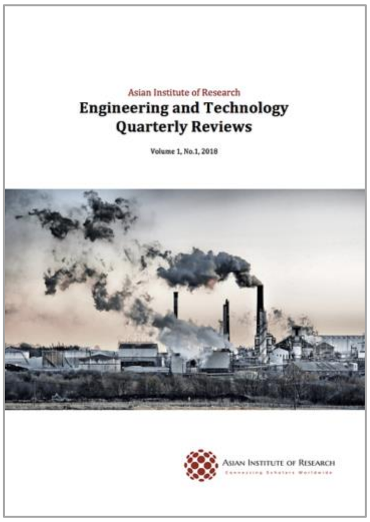

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Analysis of Ground Water Quality for Wudil Town Kano State, Nigeria

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Abstract
The need for potable water is necessary for the well-being of any community. The study was conducted to evaluate the groundwater quality of Wudil town Kano state (Nigeria). Groundwater samples were collected from 4 boreholes (wells) from high and low densely populated areas and analyzed for 10 water quality parameters, based on the analysis conducted it was observed that almost 70% of the parameters analyzed exceeded the prescribed limit for both WHO and NSDWQ standards for the case of the samples collected from densely populated areas, while the results of the samples for the low densely populated areas were found to be in conformity with the two standards. 25% were found to be within the two standards standard for the samples from both areas, while the remaining 5% were below the standards for the two areas respectively.

Key Words: Contamination, Groundwater Quality, Physicochemical Characteristics

I. INTRODUCTION

Ground Water originates from precipitation which infiltrates and goes down to water-bearing beneath the earth crust. It is well known that human health and survival depends upon the use of uncontaminated and clean water for drinking and other purposes. Most human activities involve the use of water in one way or other such as food, production, nutrition is dependent on water availability in adequate quantities and good quality (Howari F.M., 2005). It is estimated that approximately one-third of the world's population uses groundwater for drinking purposes and today more than half the world's population depends on groundwater for survival (Mohrir A., 2002). Data has shown that groundwater was less susceptible to bacterial regrowth (Niquette et al. 2001). The water supply for human consumption is often directly sourced from groundwater without biochemical treatment, and the level of pollution has become a cause for major concern (Sinha, 2004).

Groundwater resource is under threat from pollution either from human lifestyle manifested by the low level of hygiene practiced in the developing nations (Ikem, A. et al., 2002). With increasing industrialization, urbanization and growth of population, India's environment has become fragile and has been causing concern (Mohapatra and Singh, 1999). Pollution of water is due to increased human population, industrialization, use of fertilizers in agriculture and man-made activity (Rao et al., 2012).

Water pollution may result in transmission of infectious. The implications of waterborne bacteria and virus infection include polio, hepatitis, cholera, diarrhea, typhoid, etc. (Khan, T.A, 1997). Thus, contamination of drinking water from any source is of primary concern due to the danger and risk of water diseases. The World Health Organization (WHO*)* reported that 40% of deaths in developing nations occur due to infections from water-related diseases and an estimated 500 million cases of diarrhea, occurs every year in children below 5 years in parts of Asia, Africa, and Latin America (WHO, 2011).

In Northwest zone, Nigeria, the pollution of groundwater was traced to shallow water table that intercepts pit latrines and soaks away pits (Niquette et al. 2001) the water used for drinking purpose should be free from toxic elements, living and non-living organisms and an excessive amount of minerals that may be harmful to health. Pollution caused by fertilizers and pesticides used in Agriculture often dispersed over large areas is a great threat to fresh groundwater ecosystems. The probability that any particular chemical may occur in significant concentrations in any particular setting must be assessed on a case-by-case basis. The presence of certain chemicals may already be known within a particular country, but others may be more difficult to assess. The rate of human activities and the associated problems necessitate the need for regular assessment of the water bodies. (Niquette et al. 2001)

