

Determination Of Portability Potential Of Some Borehole And Wells Water Withing Industrial And Sewage Disposal Sites Using Physicochemical Parameters In Kano Metropolis, Kano State Nigeria

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Abstract- This research work investigated borehole and Well waters located within the industrial areas of Bompai, Sharada (Sabuwar gandu), Chalawa (Tsamawa) and Gyadigyadi, Wailari sewage disposal areas with a view to determine their physicochemical qualities. A total of fifty (50) samples from boreholes and wells (two from each location) were sampled and analyzed, the physicochemical parameters monitored included pH, electrical conductivity, TDS, DO, BOD, Turbidity, chloride, nitrate, phosphate, Zinc, iron, lead, manganese and chromium. The wells water samples showed elevated mean value of lead (0.14mg/l), EC (590.9 us/cm), TDS (19.13mg/l), DO (4.67mg/l), BOD (1.25mg/l), Zinc (1.76mg/l), iron (0.6mg/l), Manganese (0.44mg/l) and Chromium (0.57mg/l) when compared to the borehole samples with mean average value of lead(0.01mg/l), EC (483.75), TDS (54.01mg/l), DO (4.12mg/l), BOD(1.2mg/l), Zinc (0.91mg/l), Iron (0.16mg/l), Manganese (0.29mg/l) and Chromium (0.05mg/l). The result shows that some of the borehole and well samples are not within the recommended limit of WHO (2006) and NSDWQ (2007) standard for drinking water. The borehole and well water should therefore be protected and treated before consumption.

Keywords- Portability, Potential, Sewage, Industrial, Disposing, Physicochemical parameter

I. INTRODUCTION

Increasing population has placed ever greater burden on water supplies, both in terms of quantity, quality, demand as well as contamination potential due to increased human activity on watersheds and chemical waste disposal into waters, forcing use of less desirable supplemental raw water sources. Boreholes and wells are feed from ground water both of which are a major source of drinking water all over the world. Most communities in Nigeria make use of water dug from boreholes and wells as an alternative source; this is to complement the spatial supply of pipe borne water. However with increasing population demand, water supply from these boreholes and wells becomes insufficient, especially in dry season when groundwater levels drops. It stabilizes during rainy season when groundwater levels become replenished by rain [1]. Although industrialization is inevitable, various devastating ecological and human disasters which have continuously occurred over the years implicate industries as major contributor to environmental degradation and pollution processes of various magnitudes [2]. In heavily industrialized areas, the quality of groundwater is compromised mostly as a result of industries dumping their wastes on land as well as in surface water which ultimately leaches to groundwater. This may lead to contamination due to accumulation of toxic substances which are not completely degraded [3]. Industrial waste and emissions contain toxic and hazardous substances most of which can be detrimental to human health. These include heavy metals such as lead, chromium and cadmium, and toxic organic chemicals such as pesticides. Poly Chlorinated Biphenyl (PCBs), Poly Aromatic Hydrocarbon (PAHs), petrochemicals and phenol compounds etc. which may seeps into groundwater. Contamination of boreholes and wells within this vicinity may arise from pollutants entering the water table some distance from the industries or from sewages entering the boreholes or wells itself through cracked or corroded cases [4].

World Bank reported that about 19000 tons of hazardous waste is produced annually in Nigeria and the waste comes mainly from steel, metal processing, pharmaceuticals, textiles, tanneries, and oil refining industries [5]. Consequently this study therefore is aimed to determine the physicochemical qualities of some Boreholes and Wells at Industrial and Sewage disposal sites of Kano Metropolis and compare with the standards for Drinking Water of WHO and NSDWQ respectively.

