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Effects of Anthropogenic Activities and Particulate Matters on the Water Qualities of Lakes Gerio and Njuwa, Yola Adamawa State

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ABSTRACT
This paper evaluated the effects of anthropogenic activities and particulate matter on water qualities of lakes Gerio (LG) and Njuwa (LN). The paper conducted pH and coliform tests in order to assess water quality and identify major activities causing deterioration of lakes. Random system of data sampling was used during the collection of primary data which involved collection of water samples from both lakes at random. These water samples were tested in the microbiology laboratory. Both water turned out to contain coliforms and Lake Gerio had a pH of 6.5 while Lake Njuwa had pH of 6.0 which were both within the acidic pH range. The paper observed that the activities taking place around the lakes include; farming with the use of farm inputs like fertilizers, herbicides etc. Also, activities like fishing, washing, bathing, as well as deposition of human and animals' urine and faeces were common. All these activities affect the water quality of both lakes. Sedimentation and erosion of river also introduce particular matter to the lakes. Based on these findings, the paper proffered some recommendations to reduce the further contamination of the lakes.
Key words: *Anthropogenic activities, particulate matters, lakes, Yola*

INTRODUCTION
Water is a finite resource that is very essential for the human existence, agriculture and industry etc. Without doubt, inadequate quality and quantity of water have serious impacts on sustainable development. In developing countries where there are huge debt burdens, population explosion and moderate and rapid urbanization, people have little or no option than to accept water sources of doubtful quality, due to lack of better alternative sources or due to economic and technological constraints to treat the available water adequately before use. The scarcity of clean water and pollution of fresh water have therefore led to a situation in which one-fifth of the urban dwellers in developing countries and three-quarters of their rural dwelling population do not have access to reasonably safe water supplies (Lloyd and Helmer, 1992). Over the years, several factors have contributed to the over-exploitation and hence the degradation of water. These factors include human activities which have proven to be the most common, industrial pollution, chemical fertilizers from runoffs and polluted water from household. Advancement in scientific development and fast industrialization have taken their charge. Constructions of dam, use of water for agricultural and industrial purposes and climate change have caused expensive depletion of natural water bodies. Assessment of water is not only for sustainability human consumption but also in relation to agricultural, industrial, recreational, commercial uses and its ability to sustain aquatic life. Water quality monitoring is therefore a fundamental tool in the management of freshwater resources. To underpin its importance, World Health Organization (WHO), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO) and World Meteorological Organization (WMO) launched in 1977, a water monitoring programme to collect detailed information on the quality of global ground and surface water.

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Problem Definition

According to National Bureau of statistics (2009), at least 27% of Nigerians depended absolutely on streams, pond, river and rain falls as their source of drinking water. Research has shown high prevalence of water borne diseases such as cholera, diarrhoea, dysentery, hepatitis etc. among Nigerians (Oguntoke *et al.,* 2009). Which are mostly gotten from these sources of water. In Nigeria, as in most developing countries, water quality is generally deteriorating, especially around urban areas. Population growth, and industrial expansion are generally not managed by appropriate standards; and enforcement of infrastructures such as water treatment plants is not done (Meybeck *et al.,* 1989). Quality of river is modified mainly through human activities; such include discharge of domestic waste from households into the river, deposition of agricultural waste such as organic matter, carbon, nitrogen, phosphorus, compounds, dumping of industrial waste such as trace elements and complex organic matter; urbanization has also contributed to the deterioration of water around the world and making it unfit for domestic purpose (Kadewa et al; 2005, Gupra *et al.,* 2009; Chatterje et al,2005; Ullah *et al.,* 2013). Increase in atmospheric temperature and altered weather patterns have contributed a lot to water scarcity over the years. Precisely, water is evaporated primarily due to global warming which is caused by formation of greenhouse gases. Other activities that result to depression of river include; irrigation, industrial use and abstaining from alternative sources. Turbidity values reported for most rivers in Nigeria were for greater than the limit given by World Health Organisation. Ajibade, L. (2004) has also reported elevated turbidity values in rivers in Nigeria. This could be linked to run-off effects as well as domestic and industrial discharges on the rivers. At Lakes Njuwa and Gerio, major anthropogenic activities taking place include farming which makes farm inputs such as fertilizers, herbicides etc. to contaminate the water by the means of run off. Other activities include washing by residents of the areas, interference by animals etc. all these have affected the water quality of those Lakes.