In Wudil groundwater is one of the main sources of water used intensively for domestic and agricultural purposes; human activities in developing countries including Nigeria contribute immensely to the poor quality of groundwater. The problems of water quality are much more acute in areas which are densely populated, with localization of industries. Importantly, groundwater can also be contaminated by naturally occurring sources. A number of chemical contaminants have been shown to cause adverse health effects in humans as a consequence of prolonged exposure through drinking water from various sources much of ill health which affects humanity, especially in the developing countries can be traced to lack of safe and wholesome water supply Kumar A (2004)

Water for human consumption must be free from living and non-living organisms, toxic elements and chemical substances in concentration large enough to affect health. Water system council (2007). The addition of various kinds of pollutants through sewage, industrial effluents, agricultural runoff, etc., into the water mainstream, brings about series of changes in the physicochemical characteristics of the water, which have been the subject of several investigations Water system council (2007).

In this study, different samples were collected from high and low densely populated areas to analyze the groundwater quality from the study area in wudil town from Kano state (Nigeria) through testing water quality parameters by comparing the results obtained with standards set internationally by world health organization and Nigerian standard drinking water quality in order to detect potential quality deviation.

II. STUDY AREA

Area of Study Wudil town is located on la titude 11.570317N, 11.869425N and longitude 8.779696E, 8.936728E of the Greenwich meridian as shown in figures 1 and 2. The 2006 population census put the population of the area at 185,189 with an estimated landmass of 458 km^2 The geology of Wudil falls within the Northern Nigerian basement complex rocks, consisting of non intrusive rocks formed during the Precambrian period (Olofin, 1987; Olofin and Tanko, 2002), as well as igneous and sedimentary structures. The major landforms that can be identified within the area are the river channels, a low terrace, the high terrace and the uplands plains (Olofin (1987). The three soil types found within the region are Lithosols, Hydromorphic and Regosols (Baba1979). The natural vegetation of the area is woodland, characterized by moderately tall grasses and scattered trees that are deciduous in nature. The present climate of the region is basically wet and dry season classified by Koppens as the Aw. The mean annual rainfall is about 850mm. But great temporal variations exist in the amount of rainfall (Olofin, 1987). The area lies within the seasonally fluctuating inter-tropical discontinuity (ITD) zone. The maximum rainfall is recorded in August with a sharp decline in September and an abrupt end in October; in some cases the onset of rainfall is irregular. The mean annual temperature in the area is about 26°C, but mean monthly temperature value ranges between 21℃in the coolest months of December/ January and 31℃ in the hottest months of April/May.

