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# Physico-chemical Parameter Review of Drinking Water Portability at Daranna Community, Bagudo LGA of Kebbi State, Nigeria

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**Abstract—** *Drinking water quality was investigated at Daranna community the mineral rich part of Kaoje town in Kebbi state, to ensure the continuous supply of clean and safe drinking water for the public health protection. In this regard, a physical and chemical analysis of drinking water samples was carried out for samples collected at different locations within the community areas. A number of parameters such as colour, temperature, pH, electric conductivity, dissolved oxygen, total hardness, COD, nitrate, phosphate, sulphate, ammonia, iron, lead, zinc, potassium, copper, and magnesium were analyzed for each water sample collected during wet and dry season. The obtained values of each parameter were compared with the standard values set by the World Health Organization (WHO) and local standards such as Federal Ministry of Environment (FMEnv). The values of water quality parameters such as phosphate, sulphate, iron, lead and zinc from all samples collected from different residential and community borehole of Daranna were found to be within the recommended limits of FMEnv and WHO. However, some major ions of the water samples were found in excess of FMEnv and, WHO standard limits. There is an urgent need to educate people and bring awareness about the causes, affects and prevention of groundwater pollution and also the consequences of impacts of pollution on human health.*

**Keywords—** *Daranna community, Drinking water portability, FMEnv, Physico-chemical analysis, WHO.*

## I. INTRODUCTION

Water is one among the foremost important and abundant compounds of the ecosystem. the world has about 70 you look after water. All living organisms on the world need water for his or her survival and growth. But thanks to increased human population, industrialization, use of fertilizers within the agriculture and man-made activity it's highly polluted with different harmful contaminants. Therefore it's necessary that the standard of beverage should be checked at regular interval, because thanks to use of contaminated beverage, human population suffers from varied of water borne diseases. The potential sources of water contamination are geological conditions, industrial and agricultural activities. These contaminants are further categorized as microorganisms, inorganics, organics, radionuclides, and disinfectants (Nollet. 2000). The inorganic chemicals hold a greater portion as contaminants in beverage as compared to organic chemicals (Azrina, et al., 2011). a neighborhood of inorganics are in mineral sort of heavy metals. Heavy metals tend to accumulate in human organs and systema nervosum and interfere with their normal functions. In recent years, heavy metals like lead (Pb), copper (Cu), and zinc (Zn) have received significant attention thanks to causing health problems (WHO, 2011). The Pb is understood to delay the physical and mental growth in infants, while zinc can compete with copper within the intestine and interfere with its absorption, persons who supplement with inappropriately high level of zinc and lower level of copper may increase their risk of copper deficiency (Harris, 2001). variety of scientific procedures and tools are developed to assess the water contaminants (Dissmeyer, 2000). These procedures include the analysis of various parameters like pH, conductivity, total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC), and heavy metals. These parameters can affect the beverage quality, if their values are in higher concentrations than the safe limits set by the planet Health Organization (WHO) and other regulatory bodies (WHO, 2011). Therefore, the investigation of the beverage quality by researchers and governmental departments has been performed regularly throughout the planet (Jia, et al., 2010).

The availability of excellent quality water is an important feature for preventing diseases and improving quality of life. Natural water contains differing types of impurities, introduced into aquatic system by alternative ways like weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and therefore the use of metal based materials (Ipinmoroti and Oshodi 1993, Adeyeye 1994, Asaolu 1997)".

The recent study in Majidun community, Ikorodu, Lagos, Nigeria concluded that the bottom water (hand dug well and borehole) water analyses indicated that parameters like electrical conductivity, total dissolved solid, turbidity, colour, chloride, sodium, magnesium, COD and total hardness were above WHO acceptable limit as a results of impact of anthropogenic activities (Awoyemi et al., 2014).

