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# ASSESSEMENT OF QUALITY OF WATER SUPPLY FROM OGBOMOSO WATER WORKS OYO STATE

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**Abstract:** Water is a universal solvent, which is of inevitable use in our daily activities both domestic and industrial. There is paucity of information on quality of water supply from Ogbomoso water works. This project assess the quality of water supply in Ogbomoso water works to guarantee effective water resources management. Water samples were collected from eight (8) points, which include the raw water, clear well, and the other six (6) point, from tap at different houses around the water works. Physical–Chemical and biological parameters which include: Temperature, Colour, Turbidity, Total Dissolved Solid (TDS), pH, Electrical conductivity ($E_c$), Total Hardness, Chemical Oxygen Demand (COD), Total coliform, were carried out on the water samples. Selected heavy metals, which include Cd, Fe, Pb, Mg and Ca were analysed in the water sample. The Temperature, Turbidity, TDS, pH and $E_c$ varied from 25.25–25.65 ˚C, 0–6.75 NTU, 47–77 mg/L, 6.58–7.09 and 95–154 us/cm respectively. The corresponding value Total hardness, COD, BOD and Total coliform, ranged 36–56.6 mg/l, 1.9–7.1 mg/l, 0.9–3.85 mg/l, and 0–0.1 cfu/ml, respectively. The Cd, Fe, Pb, Mg and Ca concentration in the water varied from 0–0 mg/l, 0.063–0.294 mg/l, 0–0.085 mg/l, 0.065–0.64 mg/l and 2.55–11.35 mg/L, respectively. The supplied water from Ogbomoso water works is a portable water that satisfy all known water standards. The obtained results can be used to improve water quality supplied by Ogbomoso water works.
**Keywords:** physico–chemical, water works, Ogbomoso, water resources management

## 1. INTRODUCTION

Portable water is a human need and right for humanity. People need clean water to maintain their health and dignity. Having better water is essential in breaking the cycle of poverty since it improve people health strength, to work, and ability to go to school. However, declining water quality threatens the gains made over the past twenty years to improve access to drinking water. The quality of our global freshwater supplies is under increased threat of contamination. While water contains natural contaminants, it is becoming more and more polluted by human activities, such as open defecation, inadequate waste–water management, dumping of garbage, poor agricultural practices, and chemical spills at industrial sites (Abimbola *et. al.*, 2002).

Chemical contamination of drinking water both naturally occurring and from pollution is a very serious problem. Arsenic and fluoride alone threaten the health of hundreds of millions of people globally. But even more serious is microbiological contamination, especially from human feces. Fecal contamination of drinking water is a major contributor to diarrheal disease. Globally, an estimated 2,000 children under the age of five die every day from diarrheal diseases. Almost 90% of child deaths from diarrheal diseases are directly linked to contaminated water, lack of sanitation, or inadequate hygiene (UNICEF Canada, 2013). For every child that dies, countless others, including older children and adults, suffer from poor health and missed opportunities for work and education. Water quality testing is a tool that can be used to help identify safe drinking water whether at the source, within a piped distribution system, or within the home. Water testing plays an important role in monitoring the correct operation of water supplies, verifying the safety of drinking water, investigating disease outbreaks, and validating processes and preventative measures (Bain *et al*., 2012).

Water is an essential resource for human, animal and plant survival. It is a key player in the economic viability of nations; it is used in agriculture, transportation, recreation, and hydroelectric power generation. Life cannot exist without water (Aiyelokun *et. al*, 2017; Agbede and Ojelabi, 2017 & Okoye, 2004). Safe water is free from chemical and organisms that could cause illness. The quality of water determines its probable use. Human activities, improper waste disposal, urbanization, transportation, agricultural activities and infrastructural development impact the quality of surface and groundwater resources

Dams are barriers across flowing water that creates reservoirs, lakes or impoundments (Ezugwu, 2013). The embankment retains a large mass of water and submerges a large area of land. Dams supply water for irrigation, human and animal consumption (Oladejo *et. al*, 2014; Okeniyi *et.al*., 2013; Oladejo *et.al*, 2013), but are adversely affected by pollutants such as heavy metals and polychlorinated biphenyls (PCBs) from urban, agricultural and industrial activities. (Olayinka *et. al*., 2017) Water sourced from dams may be contaminated with microbes, chemicals, industrial wastes, leachates and solutes.