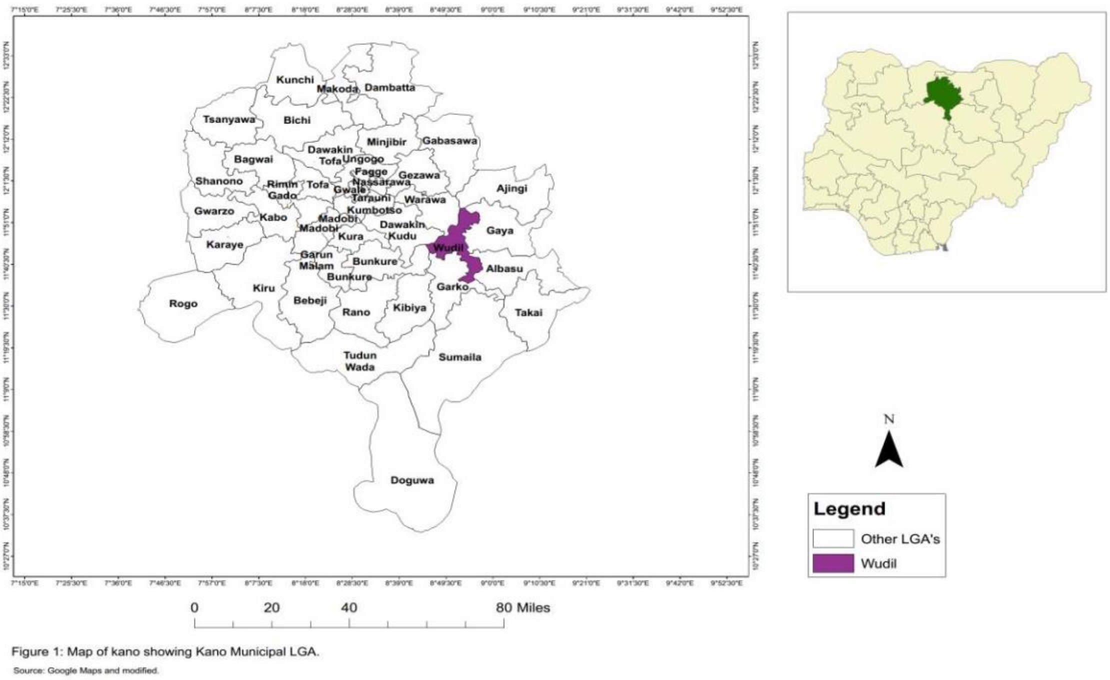

Fig. 1: Map of Kano State in Nigeria showing Wudil Town

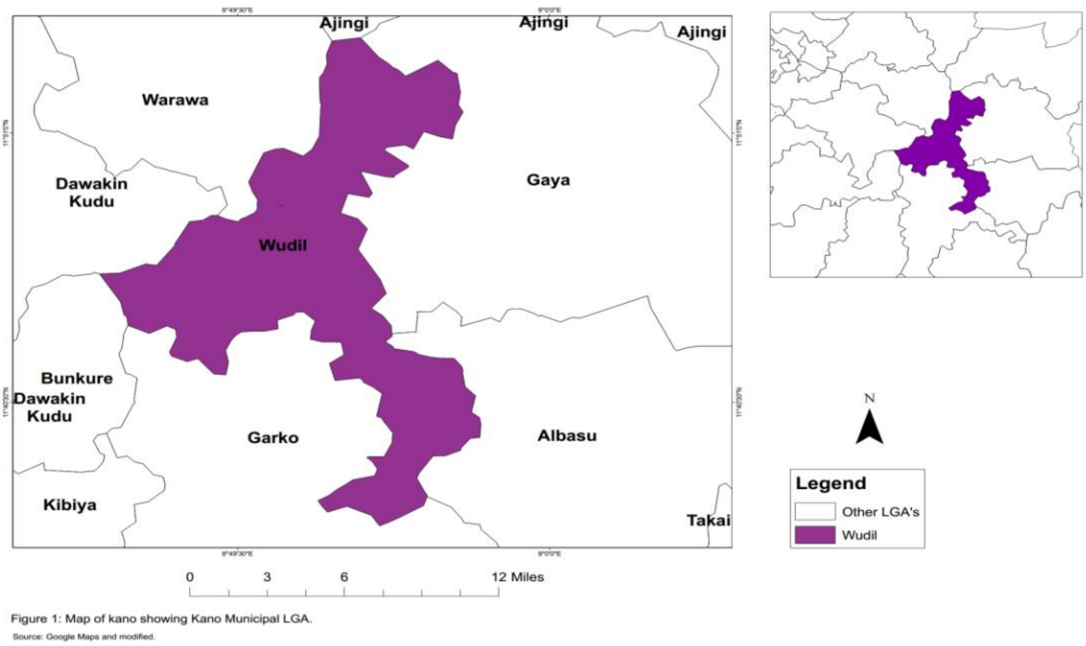

Fig. 2: Map of the Study Area (Wudil Town)

III. MATERIALS AND METHOD

Water samples were collected from boreholes (well) located in a high densely populated area like Unguwar Dafawa and Layin Yan Washi and low densely populated area like Layin Sabon Garin Bochieyle Layin Rijiya and Layin Masallaci in Wudil town, Kano State Nigeria. These samples were collected as per the standard methods prescribed for sampling. Plastic bottles of 1.5 liter capacity with stopper were used for collecting samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. Samples were analyzed to determine the concentrations of pH, Turbidity, Temperature, Total Dissolved Solids (TDS), Magnesium, Acidity, Electrical conductivity, Total Hardness, color, Alkalinity and Calcium in the laboratory of the Department of Civil Engineering Kano state university of Technology (KUST). The water samples were collected from the following areas shown in table 1.