The present study aimed to guage the beverage quality of some water collected at Daranna community. An in depth physical and qualitative analysis was administered by taking water samples from residential and commercial areas of the community. The parameters like colour, temperature, pH, conductivity, dissolved oxygen, chemical oxygen demand, nitrate, sulphate, phosphate, ammonia, total hardness, magnesium, and heavy metals like Fe, Cu, Zn, Pb were analyzed in each water sample. The results of every parameter were compared to the rules and standards set by local standards like (FMEnv, 1999 and WHO, 2011).

## II. Literature Review

### *2.1. The Study Area*

Daranna community is located in the mineralized zone of Kaoje Town at Bagudo Local Government Area of Kebbi State, North west Nigeria. There are three main ways to access water for domestic use within the community; taps, well or streams. Tap water is predominantly depended upon by locals on a daily basis whereas stream water can require a walk of between 8km to access. An inventory of water supply facilities taken in 21 local government area in Kebbi State shows that greater population of the state rely on boreholes compared by other water source (NPC, Birnin-Kebbi).

### *2.2. Types of Groundwater Pollution*

Sorts of groundwater pollution Groundwater is exposed to varied sources of pollution thanks to technological revolution alongside the shortage of appreciation of chemicals and their potential impact ashore and water bodies. The presence of pollution within groundwater may be a major challenge for delineation and identification. Leakage from chemical distribution infrastructure and petrochemicals, for instance, pipelines and sewage collection systems like sewage tanks, urban sewage channels and pipelines are few samples of the important lifetime of unknown underground pollution. Products of mining activities and industrial complexes, which were stored in or underground with none rule to regulate the contamination of land, was one among the foremost difficult and difficult problems related to pollution and management over the last hundred years (M. Amirabdollahian, et al. 2013).

#### *2.2.1. Groundwater Nitrate Contamination*

Inorganic contamination of the best concern in groundwater is nitrate ions, which usually occur in aquifers near rural and suburban populations. Although uncontaminated groundwater generally has nitrate nitrogen levels of but 2 ppm, nitrate in groundwater originates mainly from four sources: - Use of nitrogen fertilizers, inorganic and animal manure. - Atmospheric deposition. - Human sewage deposited in septic systems. - Cultivation of the soil (D.A.M. Barzinji et al., 2014). Approximately 12 million plenty of nitrogen per annum are used as fertilizer in agriculture within us, and therefore the production of manure has contributed about 7 million tons or more. In most cases, nitrogen forms reduction within the soil are oxidized to nitrate, which then migrates to groundwater, where it dissolves in water and it's diluted because nitrate removal from ground water is extremely expensive. Water contaminated with high levels of nitrate normally isn't used for human consumption, a minimum of in public-health (C. Barid, et al., 2005)

#### *2.2.2. Acidification*

Acidified precipitation may be a recognized and widespread phenomenon. The phenomenon of 'acid rain' has been known for over a century and is caused largely by the discharge of oxides of Sulphur and nitrogen into the atmosphere. acid rain effects on groundwate considered to be small. Other sources of acid in groundwater include: interaction of natural water-rock; contamination with industrial acids; and degradation of other contaminants (M. Ford, et al. 1992)

#### *2.2.3. Contaminated land*

Contaminated land presents the risk of groundwater contamination if the contaminants are able to migrate to the aquatic environment and still have potentially harmful concentrations. the results of pollution from human activities within the past and present have led and can continue to lead to serious contamination of groundwater (J.H. Tellam et al., 1994).

#### *2.2.4. Heavy metals*

Within the past there has been an excellent interest in the fate of heavy metals due to the appliance of sewage sludge on agricultural land and from landfills. Additional sources of heavy metals include mining and smelting, burning of fossil fuels, metal working, electronic and chemical industries, war and training, and therefore the launch of sports. In recent years, the popularity of potential toxic effects and long-term contaminants of heavy metal pollutants has focused on the protection of soil and groundwater (A. Briffett, et al. 1996).