II. MATERIAL AND METHODS

II.I STUDY AREA

The metropolitan area of Kano lies between latitude $11^{\circ} 55' 23.93\text{N}$ - $12^{\circ} 3' 53.10\text{N}$ and longitude of $8^{\circ} 27' 42.26\text{E}$ - $8^{\circ} 36' 41.62\text{E}$ [6]. It covers a land mass of 499km^2 and comprises of eight (8) local government areas; Dala, Fagge, Gwale, Municipal, Nassarawa, Tarauni, Kumbotso, and Ungoggo local governments. It has a population of 2,828,861 as 2006 Nigerian census, with a growth rate projected to 3.3% Kano metropolis is characterized with a daily temperature ranging from 26°C to 33°C with mean daily maximum temperature of 40°C between March and May before the onset of rains in mid-May to September. A mean annual rainfall ranging from 800mm to 100mm and the natural vegetation consisting of Sudan and the Guinea savannah.

Kano metropolis is highly industrialized with the industries in three industrial estates, namely Bompai, Challawa, and Sharada [7]. Major industries in Challawa and Sharada industrial estates are textiles, tanneries, chemicals and allied, iron and steel. The activities of these industries have led to the discharge of untreated waste water on land and in rivers and streams. Slightly dense human settlements can be found in and around these industrial areas whose major source of domestic water ranges from pipe bone water, well water to borehole water.

II.II SAMPLE COLLECTION

50 samples each from boreholes and well water were collected from Sabuwargandu in Sharada, Panshekara and Tsamawa in Challawa and some areas in Bompai, Gyadigyadi and Wailari using sterile glass containers with stoppers. The samples were transported to laboratory in ice packs and processed between 2-3 hours after collection. The pH, temperature and conductivity were determined immediately.

II.III PHYSICOCHEMICAL ANALYSIS

II.III.I Temperature

Temperature was determined using mercury-in-glass thermometer calibrated in degrees centigrade as described by [8].

II.III.II pH

pH was determine with the use of pH meter. The electrode were inserted into the sample after inserting it in distilled water for (standardization); pH readings were recorded [9].

II.III.III Electrical Conductivity

The electrolytic conductivity were determined using HI 255 multiparameter electrolytic conductivity (EC) bench meter. The meter was calibrated and the cell cap rinsed and filled with the sample. The EC mode was selected by pressing "set/hold" button. Measurements were taken after the stability symbol on the top left corner of the screen disappears [10].

II.III.IV Turbidity

The turbidity of the water samples were determined using turbidometer (HANA instrument HI93703) and the result obtained expressed in Nephelometric Turbidity Unit (NTU) as described by [8].

II.III.V Appearance, Taste and Odour

These were determined using sensory evaluation; about 10ml of water samples was tasted with tongue and snipped with nose for odour and smell [11].

II.III.VI Nitrate

Nitrate was determined according to the method described by [9]. A quantity of sample were pour into a test tube and nitrate pillow powder added, the test tube was covered and shaken vigorously until the content evens out. This was then pour into 25ml spectrophotometer test bottle, the sample was after wards put into the square box space and the Read button turned and the result was observed in mg/L.

II.III.VII Total Dissolved Solid (TDS)

This was determine using the TDS meter (HI 255 multi parameter bench meter). The probe was pre-rinsed and standardized (i.e. set at zero point) with distilled ionized water. The meter was calibrated and activated for TDS measurement after dipping the probe into the sample and left for 2 minutes until readings become stabilized. The value was recorded and expressed in mg/L [10].

II.III.VIII Dissolved Oxygen (DO)

Dissolved Oxygen level was determined by the use of DO_2 machine. The electrode was rinsed in distilled water then calibrated and inserted into the samples the final reading was recorded in mg/L [10].

II.III.IX Biochemical Oxygen Demand (BOD)

The BOD of the Water sample was determined using the 5 days incubation method. The reading for dissolved oxygen was taken on the first day before incubation using the DO₂ meter and also taken after the 5 days incubation period. The difference between the initial DO and final DO is the BOD result i.e. DO_i - DO_f = BOD mg/l [9].