Aim and Objectives

The aim of this paper is to assess the effect of anthropogenic activities and particulate matters on the water quality of Lakes Gerio and Njuwa. This aim was achieved through the following objectives:

Finding out Anthropogenic Impact on the Lakes Gerio and Njuwa

Conducting PH and Coliform Test in Order to Assess Water Quality

Identifying major activities causing deterioration to the water quality of Lakes Gerio and Njuwa, Yola. Assessing the physical properties of the water which include; colour, smell and transparency. Proffering possible solutions and recommendations that will improve water quality and make it fit for drinking.

Study Area

Adamawa is a state located in north-eastern Nigeria with a land mass of 36,917km2 and it is inhabited with 3,737,223 people. The state was established in 1991 and it is well known for its variety of tribes. Yola and Jimeta is a dual city that make up the capital of Adamawa state and is located between Longitudes 12° 26' E and Latitude 9° 16' N along the banks of

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River Benue, it also has an estimated population of 600,000 people. The state covers the Sahel region of the country and normally experiences two main seasons which are the dry and wet. This region also experiences low rainfall and humidity, but temperature is usually extremely high resulting to high evaporation rate. Jimeta is a town in Adamawa state which lies on the south bank of the Benue River, and on the highway between Taraba and Girei. Jimeta was united with Yola in 1935 by the Fulani administration. The town became a major point of transporting goods through river Benue in Yola. During rainy season when the water level is high, boats transport goods like groundnut oil, mats and slippers to places like Cameroon and Chad.