## III. Materials And Methodology

### *3.1. Materials*

#### *3.1.1. Apparatus and equipment*

Oven, Desiccators, Forceps, Glassware, litmus paper, Filter papers, Steam bath, Centrifuge, Thermometer, Incubator, Handheld Colorimeter (DR/890) and Dissolved Oxygen meter. Hot plate or gas burner, Biochemical Oxygen Demand bottles, Filtration apparatus, Analytical balance, AAS (Varian AA240FS), pH multi-meter (Jenway 4510).

#### *3.1.2. Reagents and procurement*

All reagents used were of analytical grade and were prepared in line with standard methods as described within the Manual for normal Analytical Procedures (1999), except otherwise Stated. Other procedures used are duly acknowledged. Reagents utilized in this study include: Ethyl Alcohol (95 %), Starch and methylthionine chloride were procured from FISONS Science Equipment, Wembley Middlesex England. HCl, HNO3, AgCl, CuSO4, H2SO4, Na2S2O3, and HClO4 were supplied by JHD, Guangdong Guanghua Science Tech Company Limited, Shantou, China. KHP, NaOH, Bromocresol Green indicator, barium chloride crystals, ferroin indicator solution, azo dye indicator, MnCl2, MgSO4, and AgNO3 were procured from KEM LIGHT laboratories PVT limited, Mumbai India. activated charcoal, MnSO4, ZnC4H6O4, C8H4KO4, K2Cr2O7, and (NH4)2Fe(SO4)2.6H2O were supplied by BDH.

*3.2. Methodology*

The criteria of choosing sampling points were supported the population density, proximity to areas of anthropogenic activities like minerals and mining activities. Daranna was famous for its minerals and mining activities, therefore it had been significant to ascertain the water quality in such area. Therefore, three (3) different spring water locations in Daranna community were chosen supported designed criteria. These locations were Daranna community borehole (GW1), residential borehole within Daranna(GW2) and Barki-ruwa borehole(GW3). The three water samples were carefully collected during dry and wet seasons from water source to stop the utilization of improper methodology or sampling techniques, insufficient sample preservation, inadequate identification, and transportation and to make sure it prove the validity of the info from field measurements. In-situ sample analysis for colour, temperature, pH, electric conductivity, and dissolved oxygen was recorded at each sampling point. Thereafter, a water-proof ink label containing all required information like name, location, date, time, and preservative was affixed to every of the samples collected before they were transported to a laboratory for ex-situ analysis. Laboratory analysis was conducted following standard protocols and methods of yank Public Health Association (APHA) and American Society for Testing and Materials (ASTM) using calibrated instruments and high grade reagents.

## IV. Results And Discussions

*4.1. Results*

TABLE 4.0: Daranna Community in Kebbi State – Ground Water Test Result for Dry Season

| SN | PARAMETER | UNIT | RESULT | | | FMEnv LIMIT | WHO LIMIT |
|---|---|---|---|---|---|---|---|
| | | | $GW_1$ Daranna community borehole | $GW_2$ Daranna residential borehole | $GW_3$ Barkin-ruwa borehole | | |
| 1. | Colour | Hazen unit | Colourless | Colourless | Pastel yellow | (Colourless)15.00 | Colourless |
| 2. | Temperature | $^0C$ | 24.80 | 31.20 | 30.70 | NA | NA |
| 3. | pH | - | 7.40 | 6.50 | 5.60 | 6.50-8.50 | 6.50-8.50 |
| 4. | Electric Conductivity | µs | 430.00 | 765.00 | 826.00 | NA | NA |
| 5. | Dissolved Oxygen | mg/L | 6.00 | 3.50 | 3.20 | 7.50 | NA |
| 6. | Total Hardness | mg/L | 135.00 | 255.00 | 165.00 | 200.00 | 80.00-100.00 |
| 7. | COD | mg/L | 50.00 | 49.00 | 30.00 | NA | NA |
| 8. | Nitrate | mg/L | 2.00 | 26.00 | 132.50 | 10.00 | 50.00 |
| 9. | Phosphate | mg/L | 0.50 | 0.73 | 0.44 | 5.00 | 250.00 |
| 10. | Sulphate | mg/L | 1.00 | 3.00 | BDL | 500.00 | 100.00 |
| 11. | Ammonia | mg/L | BDL | 0.12 | 0.58 | 1.00 | NA |
| 12. | Iron | mg/L | BDL | BDL | 0.79 | 1.00 | NA |
| 13. | Lead | mg/L | BDL | BDL | BDL | 0.05 | 0.01 |
| 14. | Zinc | mg/L | 0.07 | 0.40 | 1.62 | 5.00 | NA |
| 15. | Potassium | mg/L | 0.01 | 0.01 | 0.64 | NA | NA |
| 16. | Copper | mg/L | 0.01 | BDL | BDL | 5.00 | 2.0 |
| 17. | Magnesium | mg/L | 0.76 | 1.38 | 1.25 | 1.00 | 0.30 |

