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# PHYSICO-CHEMICAL AND BIOLOGICAL ANALYSIS OF HAND DUG WELLS IN ISOKO NORTH LOCAL GOVERNMENT AREA OF DELTA STATE, NIGERIA

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## ABSTRACT

*The study is aimed at assessing the quality of water from shallow hand-dug wells in Isoko North Local Government Area of Delta State from the month of September to November, 2015. The peoplein the study area highly depend on this source of water for drinking and domestic activities. Water samples were collected from nine sites (W1, W2, W3, W4, W5, W6, W7, W8& W9) from the study area. These samples were examined for trace heavy metals(Mn, Fe, Zn and Cd) using Atomic Absorption Spectrophotometer (AAS), bacteriological contamination (Total coliform and E.coli) and some physicochemical parameters. The results obtained were studied and compared with World Health Organization (2011) standard. The pH values obtained ranged from 4.22 to 6.08 showing that the water samples were slightly acidic. COD, DO and BOD values obtained all exceeded the permissible limit of WHO standard showing that the water from the study area may cause detrimental effect to human life. Phosphates and sulphates contents were higher than the WHO(2011) permissible limit. The microbiological analysis showed that the total coliform and E.coli count recorded values were not within WHO permissible limit which is an indication of faecal contamination. All other physic-chemical parameters (temperature, turbidity, electrical conductivity, total hardness, nitrate and chloride) were within the acceptable WHO(2011) Permissible limits. The water samples from the wells have higher level of heavy metals: Mn, Fe, Zn and Cd were found to be above the permissible limits of WHO (2011) specifications of 0.05 mg/l, 0.03mg/l, 0.05mg/l and 0.05 mg/l for Mn, Fe, Zn, and Cd respectively. The results obtained showed that the water from the study area were contaminated making the water unfit for drinking. Contamination of this water source may have been caused by closeness of water source to pit latrine, domestic refuse dumps, stagnant water, bad sewage system and other human activities. Consequently, these ground water sources in this study require treatment before they will be good for human consumption.*

***Keywords: Groundwater, hand dug well, contamination, water quality, physic-chemical parameters***

## INTRODUCTION

Water is important constituent of biotic community serving as a source of life for man, plants and other forms of life[1]. It is essential for the wellbeing of mankind and for sustainable development. 97% of the total volume of water available is in the Oceans, 2% stored in the form of ice-sleets and less than 1% is available as fresh water[1]. The main sources of water available to mankind are: atmospheric water, surface

water (including rivers, stream, ponds, etc) and ground water (boreholes, hand-dug wells etc.)[2].

Wells are common groundwater source readily explored to meet community water requirement or make up the short fall. This is the situation in many parts of Nigeria and several other African countries[4] and it has been observed that people use water from sources that are readily available or relatively cheap not necessarily minding the quality. The quality of groundwater resource especially shallow hand-dug wells depend largely on the management of human waste as well as the natural physico-chemical characteristics of the catchments areas [5,6]. Groundwater sources are being increasingly used as drinking water, without testing to see whether the water is of good quality. The lack of safe drinking water and adequate sanitation measures lead to a number of diseases[7] such as cholera, dysentery, and typhoid, and every year millions of lives are claimed in developing countries.

To protect the health of people and to reduce to the barest minimum of ugly experiences of drinking and/or using of low quality waters, it is necessary that the quality of water obtained from groundwater sources should be monitored with the view to finding lasting solution to health problems associated with the use and drinking of low quality waters. Therefore, it becomes imperative to investigate the effect of shallow hand dug wells of water quality.

## EXPERIMENTAL

### Description of the Study Area

Isoko North Local Government Area is one of the twenty five (25) Local Government in Delta state and among the oil producing area. It occupies an area of about 477km and density of 353.2inh/km$^2$ with the area mainly on land and small riverine terrain. According to the 2011 population census figure, it has a population of about 168,000 people. It is divided into nine communities namely, **Ozoro, Emevor, Owhelogbo, Iyede, Ofagbe, Arade, Ellu, Oyede and Okpe-Isoko**. As the name implies, the people of Isoko and their occupation includes farming, palm oil produce processing, fishing and petty trading. The study area is characterized two rainy seasons with the major rains in April to July, and the minor rains between September and October and dry season from November to March.