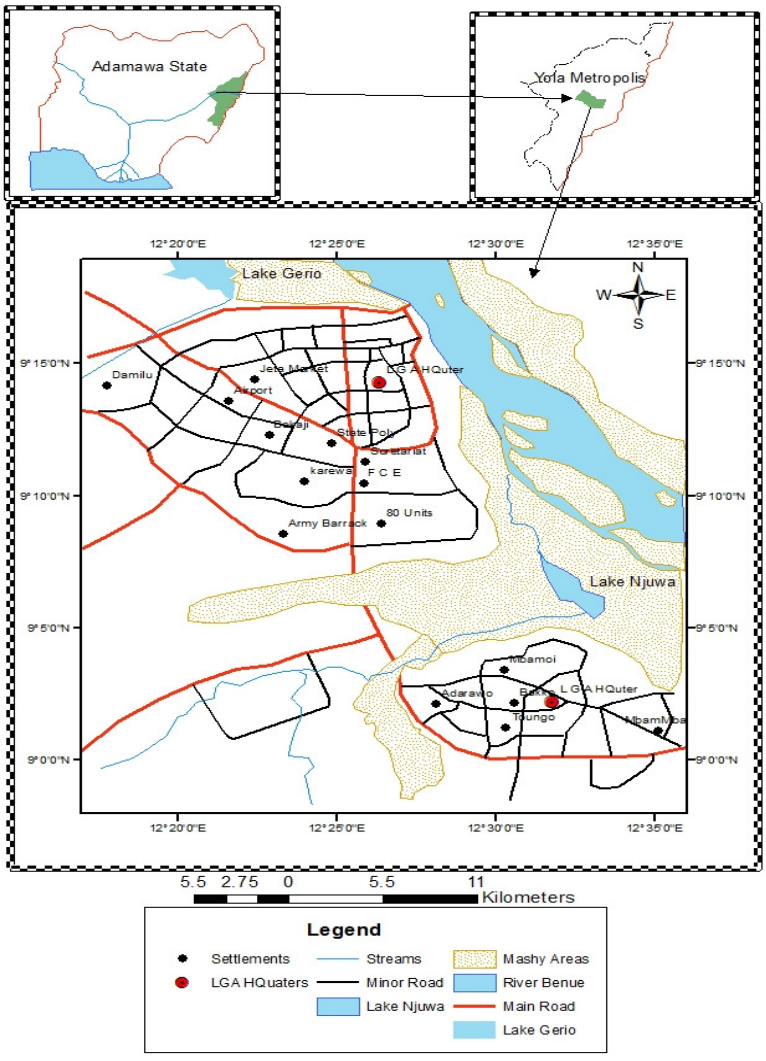

Figure 1.1: The Study Area

Fig: 1.1 Study area

Literature Review

The natural environment encompasses all living and non-living things occurring naturally, meaning in this case not artificial. The term is often applied to the earth or some part of the earth. This environment encompasses interaction of all living species, climate, weather, and natural resources that affect human survival and economic activity. The concept of natural environment can be distinguished by components. One of the components is the complete ecological units that function as natural systems without massive civilized human intervention, including all vegetation, microorganisms, soil, rocks, atmosphere, and natural phenomena that occur within their boundaries and their nature. The second component is the universal natural resources and physical phenomena that lack clear-cut boundaries, such as air, water, and climate, as well as energy, radiation, electric charge, and magnetism, not originating from civilized human activity. Environmental degradation is referred to as the deterioration of the environment in terms of the quality of water, air, wildlife, soil, ecosystem, natural and other constituents of the environment. (Satandar, 2008). In contrast to the natural environment is the built environment. In each area where man has fundamentally transformed landscapes such as urban settings and agricultural land conversion, the natural environment is greatly modified into a simplified human environment. Even acts which seem less extreme, such as building a mud hut or a photovoltaic system in the desert, modify the natural environment into an artificial one. Though many animals build things to provide a better environment for themselves, they are not human, hence beaver dams and the works of mound-building termites are thought of as natural. People seldom find absolutely natural environments on earth, and naturalness usually varies in a continuum, from 100% natural in one extreme to 0% natural in the other. More precisely, we can consider the different aspects or components of an environment and see that their degree of naturalness is not uniform. If, for instance, in an agricultural field, the mineralogical composition and the structure of its soil are similar to those of an undisturbed forest soil, but the structure is quite different. Natural environment is often used as a synonym for habitat.

Earth science generally recognizes four spheres, the lithosphere, the hydrosphere, the atmosphere and the biosphere as correspondent to rocks, water, air, and life respectively. Some scientists include, as part of the spheres of the earth, the cryosphere (corresponding to ice) as a distinct portion of the hydrosphere, as well as the pedosphere (corresponding to soil) as an active and intermixed sphere. Earth science (also known as geosciences, the geosciences or the earth sciences), is an all-embracing term for the sciences related to the planet earth. The environment can be said to be holistic in nature and therefore it covers different areas of study including: physics, geology, geography, history, economics, physiology, biotechnology, remote sensing, geophysics, soil science and hydrology (Brockington, 2005).

MATERIALS AND METHODS

The types of data used for this paper are primary and secondary data. These involved collection of raw data for analysis. Sources of data include: two different sites in Jimeta. These sites include; Lake Gerio (LG) and Lake Njuwa (LN). The secondary data included

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documentations from academic journals, textbooks and maps etc. Purposive sampling was used to select the respondents based on their knowledge about the activities taking place in both of the lakes. Direct personal observation was employed to monitor the various anthropogenic activities going on at the LG and LN. A checklist was used to record the anthropogenic activities and how they affect the river. Three laboratory tests were conducted, which include coliform test, PH test and litmus paper test. Physical properties that were observed include colour of water samples, particles present in water samples, odour of water samples and water clarity assessment. All of these were done by mere physical observation.

RESULTS

This paper used two lakes (LG and LN) as case studies, assessing the effects of anthropogenic activities and particulate matter on them. So, several laboratory processes were performed in order to evaluate the quality of the water. Interviews and investigative observation were also carried out to check the activities going on in and around the lakes.
Anthropogenic activities that occur around both lakes have great impact on their water quality. These activities determine the level of water pollution, depletion and other forms of degradation. It was found out that LN has the greater intensity of anthropogenic activity around it. Such activities have included agricultural activities like fishing, farming, and grazing; transportation; exploration; urine and faeces deposition; swimming; washing of wares, vehicles, and general laundry; and sedimentation. Through such activities, chemicals like nitrates, potassium, and phosphorus contaminate the water through run-off. More so, the dumping of refuse along the lake contributes to the concentration of heavy metals and coliforms in the water. In LG, as shown in the table, anthropogenic activities such as bathing, laundry and washing of wares and vehicles, farming, faeces and urine deposition, etc. also contribute to the unusual amount of heavy metals and other chemicals, as well as coliforms found in the water. Bacteria such as *Escherichia coli,* which is considered as the most common cause of urinary tract infection, was discovered in the water. Also, *salmonella* which causes food poisoning was also found present in the water. There was also an occurrence of heavy metals in their abnormal quantities in the water of LG. The value of metals recorded in this work is below the maximum permissible limit set out by the World Health Organization.