Table 1: Samples Location

SAMPLE LOCATION	SAMPLE CODE
UNGUWAR DAFAWA	A
LAYIN YAN WASHI	B
SABON GARIN BOCHIEYLE LAYIN MASALLACI	C
SABON GARIN BOCHIEYLE LAYIN RIGIYA	D

mMeasured by a based model no: LPV 2550 t. 97, 2002 make HACH USA. Electrical conductivity (EC) and total dissolved solids (TDS) were measured with digital EC-TDS analyzer model No: CM 183, make Elico, India. Turbidity was measured by using Nephalo-meter model No: 2100 Q-01 make Hach USA. Calcium, Magnesium.Acidty, Alkalinity concentrations were determined by a spectrophotometer, using UV-Vis laboratory spectrophotometer (Model No: DR 5000) make Hach, USA. All the general chemicals used in the study were of analytical reagent grade (Merck/BDH).

IV. RESULTS AND DISCUSSION

A. pH

The pH of a solution is the negative logarithm of Hydrogen ion moles per liter. pH is dependent on the carbon dioxide-carbonate-bicarbonate equilibrium. The pH ranged from 6.2 to 7.0 for all the samples, out of which two of the samples (C and D) had values between 6.8 -7.0 Within the NIS and the WHO Standards. While the remaining samples (A and B) had the values of 6.2 and 6.3 respectively which are below the two standards. 50% of the samples were below the standard limit (6.5 to 8.5) this could be attributed to the contamination of water with acid from agricultural and domestic activities.

B. *Temperature*

The maximum water temperature was observed 27.9^0C in S_A and minimum 21 .9^0C in S_C with an average value of 24.4^0C. The variation in temperature may be due to different timing of collection and influence of season (Jayaraman et al., 2003). Temperature controls behavioral characteristics of organisms, the solubility of gases and salts in water, No other factor has so much influence as temperature (Welch 1952).

C. Turbidity

The turbidity level ranges from 0 to 8 NTU, sample A having the highest turbidity value of 8 NTU which exceeded the limit for the two standards. Whereas other three samples (B, C, and D) were below the values recommended by WHO and NDWS permissible limit of 5 NTU. The high value recorded for turbidity may be as a result of the dissolution of solid phases into the underground water. It may also be as a result of precipitated calcium carbonate in hard water. Turbidity in water can stop light from reaching submerged plants and can raise water temperature. Turbidity may also contain particles that are toxic or help to accumulate toxic substances in water.

D. Colour

The values obtained ranges between 0-177 Pt-Co. Sample A having the highest color unit of 177 Pt – Co, followed sample B with a value of 107 Pt-co, sample D with 59 Pt-co and sample C with zero Value. The unusual high intensity of color at the source may be caused by the presence of iron and manganese, humus and peat materials. Colour is a physical parameter that is not necessarily related to toxicity or pathogenic contamination of water. Nevertheless, harmful color can create psychological rejection and fears, leading to limitation of water intake with consequent effects on personal health.

There is a relationship between turbidity and color values as shown in figure1. This is because when turbidity is not removed, "apparent color" is noted and it is possible that removing turbidity (filtration or centrifugation) may remove some true colors.