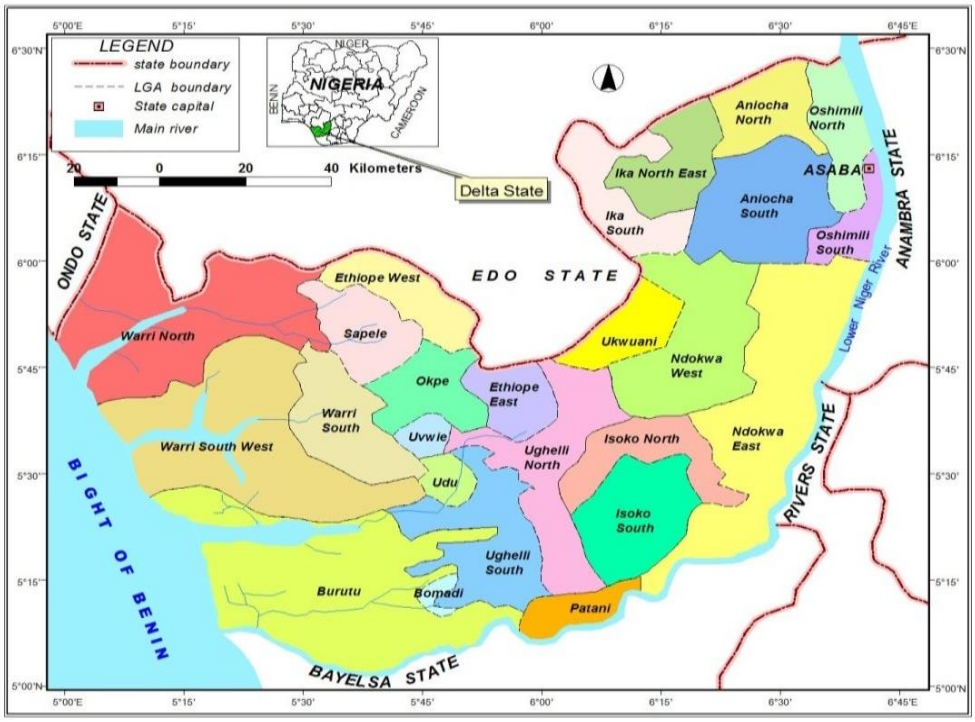


**Figure 1:**Map of Delta State showing the Study Area

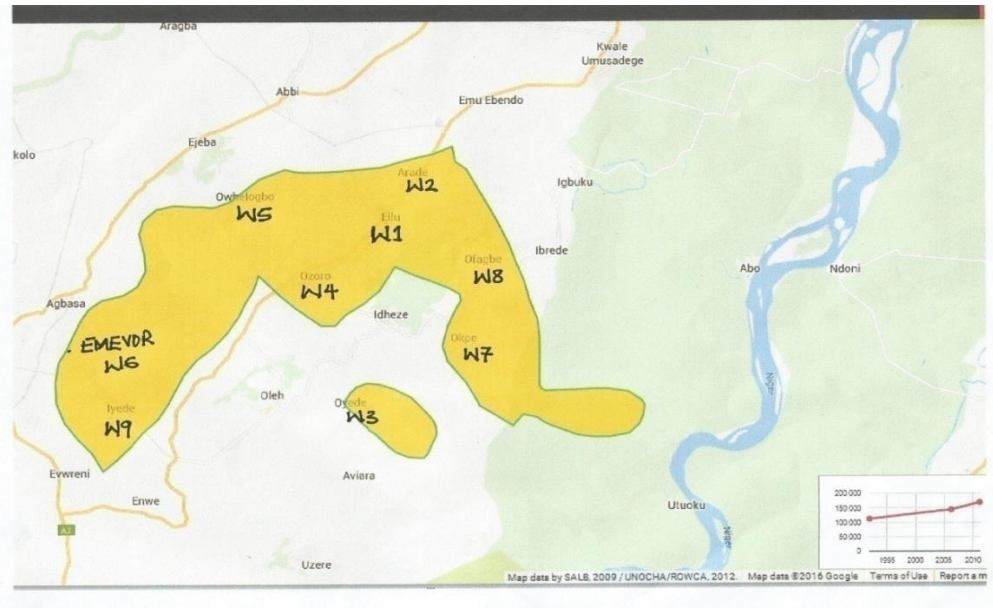


**Figure 2:** ***Map Showing Sample collection points***
**Source:***Nigeria Population Commission (1999)*


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## Sample Location

**Table 1 showed the sample locations and designation**

| Well Number | Samples Location | Coordinate points of the sample location (Lat/Lng) |
|---|---|---|
| W1 | Ellu | 5 º 59'0" N- 6 º 29' 0" E |
| W2 | Arade | 5º 62' 0"N- 6 º 30' 0" E |
| W3 | Oyede | 5º 45' 0" N – 6 º 26'0" E |
| W4 | Ozoro | 5º54' 0"N – 6 º 22'0" E |
| W5 | Owhelogbo | 5º59' 0"N - 6º19' 0" E |
| W6 | Emevor | 5º58' 0" N - 6º19'0" E |
| W7 | Okpe-Isoko | 5º 50'0" N – 6 º 33' 0" E |
| W8 | Ofagbe | 5 º56' 0" N - 6º35' 0" E |
| W9 | Iyede | 5º45' 0" N - 6º26' 0"E |