Table 4.1. The results of the Hydrion Paper PH Test.

Water Sample	pH Value (Hydrion Paper)
LG	6.5
LN	6.0

Source: laboratory test at the department of microbiology MAUTECH Yola (2018)

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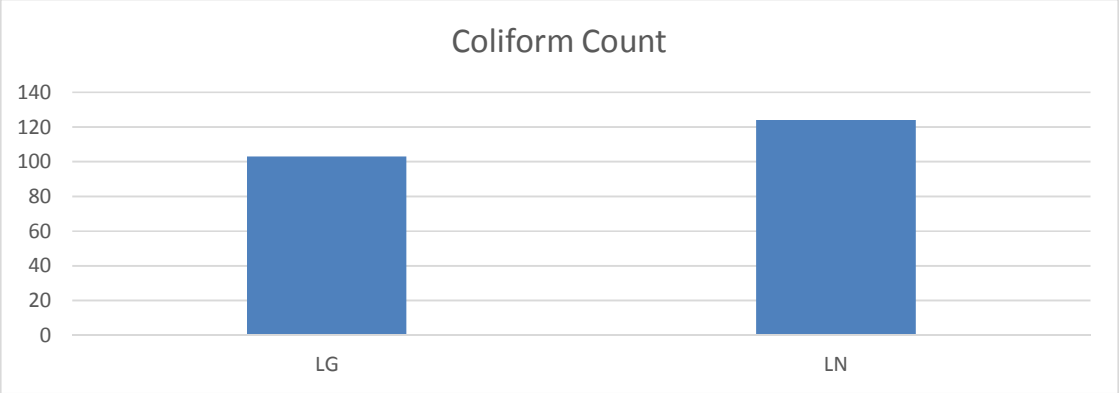

Fig. 4.1: Bar graph showing coliform count in water sample (x-axis) against pH value (y-axis)
Source: laboratory test at the department of microbiology MAUTECH Yola (2018)

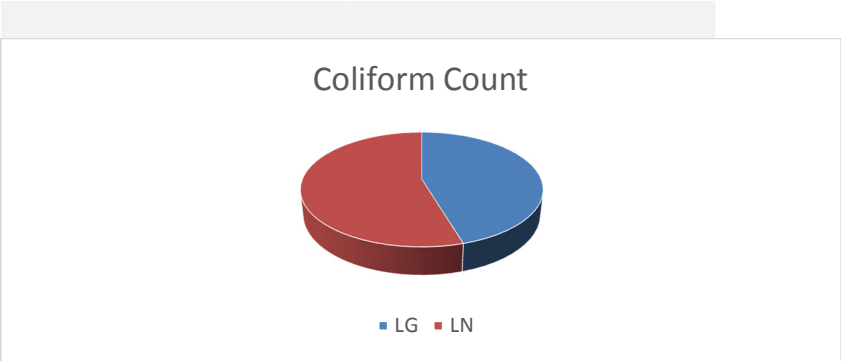

Fig. 4.2: Pie chart showing Coliform count of the water samples from the lakes

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Plate A: Incubator containing water samples

Plate B: Incubator closed at temperature of 37°C to allow formation of coliforms

Plate C: Media 1 showing coliforms in water samples

Plate D: Media 2 showing coliforms in water samples

Fig. 4.3: The plates above show the laboratory work carried out on water sample
Source: Microbiology laboratory, 2018

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Table 4.2 Observed Activities at Lakes

	LG	LN
Availability of Water at Lake Site	Always available throughout the year. But water levels vary, depending on climatic condition and the seasons.	Always available throughout the year. But water levels vary, depending on climatic condition and the seasons.
Description of activities at Lake Site	Agricultural activities like fishing, farming, and grazing; transportation; exploration; urine and faeces deposition; and sedimentation.	Agricultural activities like fishing, farming, and grazing; transportation; exploration; urine and faeces deposition; washing of wares, vehicles, and general laundry; and sedimentation.
Pollutants at Lake Site	Runoff water from farms containing chemicals from fertilizers, herbicides, pesticides, etc.; petrol and motor oil from boats; urine, and faeces.	Runoff water from farms containing chemicals from fertilizers, herbicides, pesticides, etc.; petrol and motor oil from boats; urine and faeces; waste paper, plastic, and nylon; dirty water from washing.
Effect of activity on the Lake	Pollution of water from farms, reduction in water levels by sedimentation.	Pollution of water from farms, reduction in water levels by sedimentation.