II.III.X Chloride (mg/L)

Chloride was determined using the Argentometric method as described by [12]. About 5ml to 20ml of representative water sample was transferred into a conical flask and 2 to 3 drops of potassium chromate was added. A yellow coloration was obtained. This was then titrated at 0.1 molar silver nitrate solution until a pink color end point was reached. The volumes of the titrant used were recorded and the value of the chloride calculated with the formulae below.

$$\text{Chloride mg/l} = \frac{\text{volume of AgNO}_3 \text{ used} \times M \times 35.5 \times 1000}{\text{Volume of sample}}$$

Where M = Molarity or normalcy of Silver nitrate.

II.III.XI Phosphate (mg/L)

This was done by pipetting 50ml of filtered water sample into a clean, dry 125ml Erlenmeyer flask, and then 2ml of molybdate reagent was added and mixed by swirling. 2ml of sulphonic acid was added and mixed again. After exactly 5mins, the color change was measured spectrophotometrically at 690nm as described by [12].

II.III.XII Trace Metals

Trace metals were determined using atomic absorption spectrophotometer (AAS). The method in this research determine concentrations of Iron (Fe), Lead (Pb), Manganese (Mn), Chromium (Cr), and Zinc (Zn) after digestion of the water samples. The digestion was done using HNO₃ acid method [13]. A portion of the well mixed sample (100ml) was transferred into beaker and 5ml of concentration, HNO₃ was added, the solution was evaporated to near dryness on a hot plate (sample was not allowed to boil). After cooling, another 5ml of conc. HNO₃ was added and covered with a watch glass and returned to the hot plate. A gentle reflux action of the solution was set by increasing the temperature on the hot plate.

The heating were continued with addition of acid as necessary until digestion was completed and a light colored residue will obtain. 1.2 ml conc. HNO₃ was added to dissolve the residue; the solution was filtered to remove silicate and other insoluble materials. A reagent blank was carried out, and then filtrated and reagent blank was analyzed for metals with flames [14].

III. RESULT AND DISCUSSION

The results of the physiochemical analysis of the water samples are presented in tables 1 and 2 below the results obtained were analyzed as shown

Table 1: Result of physicochemical analyses of borehole water samples from industrial and sewage disposal sites with who/NSDWQ Standards.

Parameter	Unit	BB1	BB2	CB1	CB2	SB1	SB2	GB1	WB1	Range	Mean	STD	WHO (2010)	NSDWQ (2007)
Appearance	-	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	-	-	-	Clear	Clear
Taste	-	IO	IO	IO	IO	IO	IO	IO	IO	-	-	-	IO	IO
Odour	-	IO	IO	IO	IO	IO	IO	IO	IO	-	-	-	IO	IO
Temp	°C	26.6	27.2	27.8	28.1	27.5	27.3	28	28.3	26.6-28.3	27.6	0.56	27-28	-
pH	-	6.8	6.6	8.0	7.7	7.6	7.5	6.9	6.7	6.6-8	7.2	0.53	6.5-8.5	6.5-8.5
EC	µs/cm	346	386	378	482	723	840	340	372	340-840	483.75	191.62	1000	1000
TDS	Mg/l	54.5	26.71	64.66	72.58	75.71	93.48	21.02	23.42	21.02-93.48	54.01	27.4	500	500
DO	Mg/l	5.3	4.11	3.78	4.36	3.97	4.62	3.2	3.58	3.2-53	4.12	0.62	7.5	-
BOD	Mg/l	2.95	0.12	2.54	0.45	2.43	1.05	0.11	0.14	0.11-2.95	1.2	1.22	-	3-6
Turbidity	NTU	2	2	2	3	2	2	0	0	0-3	2.2	1.06	5	5
Phosphate	Mg/l	36.62	32.1	33.58	29.63	21.04	38.44	19.03	21.02	19.0-58.44	36.48	16.46	5	-
Chloride	Mg/l	152	149	71	88.75	106.5	88.75	150.88	124.25	71-152	116.39	32.22	250	250
Nitrate	Mg/l	21.02	18.6	21.015	42.03	14.01	29.77	28.02	7.01	7.01-42.03	22.68	10.66	50	50
Zinc	Mg/l	1.64	1.21	0.53	1.94	0.33	0.33	0.64	0.67	0.33-1.94	0.91	0.61	3	3
Iron	Mg/l	0.16	0.11	0.18	0.21	0.19	0.19	0.1	0.12	0.1-0.22	0.16	0.3	0.3	0.3
Manganese	Mg/l	0.32	0.28	0.4	0.2	0.24	0.2	0.4	0.31	0.2-04	0.29	0.08	0.5	0.2
Lead	Mg/l	0.02	0.01	0.01	ND	0.01	ND	ND	ND	0-0.02	0.01	0.007	0.01	0.01
Chromium	Mg/l	ND	0.02	0.04	0.09	0.12	0.11	ND	ND	0.02-012	0.05	0.04	0.05	0.05