### Sample Collection, Preservation and Pre-Treatment

Water samples were randomly collected from nine different sources (Shallow hand-dug wells), namely W1 (Ellu), W2 (Arade), W3 (Oyede), W4 (Ozoro), W5 (Owhelogbo), W6 (Emevor), W7 (Okpe-Isoko), W8 (Ofagbe) and W9 (Iyede) which make up the Local government area. The samples were collected within the period of September, October and November, 2015. Samples were collected once every month from all designated sampling points. At each sampling site, two samples were collected into 500 ml bottlespre-rinsed with dilute nitric acid and rinsed three to four times with the water samples before filling to capacity. The samples were tightly sealed to prevent contamination and gas dissolution and then labeled accordingly. Samples for dissolved oxygen (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD) were collected in 250cm$^3$ bottles sealed with stoppers. One millimetre each of Winkler's solutions A and B were added to the samples on site to fix the oxygen. The samples were stored in coolers with ice packs before transferring them to the laboratory. The water samples collected for the study were analyzed at Springboard Research Laboratory, Awka, Anambra State.Random sampling method was used to carry out the research. This method was employed because it was difficult to know the total number of shallow wells in the study area. The samples were subjected to various laboratory analysis using standard procedures[8].

Parameters such as temperature, turbidity, Total Dissolved Solids (TDS), electrical conductivity, pH, total hardness, alkalinity, phosphate, sulphate, nitrate, chloride, iron, manganese, zinc, and cadmium were analyzed in the laboratory after samples were collected using standard analytical techniques.

## RESULTS AND DISCUSSIONS

The results of the analyses carried out on the physicochemical parameters of water samples obtained from the Nine (9) hand-dug wells in Isoko North environs conducted from September to November were shown below.

**TABLE 2: THE THREE MONTHS PHYSICOCHEMICAL PARAMETERS OF THE SHALLOW WELL WATER SAMPLES FROM SEPTEMBER TO NOVEMBER, 2015**