Source: field work, 2018

Fig. 4.4: Activities around at LN

Fig. 4.5: Farming activities at LG

Table 4.3. Physicochemical properties of the water in LG and LN, Yola

Parameters	Sample Sites	
	LG	LN
Temperature (°C)	26.6	17.9
Transparency (cm)	30.6	30.5
Conductivity (μ/cm)	23.65	10.7
Free CO_2	500.6	942

Table 4.4. Concentration of heavy metals at LG and LN, Yola

Heavy Metal	Concentration in 2 Sampling Stations	
	LG	LN
Fe	0.065	0.054
Zn	0.067	0.063
Mn	0.023	0.022
Cu	0.005	0.002
Cd	0.004	0.005
Cr	0.027	0.024
Pb	0.0007	0.006

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CONCLUSION AND RECOMMENDATIONS

The waters in both of the lakes cannot be concluded to be generally poor. It can neither be said to be excellent since both lakes extend to Cameroun and Chad which are countries outside the jurisdiction of the geographical limits of this study. Hence, the testing of water from just LG and LN cannot be used to make conclusions on the general water quality. Nevertheless, the paper studied the two stations successfully, and it was revealed that neither the water of LG nor LN is safe for drinking. It was noticed that the water of LN has the poorest quality compared to that of LG which in turn had less coliforms. From simple agar technique test carried out to check for presence of coliforms, it was discovered that coliforms were present in the water from both LG and LN respectively. There was presence of *Escherichia coli* observed in the samples from both lakes which shows faecal contamination of the water. Coliform count was highest in the water sample of LN and this could be said to be as a result of too many settlements around the lake LN, and the corresponding prevalence of human activities around it. The presence of Iron (Fe) in the water from both lakes could be as a result of weathering activities, since earth's surface contains iron. Again, the dumping of refuse (which generally contain iron) can also be a factor to the presence of iron in the water. The presence of Zinc (Zn) observed in the water from both lakes could also be as a result of the weathering and siltation in the lake. Although the World Health Organization recommends a zinc quantity of 3 millilitres per litre of drinking water, the mean value of zinc for the two lakes was 0.065 which makes the zinc concentration in the water lower than required. The particulate matter which were observed in the lake of which iron (fe) was observed to be 0.065 and 0.54mg/l in LG and LN respectively, it was observed to be low compared to be 3.0mg/l given by World Health Organisation. The particulate matter in both LG and Lake LN were present in permissible quantities in areas where the samples were taken, it cannot be concluded to be so for every part of the lakes. This could explain the reason why the respondents claimed to have been consuming the water without any negative effect and, the presence of particulate matter in high quantities in drinking water could be harmful to the body.

CONCLUSION

In conclusion, activities around the lakes which include farming, which involves the use of chemical, fertilizers and other farm chemicals sedimentation occurring in the lakes, urine, faeces, motor oil from boats all affect the quality of water in both lakes by introducing faecal contaminations and increasing the chemical concentrations of some metals in the water. Also, the water in LN has a pH value of 6.0 is considered weakly acidic of LG having a PH of 6.5 can be permissible as it is close to the range of neutrality.

RECOMMENDATIONS

Hence, the paper has suggested the following recommendations based on the findings of this study, which would be useful to the users of the lakes and relevant stakeholders and authorities that manage the lakes. Government should device a means to sensitize the users of LG and LN about the effect of their activities on the water. Other sources of drinking water should be provided to the immediate community such as boreholes either by wealthy individuals, government or non-governmental organisations. Alternative farm inputs

should be used instead of chemical fertilizers. The government should set up authorities that will check the indiscriminate use of those lakes so as to reduce further contamination of the water in the lakes.

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