## 2. MATERIALS AND METHOD

### — Brief Description of Study Area

Ogbomoso, which is one of the most important towns in Oyo state, Oyo state is located in the south western part of Nigeria. It is located on Latitude 8° 8' 0" N, and Longitude 4° 16' 0" E. Ogbomoso is the second largest town in Oyo State. It is 104km North–East of Ibadan, 57km South–West of Ilorin and 58km North–West of

Oshogbo. Ogbomoso north local government lies between latitude 8.1227°N and longitude 4.2436°E. Ogbomoso North (LGA) is bounded in the North and the East by Surulere (LGA), in the South by Ogbomoso South (LGA) and in the West by Orire (LGA) as shown in Figure 1. Ogbomoso North has its headquarters at Kinira, is the most urbanized part of the Ogbomoso. It is the largest Local Government in the city being the city's major economic with a population of 279,400 (NPC, 2016).

Eight (8) Sampling points were selected at Ogbomoso water works which include, raw water, clear well, and water from household taps. One hundred and twenty centiliters (120 cl) of water was collected from each sampling point using a water sampler. The co–ordinates of the sampling points were taken using Geographic Positioning System (GPS). The collected samples were labelled, kept in the refrigerator and taken to National Horticultural Research Institute for the analysis at Ibadan.

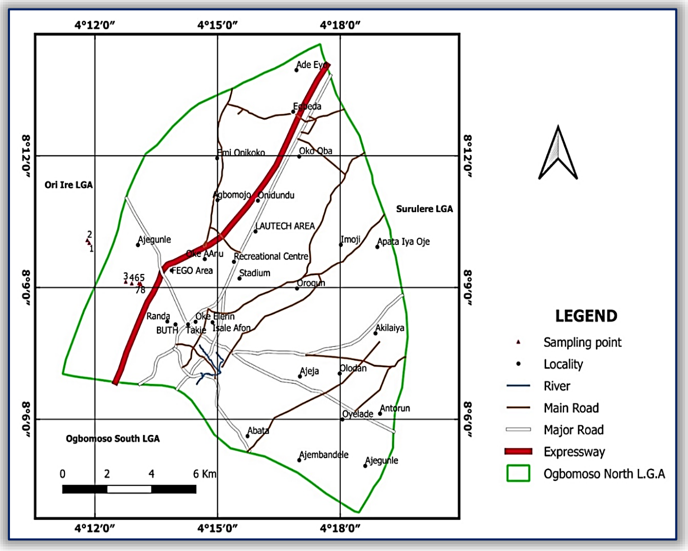


Figure 1: Ogbomoso North Local Government Study Area

— Laboratory analysis – Physical parameters

≡ Temperature: laboratory digital thermometer and conical flask were used in determining the temperature of the samples. The sample was poured into the conical flask. The temperature was then measured and recorded in degree centigrade.

≡ Turbidity: Spectrophotometer bottle and portable turbid meter (Jenway 6035) was used. The sample was put into the spectrophotometer (curvet). The spectrophotometer bottle was then put in the vacuum in the turbid meter and was aligned with a mark on a spectrophotometer bottle and turbid meter.

≡ pH: The pH meter probe was rinsed with distilled water and dried with soft tissue paper then standardized with buffer solution of known concentration (pH 7). The glass electrode was then cleaned and dried before being put into the water samples. The pH value was read and recorded immediately from the scale

≡ Electrical Conductivity and Total Dissolved Solid: Total dissolved solids and conductivity test were carried out simultaneously using conductivity meter (Jenway 470) after calibration with calibration solution (HI–7031, Henna instrument Hungry) at 25°C.