No significant difference (P=0.886)

Key: WHO –World Health Organization NSDWQ: Nigerian Standard Drinking Water Quality.

BB1:BB2 – Borehole 1&2 from Bompai, SB1:NB2 – sabuwar gandu borehole 1&2.

CB1:CB2 – Borehole 1&2 from Tsamawa, GB1-GB2 Gyadigyadi borehole 1&2

WB1:WB2- Borehole 1&2 from Wailari

INO: Inoffensive ND: None Detectable STD: Standard Deviation.

Table 2: Result of physicochemical analyses of Well water samples from industrial and sewage disposal sites with WHO/NSDWQ Standards.

Parameter	Unit	BW1	BW2	CW1	CW2	SW1	SW2	GW1	WW1	Range	Mean	STD	WHO (2010)	NSDWQ (2007)
Appearance	-	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	-	-	-	Clear	Clear
Taste	-	IO	IO	IO	IO	IO	IO	IO	IO	-	-	-	IO	IO
Odour	-	IO	IO	IO	IO	IO	IO	IO	IO	-	-	-	IO	IO
Temp	°C	27.4	28.1	26.9	27.2	28	28.7	28.1	28.4	26.9-28.7	27.85	0.62	27-28	-
pH	-	7.1	7.4	8.3	8.1	8.5	8.1	6.8	6.9	6.8-8.5	7.7	0.76	6.5-8.5	6.5-8.5
EC	µs/cm	361	338	753	816	858	893	352	356	338-893	590.9	258.7	1000	1000
TDS	Mg/l	93.48	74.92	109.18	151.24	205.22	211.10	44.32	63.48	44.3-211.1	119.13	63.6	500	500
DO	Mg/l	4.21	3.98	4.97	5.34	4.93	3.48	3.48	4.66	3.48-5.82	4.67	0.76	7.5	-
BOD	Mg/l	0.81	0.52	1.34	1.62	1.91	0.94	0.94	1.01	0.52-1.91	1.25	0.5	-	3-6
Turbidity	NTU	2	2	3	3	4	4	2	2	2-4	2.8	0.99	5	5
Phosphate	Mg/l	21.82	23.01	23.7	25.68	26.88	17.53	32.57	8.35	8.35-32.57	27.44	9.49	5	-
Chloride	Mg/l	40.18	38.92	195.25	195.25	53.25	88.75	124.25	79.25		101.89	64.10	250	250
Nitrate	Mg/l	9.11	10.01	56.04	70.05	38.66	17.51	52.54	7.01	38.92-195.25	32.62	24.9	50	50
Zinc	Mg/l	2.12	1.48	6.24	0.94	0.29	0.17	1.07	0.75	7.01-70.05	1.76	1.98	3	3
Iron	Mg/l	0.28	0.35	0.92	1.23	0.38	0.38	0.58	0.68	0.17-6.24	0.6	0.33	0.3	0.3
Manganese	Mg/l	0.92	0.61	0.4	0.65	0.2	0.28	0.25	0.22	0.28-1.23	0.44	0.26	0.5	0.2
Lead	Mg/l	ND	ND	0.32	0.27	0.19	0.11	ND	ND	0.2-0.92	0.11	0.12	0.01	0.01
Chromium	Mg/l	0.03	0.04	0.92	1.25	1.1	1.17	0.02	ND	0-0.32 0-1.25	0.57	0.59	0.05	0.05

No significant difference (P=0.886)

Key: WHO –World Health Organization NSDWQ: Nigerian Standard Drinking Water Quality.