| Samples | Temp (°C) | pH | Turbidity (NTU) | E. Cond (µs/cm) | TDS (mg/L) | Alkalinity (mg/L) | Total Hardness (mg/L) | COD (mg/L) | DO (mg/L) | BOD (mg/L) | $NO_3$ (mg/L) | $PO_4$ (mg/L) | $SO_4$ (mg/L) | $Cl^-$ (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sept - W1 | 29.00 | 5.87 | 1.00 | 11.60 | 0.02 | 7.50 | 224.00 | 16.00 | 111.90 | 34.45 | 5.16 | 11.86 | 572.81 | 52.00 |
| Sept - W2 | 28.00 | 6.01 | 5.00 | 60.10 | 0.06 | 17.50 | 150.00 | 11.20 | 41.50 | 29.45 | 6.68 | 15.45 | 514.33 | 56.00 |
| Sept - W3 | 27.20 | 5.67 | 1.00 | 9.40 | 0.02 | 17.50 | 204.00 | 19.20 | 23.10 | 46.75 | 6.95 | 13.60 | 595.85 | 87.00 |
| Sept - W4 | 27.00 | 4.44 | 1.00 | 10.20 | 0.03 | 7.50 | 130.00 | 16.00 | 41.50 | 37.25 | 7.27 | 27.91 | 485.16 | 80.00 |
| Sept - W5 | 28.00 | 5.26 | 5.00 | 68.20 | 0.05 | 22.50 | 86.00 | 32.80 | 20.80 | 42.85 | 5.14 | 15.23 | 426.31 | 70.00 |
| Sept - W6 | 29.00 | 5.51 | 1.00 | 9.50 | 0.02 | 20.00 | 210.00 | 14.40 | 76.50 | 27.36 | 4.79 | 15.45 | 548.91 | 53.00 |
| Sept - W7 | 28.00 | 4.34 | 1.00 | 14.60 | 0.01 | 12.50 | 152.00 | 16.00 | 25.50 | 33.65 | 4.75 | 20.13 | 577.34 | 62.00 |
| Sept - W8 | 28.80 | 5.71 | 10.00 | 33.00 | 0.04 | 25.00 | 188.00 | 19.20 | 46.90 | 18.25 | 6.41 | 23.94 | 742.35 | 59.00 |
| Sept - W9 | 28.00 | 4.34 | 5.00 | 11.20 | 0.01 | 12.50 | 200.20 | 42.40 | 52.90 | 19.45 | 5.57 | 17.30 | 434.54 | 85.00 |
| Oct - W1 | 29.00 | 5.96 | 1.00 | 10.20 | 0.03 | 7.20 | 219.00 | 16.00 | 111.90 | 34.45 | 4.87 | 10.28 | 505.34 | 50.00 |
| Oct - W2 | 28.50 | 5.86 | 1.00 | 55.60 | 0.07 | 19.47 | 143.00 | 11.20 | 41.50 | 29.45 | 5.89 | 13.90 | 504.34 | 53.00 |
| Oct - W3 | 28.70 | 4.96 | 1.00 | 8.70 | 0.03 | 15.64 | 220.00 | 19.20 | 23.10 | 46.75 | 5.98 | 13.89 | 519.38 | 72.00 |
| Oct - W4 | 28.20 | 4.49 | 2.00 | 8.80 | 0.03 | 8.39 | 125.00 | 16.00 | 41.50 | 37.25 | 7.39 | 28.48 | 502.45 | 68.00 |
| Oct - W5 | 27.60 | 5.29 | 0.89 | 67.30 | 0.13 | 17.10 | 82.00 | 32.80 | 20.80 | 42.85 | 5.39 | 14.29 | 419.45 | 64.00 |
| Oct - W6 | 28.00 | 5.46 | 0.40 | 9.20 | 0.02 | 15.96 | 236.00 | 14.40 | 76.50 | 27.36 | 4.67 | 14.29 | 526.47 | 50.00 |
| Oct - W7 | 29.20 | 4.22 | 1.00 | 12.30 | 0.02 | 14.50 | 138.00 | 16.00 | 25.50 | 33.65 | 4.77 | 16.89 | 545.37 | 65.00 |
| Oct - W8 | 27.50 | 5.68 | 25.00 | 30.00 | 0.03 | 22.01 | 174.00 | 19.20 | 46.90 | 18.25 | 6.80 | 19.47 | 734.89 | 53.00 |
| Oct - W9 | 28.00 | 4.38 | 5.00 | 9.30 | 0.01 | 10.32 | 202.00 | 42.40 | 52.90 | 19.45 | 5.84 | 13.89 | 422.46 | 81.00 |
| Nov - W1 | 27.20 | 5.89 | 0.40 | 12.42 | 0.03 | 7.70 | 200.00 | 19.30 | 98.96 | 29.87 | 4.92 | 9.78 | 524.00 | 47.00 |
| Nov - W2 | 28.20 | 6.08 | 0.80 | 48.90 | 0.06 | 22.30 | 142.00 | 13.80 | 46.45 | 34.20 | 5.94 | 16.89 | 515.35 | 59.00 |
| Nov - W3 | 27.40 | 5.88 | 1.00 | 8.91 | 0.03 | 16.30 | 204.00 | 22.40 | 29.90 | 45.22 | 5.88 | 14.29 | 522.45 | 79.00 |
| Nov - W4 | 29.00 | 4.53 | 1.00 | 8.20 | 0.02 | 9.20 | 120.00 | 14.70 | 44.20 | 33.26 | 7.30 | 29.89 | 490.40 | 74.00 |
| Nov - W5 | 28.00 | 5.36 | 1.00 | 72.90 | 0.18 | 19.30 | 80.00 | 30.20 | 24.70 | 40.33 | 5.19 | 13.48 | 422.73 | 66.00 |
| Nov - W6 | 29.00 | 5.49 | 1.00 | 10.82 | 0.02 | 18.50 | 211.00 | 13.80 | 70.20 | 30.29 | 4.78 | 13.39 | 530.22 | 48.00 |
| Nov - W7 | 28.02 | 4.39 | 1.00 | 10.82 | 0.03 | 10.40 | 132.00 | 18.70 | 28.60 | 30.16 | 4.24 | 14.39 | 548.89 | 68.00 |
| Nov - W8 | 28.50 | 5.78 | 2.00 | 10.20 | 0.03 | 27.00 | 173.00 | 18.20 | 51.30 | 25.34 | 7.38 | 17.24 | 749.67 | 59.00 |
| Nov - W9 | 27.90 | 4.92 | 5.00 | 9.04 | 0.02 | 12.40 | 210.00 | 43.90 | 50.20 | 24.33 | 6.28 | 13.20 | 406.20 | 83.00 |

**TABLE 3: THE THREE MONTHS RESULTS OF THE HEAVY METALS CONCENTRATION LEVEL OF THE SHALLOW WELL WATER SAMPLES FROM SEPTEMBER TO NOVEMBER, 2015**

| Samples | Manganese | Iron | Zinc | Cadmium |
|---|---|---|---|---|
| Sept - W1 | 0.04 | 0.17 | 0.33 | BDL |
| Sept - W2 | 0.05 | 0.09 | 0.23 | 0.09 |
| Sept - W3 | 0.14 | 0.06 | 0.28 | 0.10 |
| Sept - W4 | 0.10 | 0.21 | 0.46 | BDL |
| Sept - W5 | 0.06 | 0.17 | 0.13 | BDL |
| Sept - W6 | 0.20 | 1.05 | 0.83 | 0.53 |
| Sept - W7 | 0.04 | 0.20 | 0.30 | BDL |
| Sept - W8 | 0.05 | 0.11 | 0.39 | 0.80 |
| Sept - W9 | 0.17 | 0.26 | 0.37 | 0.25 |
| Oct - W1 | 0.03 | 0.01 | 0.29 | BDL |
| Oct - W2 | 0.04 | 0.03 | 0.21 | 0.02 |
| Oct - W3 | 0.11 | 0.04 | 0.27 | 0.03 |
| Oct - W4 | 0.10 | 0.19 | 0.37 | 0.02 |
| Oct - W5 | 0.05 | 0.21 | 0.10 | BDL |
| Oct - W6 | 0.13 | 0.73 | 0.78 | 0.40 |
| Oct - W7 | 0.03 | 0.19 | 0.32 | BDL |
| Oct - W8 | 0.03 | 0.10 | 0.32 | 0.67 |
| Oct - W9 | 0.17 | 0.25 | 0.32 | 0.21 |
| Nov - W1 | 0.03 | 0.26 | 0.30 | 0.11 |
| Nov - W2 | 0.28 | 0.01 | 0.29 | 0.02 |
| Nov - W3 | 0.12 | 0.04 | 0.28 | 0.06 |
| Nov - W4 | 0.78 | 0.17 | 0.39 | BDL |
| Nov - W5 | 0.34 | 0.20 | 0.12 | BDL |
| Nov - W6 | 0.19 | 0.82 | 0.80 | 0.31 |
| Nov - W7 | 0.03 | 0.17 | 0.34 | 0.01 |
| Nov - W8 | 0.02 | 0.98 | 0.32 | 0.61 |
| Nov - W9 | 0.90 | 0.24 | 0.34 | 0.20 |