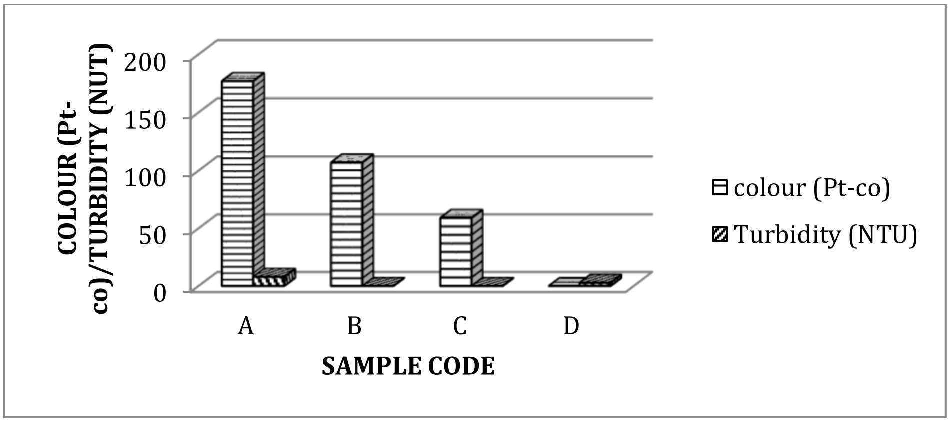

Figure: 1: Colour and turbidity of water samples

Table 2: Comparisons of the Range of the Samples to WHO and NDWS Standards of the high densely populated area (sample code of A and B)

S/N	Parameter	Permissible Limits as per the Standard		Experimental Results of the 2 Samples Range	Samples Exceeding Permissible Limit
		WHO	NSDWQ		No.
1	PH	6.85 – 8.5	6.5 – 8.5	6.2-6.3	A and B
2	Temperature	≤ 26	≤ 26	25.5-27.9	A
3	Electrical Conductivity	-	1000	2019-2360	A and B
4	Turbidity	5 – 25	≤ 5	8.0-0.0	A
5	Total Hardness	500	200	217-289	A and B
6	Total Dissolved Solids	1000	500	1270-1310	A and B
7	Manganese	250	-	139-152	None
8	Calcium	250	-	78-137	None
9	Alkalinity	500	100	104.5-260	A and B
10	Acidity	6.5	-	120.2-170.5	A and B

E. Conductivity

Sample D has the conductivity of 1658 µs/cm which lies slightly within the range, while the other three samples A, B and C have the highest values of 2360 µs/cm, 2019 us/cm,1958 us/cm respectively, these values did not agree with the NDWS and the WHO standard limit, usually samples with the highest conductivity values has the highest concentration of sodium. This is because conductance of water increases with salts.

F. Total Dissolved Solid (TDS)

Total dissolved solids of the water samples range from 828 to 1310 mg/L for all the samples. Sample A, B, and C having the highest values of 1310 mg/L, 1270 mg/L and 1197mg/L These samples did not agree with the NDWS and the WHO standard limit, while sample D has a value of 828 mg/L which is in conformity with the two standards. The higher the concentration of electrolytes in water the more is its electrical conductance. Total dissolved solids and conductivity can be used to delineate each other. In this study, conductivity is proportional to the dissolved solids as shown in figure 2.

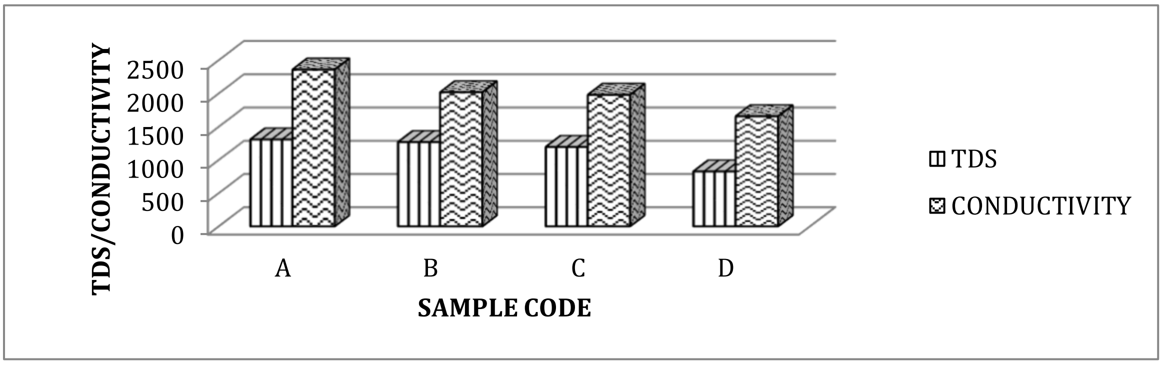

Figure 2: Total dissolved solids (TDS) and conductivity 0f water sample

Table 3: Comparisons of the Range of the Samples to WHO and NDWS Standards of the low densely populated area (sample code of C and D)