BW1:BW2 – Well 1&2 from Bompai, SW1:SW2 – sabuwar gandu wells 1&2.

B1:CB2 – Well 1&2 from Tsamawa, GW1-GW2 Gyadigyadi Well 1&2

WW1- Well 1&2 from Wailari

INO: Inoffensive ND: None Detectable STD: Standard Deviation.

There was no significant difference in parameters analyzed between waters from boreholes and the wells (P>0.05), however, the value of temperature in the study area ranged from 26.6-28.7°C. It is noted that high water temperature enhances the growth of microorganisms and may increase taste, odour and colour. Warm temperature gives rise to accelerated bacterial activities thereby creating potentials of odour development through oxygen depletion [15].

About 100% of the samples are odourless with similar pattern displayed in taste, while about 50% of the well water samples had cloudy appearance, which could be attributed to materials in solution [16]. Affected wells can be treated by coagulation. Similar result was reported by [17] in the Physiochemical status of water samples from hand-dug wells in Ajebamidele area of Ado-Ekiti, Nigeria.

The mean pH values of all the samples range between 6.6 and 8.5, which conforms to standard set by WHO and NSDWQ for drinking water. However, the highest mean values were recorded in samples from Challawa and Sabuwargandu compared to sewage site which showed lower mean pH levels. Sa'ced and Amira [18] reported a pH range of 7.3- 8.1 in ground water samples in Nasarawa LGA in Kano state. A pH range of 6.6-8.5 is generally suggested by most guidelines and standards [15].

The Electrical conductivity (EC) concentrations range was 352-893 ps/cm for well samples and 340-840 us/cm for boreholes samples. These values are much greater compared to those found by [4] which was 30.6-30.9 ps/cm. Benard and Ayeni [19] found EC values of 126-143 us/cm while [18] found EC values ranging between 113-1907 us/cm. For the present study, the EC values of all the samples were within 1000 ps/cm acceptable WHO and NSDWQ limits for drinking water. Conductivity is affected by the presence of dissolved ions in water. The importance of EC is its measure of salinity, which generally affects the taste and therefore impacts on the users' acceptance of the water [20].

The well water samples from Challawa and Sabuwargandu recorded the highest mean values of total dissolved solids (TDS) i.e. 109.18 mg/l and 151.24 mg/l for CW1 and CW2, 205.22 mg/l and 211.10 mg/l for SW1 and SW2 respectively. These values were higher compared to the borehole water samples from the same sites. Although all the samples fall within the allocated standard set by WHO and NSDWQ, the above sites recorded the highest values compare with the other sites. TDS in drinking water has been associated with natural sources, sewage, industrial waste water, urban run-off and chemicals used in Water treatment process [19]. Concentrations of TDS in water vary considerably in different geological regions owing to differences in the solubility of minerals. The palatability of water with a TDS level of less than 6001 nig/l is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l. The presence of high levels of TDS may also be objectionable to consumers, owing to excessive scaling in water pipe, heaters, boilers and household appliances. No health-based guideline value for TDS has been proposed. But to this end, water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste [19].

Dissolved oxygen (DO) reflects the physical and biological processes prevailing in the water. A high DO level in a community water supply is good because it makes drinking water taste better. However, high DO levels speed up corrosion in Water pipes. The DO in this study ranges from 3.2-5.3 mg/l for the boreholes samples and 3.48-5.82 mg/l for the well samples. An increasing trend was observed in the water samples from Challawa and Sabuwargandu compared to the samples from Jaba and Bompai. All the samples however, were within the limit stipulated by WHO for drinking water. Thus did not show any organic pollution or thermal pollution. Biochemical oxygen demand (BOD) is widely used as an indication of the organic quality of water; it measures the amount of oxygen used by microorganism, in these case bacteria, to oxidize organic matter present within the water sample [21]. This study reports BOD levels ranging from 0.1 1-2.95 mg/l for borehole samples and 0.52-1.91 mg/l for well samples. These values obtained falls within the WHO limits of 5 mg/l for drinking water.