**Note: BDL = Below Detectable Limit**

**TABLE 4: THE THREE MONTHS RESULTS OF MICROBIOLOGICAL ANALYSIS OF THE SHALLOW WELL WATER SAMPLES FROM SEPTEMBER TO NOVEMBER, 2015**

| Samples | Total Coliform (cfu/100ml) | *E.Coli* (cfu/100ml) |
|---|---|---|
| Sept - W1 | 10.00 | 2.00 |
| Sept - W2 | 4.00 | 1.00 |
| Sept - W3 | 4.00 | BDL |
| Sept - W4 | 10.00 | 2.00 |
| Sept - W5 | 18.00 | 2.00 |
| Sept - W6 | 13.00 | 1.00 |
| Sept - W7 | 10.00 | BDL |
| Sept - W8 | 17.00 | 3.00 |
| Sept - W9 | 9.00 | BDL |
| Oct - W1 | 6.00 | 1.00 |
| Oct - W2 | 2.00 | BDL |
| Oct - W3 | 1.67 | BDL |
| Oct - W4 | 7.23 | 1.00 |
| Oct - W5 | 17.00 | 1.00 |
| Oct - W6 | 9.00 | BDL |
| Oct - W7 | 7.00 | BDL |
| Oct - W8 | 14.00 | 1.00 |
| Oct - W9 | 5.00 | BDL |
| Nov - W1 | 4.00 | 1.00 |
| Nov - W2 | 2.00 | BDL |
| Nov - W3 | 1.00 | BDL |
| Nov - W4 | 5.00 | 1.00 |
| Nov - W5 | 6.00 | BDL |
| Nov - W6 | 2.00 | BDL |
| Nov - W7 | 4.00 | BDL |
| Nov - W8 | 5.33 | 1.00 |
| Nov - W9 | 2.00 | BDL |

**BDL: Below Detectable Limit**

**Table 5: The Monthly Mean of the Physico-chemical Parametersof the Shallow Hand-Dug Well Water Samples**

| PARAMETERS | SEPTEMBER | OCTOBER | NOVEMBER | WHO (2011) |
|---|---|---|---|---|
| Temp (°C) | 28.11 | 28.30 | 28.14 | Ambient Temperature |
| pH | 5.24 | 5.14 | 5.37 | 6.5 – 8.5 |
| Turbidity (NTU) | 3.33 | 4.14 | 1.47 | 5 NTU |
| E. Cond (µs/cm) | 25.31 | 23.49 | 21.36 | 1000µS/cm |
| TDS (mg/L) | 0.03 | 0.04 | 0.05 | 500mg/L |
| Alkalinity (mg/L) | 15.83 | 14.51 | 15.90 | 100mg/L |
| Total Hardness (mg/L) | 171.58 | 171.00 | 163.56 | 250 mg/L |
| DO | 48.96 | 48.96 | 49.39 | 7 mg/L |
| BOD | 32.16 | 32.16 | 32.56 | 6.5 – 9.0 mg/L |
| COD | 20.80 | 20.80 | 21.67 | 10mg/L |
| Chlorides (mg/L) | 67.11 | 61.78 | 64.78 | 200 mg/L |
| Nitrates (mg/L) | 5.86 | 5.73 | 5.77 | 50 mg/L |
| Phosphates (mg/L) | 17.87 | 16.15 | 15.84 | 10 mg/L |
| Sulphates (mg/L) | 544.18 | 520.02 | 523.32 | 200 mg/L |