TABLE 4.1: Daranna Community in Kebbi State – Ground Water Test Result for Wet Season

| SN | PARAMETER | UNIT | RESULTS | | | FMEV LIMIT | WHO LIMIT |
|---|---|---|---|---|---|---|---|
| | | | $GW_1$ Daranna community borehole | $GW_2$ Daranna residential borehole | $GW_3$ Barkin-ruwa borehole | | |
| PHYSICOCHEMICAL ANALYSIS | | | | | | | |
| 1. | Colour | Hazen unit | Colourless | Colourless | Pastel yellow | (Colourless)15.00 | Colourless |
| 2. | Temperature | $^0C$ | 24.00 | 25.50 | 27.10 | NA | NA |
| 3. | p H | - | 7.45 | 7.09 | 7.27 | 6.50-8.50 | 6.50-8.50 |
| 4. | Electrical Conductivity | µS/cm | 407.00 | 854.00 | 208.00 | NA | NA |
| 5. | Dissolved Oxygen | mg/L | 1.80 | 1.70 | 1.30 | 7.50 | NA |
| 6. | Total Hardness | mg/L | 144.00 | 315.00 | 84.00 | 200.00 | 80.00-100.00 |
| 7. | Chemical Oxygen Demand(COD) | mg/L | 48.00 | 48.00 | 42.00 | NA | NA |
| 8. | Nitrate ($NO_3^-$) | mg/L | 18.00 | 9.20 | 12.00 | 10.00 | 50.00 |
| 9. | Phosphate ($PO_4^{2-}$) | mg/L | 0.76 | 0.91 | 0.60 | 5.00 | 250.00 |
| 10. | Sulphate ($SO_4^{2-}$) | mg/L | 2.00 | 2.00 | 1.00 | 500.00 | 100.00 |
| 11. | Ammonia ($NH_3$) | mg/L | 0.08 | 0.17 | 9.53 | 1.00 | NA |
| 12. | Iron ($Fe^{2+}$/ $Fe^{3+}$) | mg/L | 0.02 | 0.14 | 0.21 | 1.00 | NA |
| 13. | Lead ($Pb^{2+}$) | mg/L | 0.01 | 0.02 | 0.01 | 0.05 | 0.01 |
| 14. | Zinc ($Zn^{2+}$) | mg/L | BDL | 0.01 | 1.51 | 5.00 | NA |
| 15. | Potassium ($K^+$) | mg/L | 0.07 | 0.06 | 0.03 | NA | NA |
| 16. | Copper ($Cu^{2+}$) | mg/L | 0.01 | BDL | 0.06 | 5.00 | 2.0 |
| 17. | Magnesium ($Mg^{2+}$) | mg/L | 0.03 | 0.07 | 0.05 | 1.00 | 0.30 |

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*4.2. Discussions:*

*4.2.1 Colour and Odour*

The groundwater samples collected represents a typical groundwater quality within the parameters of colour; the samples were colourless in both dry and wet seasons. Only GW3 at both seasons deviated from standard beverage quality of both FMEnv and WHO. The pastel yellow colouration could also be attributed to dissolved natural organic matters like tannins.

