents especially the less privileged and those living in unplanned residential areas should be educated in local dialects where necessary on socioeconomic effects of wastewater.
- b. Large cities such as Kano metropolis should have central sewage systems, wastewater treatments plants and good drainage channels.
- c. Residents should be encouraged to build standard soakaways or septic tanks to house wastewater in their homes and communities.
- d. There shall be strong legislation to punish especially industries that dispose poorly treated effluent and influents in the environment or in water bodies.
- e. Government as a matter of duty should key into the sustainable development goals for environmental sustainability.
- f. Provision of adequate fund, proper monitoring of the fund and supervision of wastewater management in Kano metropolis.

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