The mean turbidity value of the study area ranged between 0-4 NTU with the highest values of 4 NTU recorded from wells in Sabuwargandu. Turbidity in drinking water may be due to the presence of inorganic particulate matter in some ground water or sloughing of biofilms within the distribution system. High Turbidity value protects microorganisms from the effects of disinfection thereby stimulating bacterial growth [19]. The values obtained in present study were within standards set by WHO and NSDWQ for drinking water.

Phosphate concentrations tend to increase as a result of the discharge of industrial waste, domestic sewage, agricultural run-off from crops etc. it also occurs naturally, found in rocks as inorganic phosphates and can enter water ways when water runs over and through rocks [1]. The values obtained for phosphate in this study were very high especially in the borehole water samples from Sabuwargandu, Bompai, and Challawa with the highest mean values recorded in SB2 (58.44 mg/l), BB1(34.62 mg/l) and CB1(33.58 mg/l) respectively. For the well water samples, SW1 and CW2 had mean values of 26.88 mg/l and 25.68 mg/l respectively which were the highest values recorded from the well water samples from the non-industrial area. This can possibly be attributed to the proximity of these boreholes and wells to waste channels and also to seepage of phosphate rich waste into the water table. The boreholes therefore had higher concentrations compared to the wells. This could be attributed to the depths of the drills and also due to the presence of inorganic phosphate in the basement rocks. The high concentrations of 32.57 mg/l (NW1) and 19.03 mg/l, 21.02 mg/l (NB1 and NB2) in borehole and wells from the sewage disposal site could be as a result of contact with domestic sewage and/or agricultural run-off. Hence, all values obtained were above standards Set by [22,23] which may be indicative of pollution.

Chloride in drinking water originates from natural sources, sewage and industrial effluents, urban run-offs containing de-icing salt and saline intrusions [19]. No health based guideline value is proposed for chloride in standards for drinking water by [22,23]. However chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water and the observed range in the present study are 38.92-195.25 mg/l for well samples and 71-152 mg/l for borehole samples. This can largely be attributed to proximity to sewage or industrial effluent while for samples obtained from the non-industrial location, domestic waste can be a contributing factor.

Nitrates can reach both surface Water and ground water as a result of agricultural activity (Including excess application of inorganic nitrogenous fertilizers and manure). Natural nitrate concentration in ground Water range from 0.1 to 10 mg/l and generally show relatively slow changes [24]. Nitrate in concentration greater than 45 mg/l is undesirable in domestic water supply because of the potential toxic effect on young infants. Methemoglobinemia is a disease caused by nitrate which is converted to nitrite in intestines [24]. The safe nitrate limit for domestic water is set at 50 mg/l [25]. Nitrate cannot be removed from Water by boiling but must be treated by distillation. For the present study all the boreholes and some of the wells were below allotted standard for [22,23] except for wells CW1,CW2 (from Challawa) and NW1 (Jaba) which had values of 56.04 mg/l, 70.05 mg/l and 52.54 mg/l respectively. Thus, nitrate was found to be higher in the water samples from Challawa compared to the other sites. This high value could be attributed to the nature of industrial activities carried out in Challawa which include cooking gas production and casing, plastic manufacturing etc. The elevate nitrate level in Jaba can be attributed to agricultural activities e.g. gardening.

Some of the concentrations of the trace metals (Iron, Zinc, Lead and Manganese) in the water samples were relatively low compared with the [22,23] standards. All the water samples had minimum levels of Zinc except for CW1 which had the highest value of 6.24 mg/l way above the stated (3 mg/l) [22,23] limit. The entire samples from Sabuwargandu were found to have the lowest mean values of 0.33 mg/l, 0.33 mg/l, 0.29 mg/l and 0.17 mg/l in SB1, SB2, SW1 and SW2, respectively. These values were lower than even the sewage water samples with values of 0.64 mg/l, 0.67 mg/l, 1.07 mg/l and 0.75 mg/l in GBI, WB1, GW1 and WW1, respectively. The high value recorded for zinc in CW1 may be attributed to pollution due to persistent leaching along the top layers of the soil. A similar result was reported by [14] in Heavy metal concentration of ground water deposits in Odeda region, Ogun state.