S/N	Parameter	Permissible Limits as per the Standard		Experimental Results of the 2 Samples Range	Samples Exceeding Permissible Limit
		WHO	NSDWQ		No.
1	PH	6.85 – 8.5	6.5 – 8.5	6.8-7.0	None
2	Temperature	≤ 26	≤ 26	21.9-22.2	None
3	Electrical Conductivity	-	1000	1658-1981	C and D
4	Turbidity	5 – 25	≤ 5	0.0	None
5	Total Hardness	500	200	154-162	None
6	Total Dissolved Solids	1000	500	828-1197	C
7	Manganese	250	-	40-103	None
8	Calcium	250	-	59-112	None
9	Alkalinity	500	100	144-231.6	C and D
10	Acidity	6.5		180-295	C and D

G. Total hardness, Calcium hardness, and Magnesium hardness

Hardness is one of the important properties of underground water from a utility view for different purposes. The water samples showed moderate hardness, ranging from 154 to 289 mg/ L.Water could be considered to be very hard if the value exceeds the NDWS and the WHO permissible limit. It is well known that hardness is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium ions, although other ions like barium, iron, manganese, strontium, and zinc also contributed. Very hard water is not good for drinking and is associated with rheumatic pains and gouty condition. Such water does not lather with soap and produces deposits in scaling in pipes, and steam boilers hardens vegetables and would not allow it to cook well. When used for bathing it tends to harden the skin or make the skin rough due to impregnation of insoluble calcium and magnesium soaps.

The calcium and magnesium levels ranged between 59 to 137 mg/L and 40 to 152 mg/L respectively. In this study, the total hardness was positively related with calcium and magnesium hardness as shown in figure 3, Samples A, B, C, and D have the values for the total hardness as (289,217,154,162) mg/L, calcium hardness as (137, 78, 112, 59) mg/L and magnesium hardness as (152, 139, 40,103) mg/L respectively. This is as a result of the significant effect of magnesium and calcium ions on the hardness of water.