**Table 6: The Monthly Mean Values of the Heavy metals Concentration Level in the Shallow Hand-Dug Well WaterSamples**

| PARAMETERS | SEPTEMBER | OCTOBER | NOVEMBER | WHO (2011) |
|---|---|---|---|---|
| Lead | 0.91 | 0.91 | 0.91 | 0.01 mg/L |
| Manganese | 0.09 | 0.08 | 0.30 | 0.05 mg/L |
| Iron | 0.26 | 0.20 | 0.32 | 0.03 mg/L |
| Zinc | 0.37 | 0.33 | 0.35 | 0.05 mg/L |
| Cadmium | 0.20 | 0.15 | 0.15 | 0.05 mg/L |

**Table 7: The Monthly Mean Values of the microbiological parameters of the the Shallow Hand-Dug Well Water Samples**

| PARAMETERS | SEPTEMBER | OCTOBER | NOVEMBER | WHO (2011) |
|---|---|---|---|---|
| Total Coliform (cfu/100ml) | 10.56 | 7.66 | 3.48 | 0 cfu/ml |
| *E.Coli* (cfu/100ml) | 1.22 | 0.44 | 0.33 | 0 cfu/ml |

**pH**

The observed mean pH recorded in the various wells ranged from 5.14 to 5.37 (Table 4.4). It exhibited acidic characteristics. These values were below the recommended standard of pH range of 6.5 to 8.5. This showed that the water is moderately acidic. The low pH values might have come from the source of the water or the materials used in the construction of the wells and the soil type (result of natural geological conditions at the site. Acidic water could leach metals from pipes and fixtures such as copper, lead, and zinc. It could also damage metal pipes and cause aesthetic problems such as metallic or sour taste, laundry staining, or blue-green stains in sinks and drains.

**Turbidity**

Turbidity was within the WHO permissible level of 5NTU.High turbidity can affect the clarity of the water and reduce the depth to which light could penetrate and also hinder disinfection by shielding microbes, some of them perhaps pathogens. The low level of turbidity in this study could be to the fact that human activities including logging, agriculture and road construction may not have affected the wells sampled.

**Electrical conductivity (EC)**

The mean values obtained ranged from 21.36 to 25.31 $\mu S/cm$ .The observed Electrical Conductivity of water were within the water quality standard (i.e. 1000µg/cm)[9], the values obtained indicates dissolution of inorganic compounds while percolating & flowing within the ground.

**Total dissolve solid (TDS)**

Total dissolve solid (TDS) mean values were generally below 500mg/L which was within the WHO (2011) permissible limit for potable water; this showed that shallow well water in the area were quite fresh in most locations.

**Alkalinity**

The alkalinity mean values of all the sampled water were below the stipulated limit of 100 mg/Lranging from 14.51 to 15.90 mg/L. This again confirmed the slightly acidic nature of water of the water samples.

**Total Hardness**

The mean values of Total Hardness of the water samples (163.56 – 171.58mg/L) can be said to be moderately hard. This is caused by the present of calcium and magnesium. Ground water is much prone to hardness due to high concentration of calcium and magnesium ions.

The water from the wells were suitable for domestic use in terms of hardness.

**Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO)**

Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO) mean values obtained were all generally above WHO (2011) permissible limit of 6.5-9mg/L, 10mg/L and 7mg/L respectively. It means that the ground water sources from the sampling sites were organically contaminated from different sources such as mixing of sewage and runoff from agricultural fields.

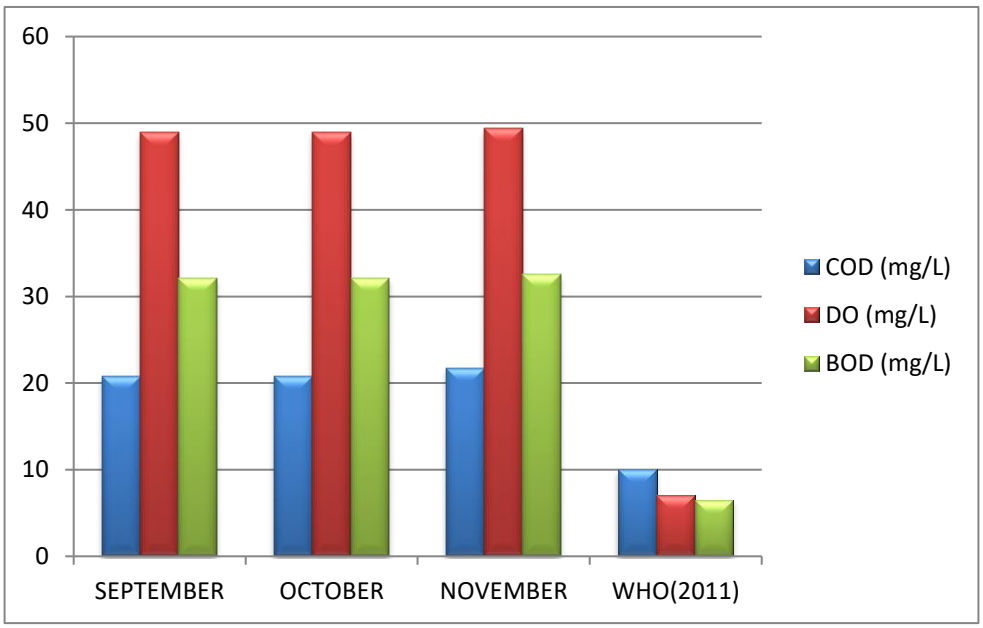


**Figure 3:** *Graphical representation of the monthly mean values of DO, BOD and COD*

**Chlorides ($Cl^-$)**

Clorides ($Cl^-$) level in the water samples were all within the WHO maximum acceptable WHO (2011) limit of 200mg/l for drinking water. Chloride ($Cl^-$) in groundwater comes from both natural and anthropogenic sources, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds,industrial effluents, irrigation drainage, and seawater intrusion in coastal areas. Higher chloride content generally indicates fecal pollution.