≡ Chemical Oxygen Demand (COD): This was carried out by the addition of mercuric sulphate and sulphuric acid into an aliquot of wastewater sample in a reflux flask. On cooling, the obtained solution was reacted with known concentration of potassium dichromate and known volume of sulphuric acid. The solution was refluxed for 2 hours and then cooled. The obtained solution was diluted to twice its volume, cooled to room temperature and excess $K_2Cr_2O_7$ in it determined by titrating with ferrous ammonium sulphate (FAS) using ferroin indicator. Similarly, a blank with all reagents added to 25 mL of distilled water was titrated. COD was computed using equation 1.

$$\text{COD}(\mathrm{Mg/l}) = \frac{(\mathrm{A-B})\times \mathrm{C}\times 8000}{\text{Volume of the sample(ml)}} \tag{1}$$

where A = volume of titrant used for the sample (ml); B = volume of titrant used for the blank sample (ml); C = the normality of the ferrous ammonium sulphate.

≡ Dissolved Oxygen: The DO was carried out with the use of a dissolved oxygen meter sensor METTLER TOLEDO (Seven excellence S900 bench top meter).

≡ Total Hardness: Total hardness was determined by taking 10ml of the water sample, diluted to approximately 50ml with deionized water. 1 to 2 ml buffer solution (pH 10) was added. 250 mg Sodium Cyanide (Scharlau Chemie, SO 0190) and 200mg indicator powder were added and mixed by shaking well. The solution was then titrated within 5 minutes with EDTA standard solution slowly with continuous stirring until reddish tinge disappeared.

≡ Total Coliform: Total coliform numbers were determined using Standard Method 9221 B: Standard Total Coliform Fermentation Technique. Heterotrophic bacteria were enumerated using Standard Method 9215C.

≡ Determination of Heavy Metal: The following minerals and heavy metals; Calcium (Ca), Cadmium (Cd), Iron (Fe), Magnesium (Mg) and Lead (Pb) were determined for each water sample using Atomic absorption spectrophotometry.

## 3. RESULT AND DISCUSSION

The physico–chemical, biological and heavy metal analysis on the water samples are presented in Table 1 and 2. Clear well, samples 1–6 were all within the permissible limits set by WHO and NSDWQ, while the raw water samples exceed the permissible limit of WHO and NSDWQ which was 5.8 NTU for both. High turbidity is caused by the presence of suspended matter such as clay, silts and fine particles of organic and inorganic matter, plankton and other microscopic organisms. Turbidity is a measure of how much light can filter through the water samples. Turbidity may not adversely affect health but may cause a need for additional treatment.

The temperature value ranged from 25.25°C to 25.65°C. All samples are within the range of WHO standard and for the NSDWQ standard an ambient temperature was recommended while WHO has a maximum permissible limit of 30 °C. The pH value ranged from 6.66 to 7.09. All samples are within the range of W.H.O and NSDWQ standard of 6.5 and 8.5 respectively.

The Total Dissolved Solid value ranged from 47–77mg/l. The raw water shows the lowest value (47mg/l) while point 4 shows the highest value (77mg/l). All samples are within the range of NSDWQ and WHO standard of 500 mg/l for both. The total hardness of water is an important parameter for domestic use of water. Hardness in water may even result from the presence of toxic heavy metal. The total hardness value ranged from 36 – 56.6mg/l. Point 3 and 6 show the lowest and highest value of 36 and 56.6 mg/l, respectively. Samples are within the range of WHO and NSDWQ standard of 100 and 150 mg/l respectively.