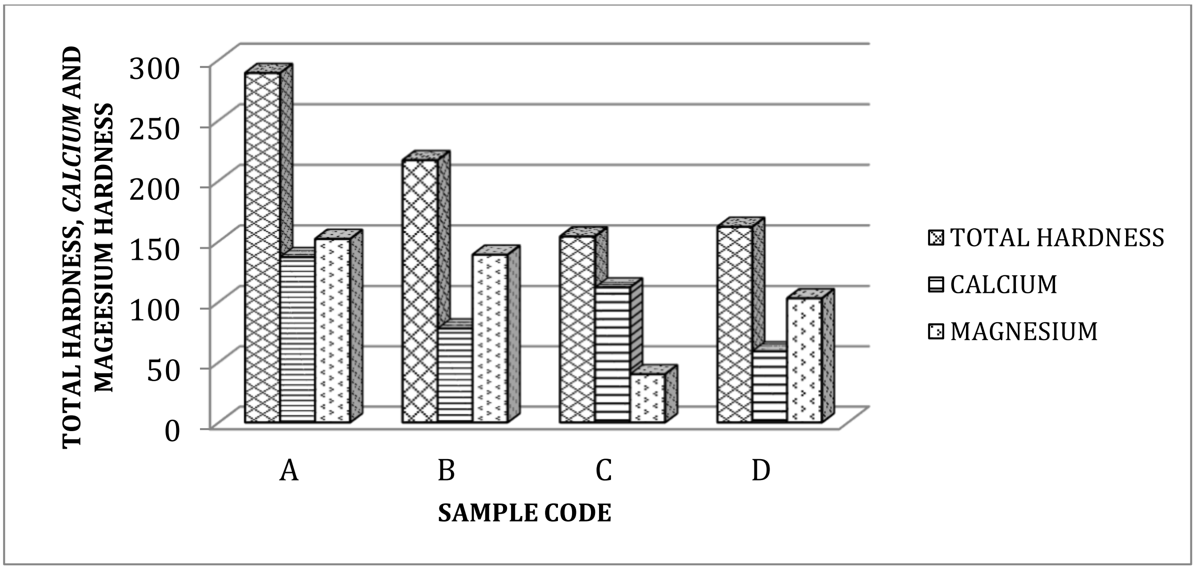

Figure 3: Total Hardness, Magnesium and Calcium Hardness of Water Samples

H. Total Alkalinity

The alkalinity for the samples ranged between 104.5 to 260.5 mg /L. Sample A and C were having the highest values of 260.5 mg/L and 231.5mg/L, while sample B and D had the least values of 104.5mg/L and 144mg/L respectively. All the samples were below the range of permissible limit of WHO of 500mg/L but exceeded NIS permissible limit of 100mg/L, the constituents of alkalinity in the neutral system include mainly carbonate, bicarbonate and hydroxide components.

I.Total Acidity

The acidity for the samples ranged between 120.1 mg/L to 295mg/L. Sample D, C, and B were having the highest values of 295mg/L, 180mg/L and 120.1 respectively, while sample A has the least value of 120.1mg/l. All the samples were out of range of the permissible level of the two standards.

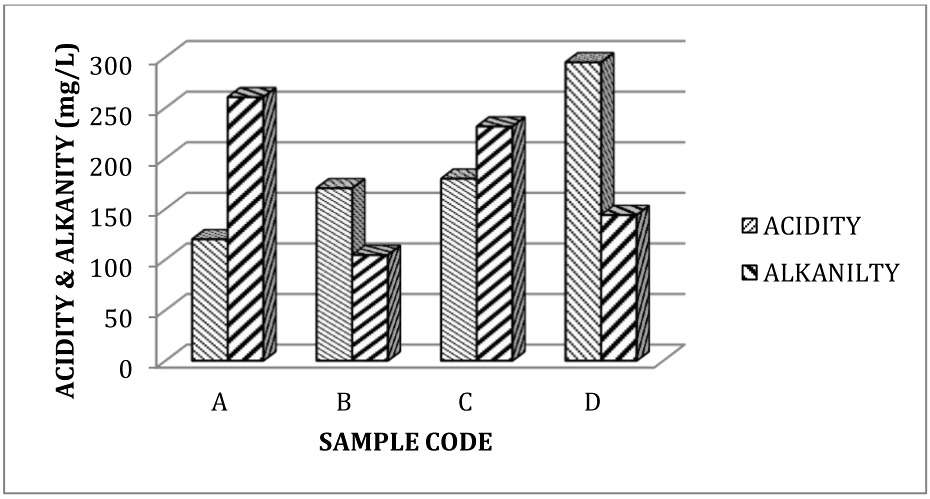

Figure 4: Acidity and Alkalinity of Water Samples

V. CONCLUSION

The present study clearly reveals that the sample collected from a high densely populated area is not suitable for the utilization of water. From the present study, the following conclusions were drawn:-

- The pH values of the high densely populated area exceed prescribed limit of both WHO and NSDWQ standard limit while low densely populated area value was within the prescribed limit.
- One of the temperature value of a high densely populated area exceeds limit while low densely populated area value does not exceed the prescribed limit.
- The electrical conductivity for both areas was exceeded the standard limit of WHO and NSDWQ.
- Turbidity value of high densely populated area exceeded the limit while low densely populated areas were within the prescribed limit.
- The hardness values of high densely populated area exceed limit according to NSDWQ while low densely populated area was within the limit.
- The calcium and magnesium for both two areas were not exceeded the prescribed limit.
- The total alkalinity values for both two areas were exceeded according to NSDWQ but according to WHO the values were within the limit.
- The total acidity value for the areas was exceeded the both prescribed limit of WHO and NSDWQ.

There is an immediate and urgent need for the implementation of a better water quality management policy incorporating the following recommendations:

VI. RECOMMENDATIONS

- Federal and the State Government are to construct and develop good boreholes which penetrate into the aquiferous zones while the local Government councils are to monitor the sanitary conditions of the communities.
- Proper planning and management sa r e required to mitigate the problem of drinking water contamination in the study area.

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