**Nitrates ($NO_3^-$)**

Nitrates ($NO_3^-$) concentrations were considered to be normal and within the WHO (2011) permissible limit of 50mg/L for drinking water. Nitrate may haveoccurred through excessive use of fertilizers in combination within inappropriate farming practices and improper disposal of sewage.

**Phosphates**

Phosphates values (15.84 – 17.87mg/L) were generally above the permissible limit of 10mg/L which may have resulted from domestic activities such as washing with detergent carried out on top or around the wells, fertilizers and other phosphates compounds. It is established that high phosphate concentration has no health implication (WHO, 2011) except that the enrichment of water with organic phosphates results in an excessive growth of plants and other micro-organisms leading to eutrophication and increased biochemical oxygen demand.

**Sulphate**

The mean concentration of sulphate from the samples collected ranges from 520.02 – 544.18mg/L which were above permitted limit of 200mg/L. The presence of sulphate in drinking-water may cause noticeable taste and may contribute to the corrosion of the well linings (WHO, 2011). Therefore the water samples were recommended on the sulphate basis.

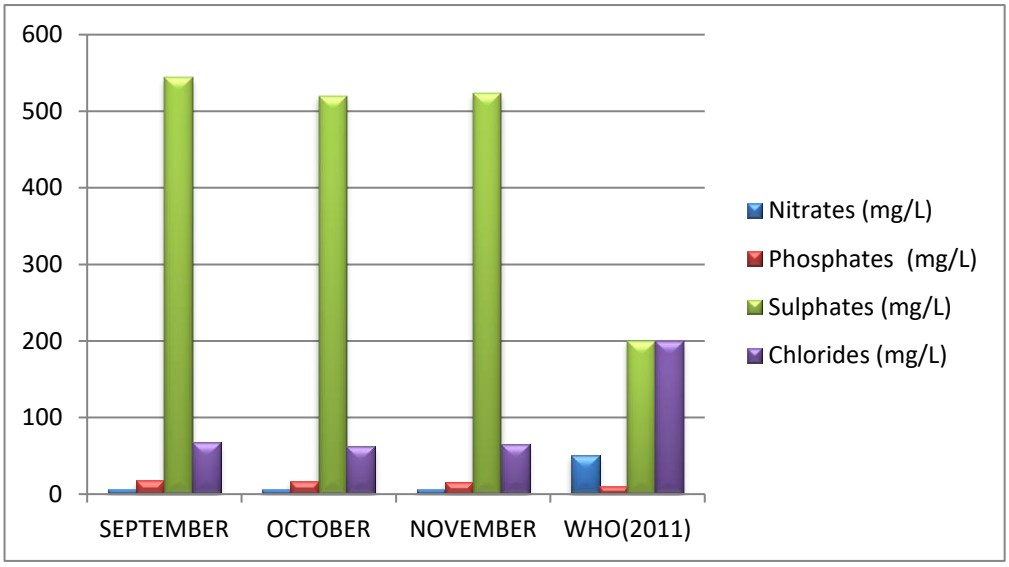


**Figure 3:** *Graphical representation of the monthly mean values of Nitrate, Phosphate, Sulphate and Chlorides*

**Manganese (Mn)**

The mean values of Manganese (Mn) obtained from the sampling sites were higher than WHO (2011) permissible levels of 0.05mg/l. Mn is an essential element for humans and animals. However exposure to very high levels in drinking water can affect the respiratory tract and the brain. Symptoms of Mn poisoning are hallucination, forgetfulness and nerve damage. Mn can also cause Parkinson disease, lung embolism and bronchitis. The high level of manganese can be attributed to nearness of refuse dumps to the well.

**Iron (Fe)**

Iron (Fe) level in all the wells were above the WHO maximum acceptable limit of 0.03mg/L. Thus the high level of Fe in these well water

samples has been attributed to geographical composition of the soil resulting from poorly weathered crystalline basement complex rocks since Iron occurs naturally in groundwater, indiscriminate dumping of refuse around most of the wells which could leach down from the surface and poor drainage system.