The concentration of iron in the borehole samples were all low and the limits set by [22,23]. The well samples however. Had slightly higher values with high mean values of 0.58 mg/l and 0.68 mg/l obtained from the control wells NW1 and

NW2 while 0.92 mg/l and 1.23 mg/l were recorded for CW1 and CW2. Furthermore, when comparing the concentrations based on sampling sites, samples from Challawa showed higher levels of iron compared to the other sites. This can be attributed to naturally occurring iron in basement rocks or to the dissolution of iron bearing rocks and/or soils. It is noted however, that anaerobic groundwater may contain ferrous iron at concentrations of up to several mg/l without discoloration or turbidity in water when directly pumped from a borehole. On exposure to the atmosphere, however the ferrous iron oxidizes to ferric iron, giving an objectionable reddish-brown colour to the water [15]. Iron also promotes the growth of 'Iron bacteria' which derive their energy from oxidation of ferrous iron to ferric iron and in the process deposit a slimy coat on the piping [15].

Interestingly, the level of Manganese in the water samples showed slight variation when compared to the iron level. All the samples with the exception of BW1, BW2 and CW2 fell below the allocated 0.5 mg/l [22,23] standard. The highest values however, were recorded in samples BW1 i.e. 0.92 mg/l and BW2 having 0.61 mg/l. Elevated lead levels were observed in both well samples from Challawa and Sabuwargandu with values of 0.32 mg/l, 0.27 mg/l, 0.19 mg/l and 0.11 mg/l in CW1, CW2, SW1 and SW2, respectively. However, it was observed that all the values obtained from the borehole water samples fell within the guideline value stipulated by [22,23]. In the entire borehole samples lead level fell below the drinking water standard set by [22,23]. The sewage disposal site samples however, showed no trace of Lead or Chromium. Traces of chromium were however found in some of the borehole samples notably in CB2, SBI and SB2. This could probably be attributed to the nature of the industrial waste found in the environs. It should be noted that activities of interest found around these sampling sites includes tanning of hides, leather manufacturing among others; largely of which makes uses of chemicals containing some of these metals in their manufacturing processes [2].

The Well samples on the other hand, showed varying concentrations of Chromium that were surprisingly higher than the stipulated drinking Water limits set by [22,23] the well samples from Challawa and Sabuwargandu recorded a mean average of 0.92 mg/l, 1.25mg/l for CW1 and CW2; 1.1mg/l and 1.17mg/l for SW1 and SW2 (WHO standard being 0.01mg/l). These findings appear to be similar to some other studies such as [26,27,28].

The presence of these metals especially in the well samples can probably be attributed to the low depth of the wells, nearness to waste channels and leaching of these metals into the aquifers etc. [14]. Several studies have confirmed the great risk people are exposed to particularly where they consume the water without appropriate treatment [14,27]. For this reason, it becomes essential that the issue of microorganisms and chemicals in water consumed by the public ought to be given appropriate attention.

IV. CONCLUSION AND RECOMMENDATION

This research has shown that borehole and well water sources in closed proximity to effluent from industries, urban and domestic sewage might experience some negative effects on the water quality overtime. Contaminants of boreholes and wells may arise from pollutants entering the water the water table some distance from the industries or sewage entering the water source itself through leakages, cracks or corroded cases. The increase level of some physicochemical parameters and also presence of some bacteria in boreholes and wells was an indication of fecal pollution. At this juncture the result from this study showed that most of the boreholes and wells yield water of very poor quality chemically. All boreholes and wells fail to meet the 0.00cfu/100ml set by WHO and NSDWQ. More house hold treatment process such as boiling should be encouraged before water from these boreholes and wells is used for drinking and domestic purposes.

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