*4.2.2 Temperature*

Water temperature may be a property expressing how hot or cold water is. As hot and cold are both arbitrary terms, temperature can further be defined as a measurement of the typical thermal energy of a substance (Brown, W. 1999). Thermal energy is that the K.E. of atoms and molecules, so temperature successively measures the typical K.E. of the atoms and molecules (Brown, W. 1999). This energy are often transferred between substances because the flow of warmth. Heat transfer, whether from the air, sunlight, another water source or pollution can change the temperature of water. Temperature is a crucial factor to think about when assessing water quality. additionally to its own effects, temperature influences several other parameters and may alter the physical and chemical properties of water. during this regard, water temperature should be accounted for when testing (Wilde, F. 2006). The temperature across the representative samples collected across all sample points ranged between 24.00°C – 27.10°C and 24.80°C – 31.20°C within the wet and season respectively

*4.2.3 pH*

pH is classed together of the foremost important water quality parameters. Measurement of pH relates to the acidity or alkalinity of the water. A sample is taken into account to be acidic if the pH is below 7.0. Meanwhile, it's alkaline if the pH is above 7.0. the traditional beverage pH range mentioned in WHO and FMEnv guidelines is between 6.50 and 8.50 (Table 1.0 and 1.1). The pH values of all the beverage samples were found to range from 5.60 - 7.40 at season and seven.27 – 7.45 at wet season. All the samples at both seasons were within the approved limits, apart from GW3 collected at Barkin-ruwa borehole which recorded a rather acidic value of 5.60 during the season. Acidic water can cause corrosion of metal pipes and plumping system. Meanwhile, alkaline water shows disinfection in water.

*4.2.4 Electrical Conductivity (EC)*

Conductivity may be a measure of water's capability to pass electrical flow. This ability is directly associated with the concentration of ions within the water (EPA, 2012). These conductive ions come from dissolved salts and inorganic materials like alkalis, chlorides, sulfides and carbonate compounds (Miller, R.L. et al 1988). Compounds that dissolve into ions also are referred to as electrolytes. It shows significant correlation with ten parameters like temperature, pH value, alkalinity, total hardness, calcium, total solids, total dissolved solids, chemical oxygen demand, chloride and iron concentration of water. Navneet Kumar et al (2010) suggested that the underground beverage quality of study area are often checked effectively by controlling conductivity of water and this might even be applied to water quality management of other study areas. The groundwater samples collected ranged from 208.00mg/L – 854.00mg/L during the wet season and 430.00mg/L – 826.00mg/L during the season.

*4.2.5 Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO)*

COD is that the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. COD of the groundwater representative samples within the wet season ranged from 42.00mg/L – 48.00mg/L and through the season 30.00mg/L – 50.00mg/L while DO content within the water samples ranged from 1.10mg/L – 1.80mg/L within the wet season and three.20mg/L – 6.00mg/L within the season. These however fall within the FMEnv standard limit of seven.50mg/L.

*4.2.6 Total Hardness, Magnesium and Potassium*

The hardness of groundwater recorded during the wet season ranged from 84.00mg/CaCO3L – 315.00mg/CaCO3L and through the season 135.00 mg/CaCO3L – 255.00 mg/CaCO3L during the wet and dry seasons all the values recorded exceeded WHO limit of 80-100 mg/CaCO3L for total hardness. The concentrations of magnesium (associated with total hardness) recorded ranged between 0.03- 0.07mg/l within the wet season and from 0.76 – 1.38mg/l in season. Wet season values for all samples were above WHO limit of 0.30 mg/l for beverage. Magnesium and hardness is found in spring water that has are available contact with certain rocks and minerals, especially gypsum. Potassium concentration obtained ranged from 0.03 - 0.07mg/l within the wet season. season was from 0.01 - 0.64mg/L.