### Zinc (Zn)

Significant levels of Zinc (Zn) were detected in all the well water samples. Mean Level as high as 0.37mg/1 which is higher than WHO maximum allowable limit of 0.05mg/l for Zn, were detected in water samples. Some of these wells are located close to dumpsite, domestic wastes and drainages where all sorts of metal wastes are found. The leaching of these metals by rainfall is the probable cause of the high levels of these pollutants in the water samples of these wells.

### Cadmium (Cd)

Cadmium (Cd) content were generally higher than the maximum permissible level of 0.05mg/L. Cadmium may have occurred as an impurity in zinc since Cadmium is a by-product of zinc production, much rarer and used only in small amounts which is mostly used as roofing materials in all the communities. Due to reactions of rain water with these roof materials (iron or zinc), some of the dissolved materials find their way into the surrounding open shallow wells thus increasing the presences of cadmium.

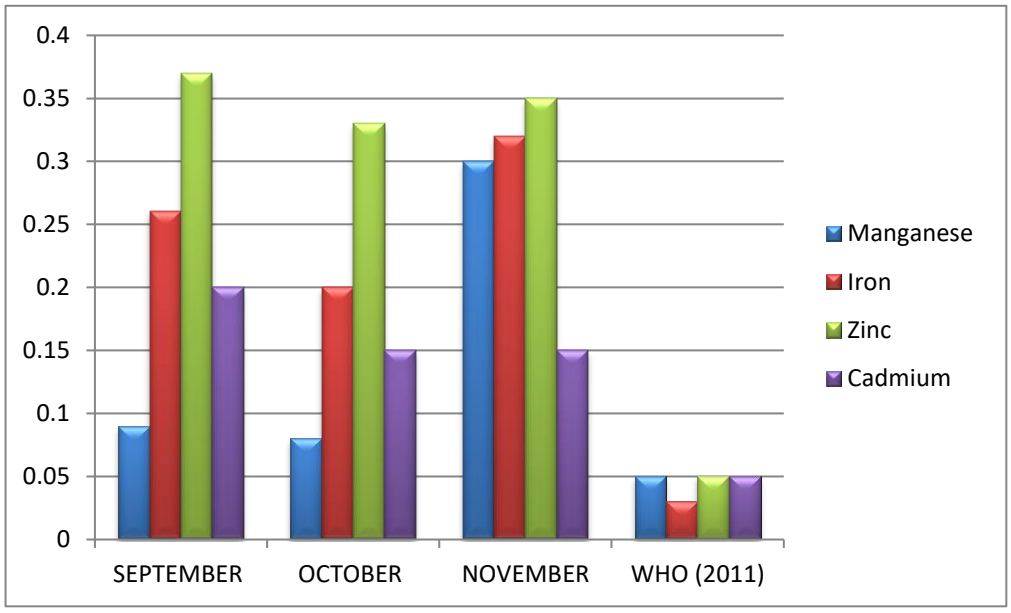


**Figure 4:** *Graphical representation of the monthly mean values ofManganese,Iron, Zinc and Cadmium*

### Total coliform count and E.coli

For water to be considered no risk to human health, the total coliform bacteria and *E.coli*in water sample should be zero[9]. Total coliform bacteria count ranged from 0 to 13.67cfu/100ml and that of *E.coli*ranged from 0 to 1.67cfu/100ml. Total coliform and *E.coli* count recorded values were not within WHO

acceptable limit. The high levels of microbial indicators in the wells might be due to soak away pits and latrines in the vicinity that had extended their influence on water qualities or presumably, the extreme high values of these microbial indicators recorded in the water samples, might be due to anthropogenic activities by human. The microbial indicator levels observed at these sampling sites make water unsuitable for drinking (WHO, 2011), and will pose significant health risks to humans. Similar study carried out indicated the presence of Total coliform and E.coli bacteria in the well water from Agbarho in Delta State showing that the water sampled were contaminated[9].

## CONCLUSION

The study was untaken with the aim to analyze the physico-chemical parameters, heavy metal concentrations and microbial contents of the water samples collected from selected hand-dug wells in Isoko North Local Government Area of Delta State. From the results obtained, it were observed that most physico-chemical parameters were within the permissible guideline of WHO (2011) with the exception of DO, BOD and COD which were higher than the WHO standard for drinking water. This indicated that the well water within the study areas were contaminated and can pose risk to the populace using the water for domestic and drinking purposes. Also it was observed that Sulphate exceeded the permissible limit of 200mg/L set by WHO(2011). The concentration of Fe, Zn, Mn and Cd analyzed in the water samples of the wells exceeded the WHO (2011) standard limits in all the wells studied. High level of heavy metals can pose harm to the rural dwellers that uses these water sources for drinking and other domestic uses. The values obtained from the microbial analysis indicate high densities of total coliform count and *E.coli* in the water samples studied. This is an indication of faecal contamination of the water. The contamination may be due to the sewage leakage and other impurities from non-point sources. Therefore, it is recommended that Thus the inhabitants should be educated on the need to keep their surroundings clean most especially around the wells this will ensure that incidences of contamination are noticed earlier for remedial action to be taken.

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