*4.2.7 Nitrate, Phosphate, Sulphate and Ammonia*

Nitrate concentration at Daranna community borehole (GW1) was below FMEnv detention limit of 10.00mg/l during the season and within the wet season recorded 18.00mg/l which is above FMEnv limit. GW2 residential borehole recorded 9.20mg/L and 26.00mg/L and Barkin- ruwa borehole (GW3) was 12.00mg/L and 132.50mg/L during wet and dry seasons respectively. These values were above below FMEnv limits at GW1 and GW3 during wet season and at GW2 and GW3 during season. However, the high value of nitrate are often as a results of farming activities causing some nitrogen from fertilizer to dissolve and enter into groundwater reservoirs. Phosphates are formed from phosphorus. It recorded 0.60 - 0.91mg/L during wet season and from 0.44 - 0.73 mg/L at season and every one below FMEnv and WHO limit of 5.00 and 250.00mg/l respectively. The FMEnv and WHO limit have set values of 500mg/L and 100mg/L respectively for sulphate. The ranges of sulphate content for wet and season ranges from 1.00 – 2.00mg/L and 0.00 – 3mg/L respectively. Ammonia concentration measured from 0.08 – 9.53mg/l within the wet season, and from 0.00 – 0.58mg/l within the season. The values are below FMEnv limit of 1.0mg/L except at GW3 during wet season, this might be as a results of degradation of present organic matter.

*4.2.8 Heavy Metal*

The presence of heavy metals in beverage above a particular concentration can cause detrimental impacts on human health. Therefore, it's important to analysis heavy metals in beverage, and most of the studies on beverage quality involve investigation of heavy metals. within the present study, the results of heavy metals like Cu, Zn, Fe, and Pb (Table 1.0 and 1.1) are compared with the safe limits set by FMEnv and WHO. Total Iron concentration recorded ranged from 0.02- 0.21mg/L within the wet season and 0.00-0.79mg/L within the season. Lead recorded was below detention limit in season and ranged from 0.01- 0.02mg/L wet season. The copper concentrations ranged between 0.00 – 0.06mg/L within the wet season and from 0.00 – 0.01mg/L within the season. The zinc recorded ranged from 0.00 -1.51 mg/L within the wet season and 0.07 – 1.62mg/L within the season. All the values were below both FMEnv and NIS limit of 5.00mg/L and three.00mg/L. The heavy metals tested were all within FMEnv and WHO standards limit respectively.

## V. Conclusion and Recommendations

*5.1. Conclusion*

Groundwater contamination is one among the environmental problems, resulting out of improved living standards, growing population and interference with natural eco-system. during this study, the values of water quality parameters like phosphate, sulphate, iron, lead and zinc from all samples collected from different residential and community borehole of Daranna were found to be within the recommended limits of FMEnv and WHO. However, some major ions of the water samples were found in more than FMEnv and, WHO recommended guideline values thanks to the dissolution of the community's mineral rich earth crust into spring water system and impact of mining activities.

*5.2. Recommendations*

- Regular monitoring of groundwater quality is required to assess pollution activity from time to time for taking necessary measures to mitigate the intensity of pollution activity.
- Proper environment management plan could also be adopted to see mining activities.
- Regular monitoring of groundwater quality is required to assess pollution activity from time to time for taking necessary measures to mitigate the intensity of pollution activity.
- Proper environment management plan could also be adopted to see mining activities.
- There is an urgent got to educate people and convey awareness about the causes, affects and prevention of groundwater pollution and also the results of impacts of pollution on human health.
- However, it's also important to research other potential water contaminations like chemicals and microbial and radiological materials for an extended period of your time, including physical body fluids, so as to assess the general water quality of Daranna community

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