Table 1: Results of Water Analysis of the Samples

| Samples | pH | Temp | Conductivity | Turbidity | Hardness | TDS | COD | BOD | OD |
|---|---|---|---|---|---|---|---|---|---|
| Unit | | °C | us/cm | NTU | mg/L | mg/L | mg/L | mg/L | mg/L |
| clear water | 6.63 | 25.2 | 129 | 0.2 | 45 | 64 | 4.0 | 2.9 | 8.6 |
| | 6.69 | 25.1 | 122 | 0.1 | 48 | 62 | 4.2 | 3.1 | 8.8 |
| raw water | 7.01 | 25.3 | 96 | 6.7 | 35 | 48 | 7.0 | 3.8 | 7.5 |
| | 7.17 | 25.2 | 94 | 6.8 | 37 | 46 | 7.4 | 3.9 | 7.6 |
| point 1 | 6.53 | 25.4 | 128 | 0.5 | 55 | 64 | 2.0 | 1.3 | 4.7 |
| | 6.63 | 25.5 | 126 | 0.8 | 57 | 63 | 1.8 | 1.2 | 4.6 |
| point 2 | 6.91 | 25.2 | 124 | 0 | 55 | 66 | 4.0 | 0.9 | 4.5 |
| | 6.72 | 25.4 | 129 | 0.1 | 56 | 68 | 4.2 | 1.0 | 4.4 |
| point 3 | 6.99 | 25.3 | 139 | 0.3 | 40 | 69 | 2.0 | 1.1 | 4.6 |
| | 6.72 | 25.5 | 131 | 0.6 | 42 | 65 | 2.2 | 1.0 | 4.5 |
| point 4 | 6.51 | 25.4 | 152 | 1 | 35 | 76 | 2.0 | 1.2 | 4.3 |
| | 6.55 | 25.6 | 156 | 1.3 | 37 | 78 | 1.8 | 1.1 | 4.4 |
| point 5 | 7.09 | 25.5 | 136 | 0 | 45 | 68 | 2.5 | 0.9 | 4.5 |
| | 6.59 | 25.4 | 138 | 0.1 | 48 | 69 | 2.4 | 0.9 | 4.6 |
| point 6 | 6.98 | 25.6 | 147 | 0 | 55 | 73 | 3.0 | 1.1 | 4.7 |
| | 6.9 | 25.7 | 149 | 0 | 58 | 75 | 2.8 | 1.2 | 4.5 |
| WHO | 6.5–8.5 | 30 | 100 | 5 | 100 | 500 | 150 | NS | NS |
| NSDWQ | 6.5–8.5 | Ambient | 0 | 5 | 150 | 500 | 0 | 10 | NS |

Table 2: Results of Selected Heavy metals in Water Sample

| Samples | Pb | Cd | Fe | Ca | Mg | Total coliform | Colour |
|---|---|---|---|---|---|---|---|
| Unit | mg/L | mg/L | mg/L | mg/L | mg/L | cfu/ml $10^3$ | |
| clear water | ND | ND | 0.067 | 4.7 | 0.13 | NG | Colourless |
| | ND | ND | 0.064 | 4.65 | 0.15 | NG | Colourless |
| Raw water | ND | ND | 0.062 | 9.4 | 0.09 | 0.1 | Colourless |
| | ND | ND | 0.064 | 9.56 | 0.11 | 0.1 | Colourless |
| point 1 | ND | ND | 0.077 | 6.5 | 0.06 | NG | Colourless |
| | ND | ND | 0.079 | 6.35 | 0.07 | NG | Colourless |
| point 2 | 0.086 | ND | 0.32 | 11.5 | 0.11 | NG | Colourless |
| | 0.084 | ND | 0.287 | 11.2 | 0.14 | NG | Colourless |
| point 3 | ND | ND | 0.131 | 4.9 | 0.53 | NG | Colourless |
| | ND | ND | 0.128 | 4.75 | 0.59 | NG | Colourless |
| point 4 | ND | ND | 0.062 | 6.8 | 0.62 | NG | Colourless |
| | ND | ND | 0.059 | 6.65 | 0.66 | NG | Colourless |
| point 5 | ND | ND | 0.095 | 2.6 | 0.25 | NG | Colourless |
| | ND | ND | 0.098 | 2.5 | 0.23 | NG | Colourless |
| point 6 | 0.045 | ND | 0.231 | 9.6 | 0.15 | NG | Colourless |
| | 0.042 | ND | 0.219 | 9.44 | 0.18 | NG | Colourless |
| WHO | 0.08 | 0.003 | 0.3 | 200 | 150 | NS | |
| NSDWQ | 0.01 | 0.003 | 0.5 | 75 | 0.2 | 10 | |

NG: No Growth ND: Not Detected NS: Not Stated

The value of the COD ranges from 1.9–7.1mg/l. The highest and lowest values is at the raw water and point 4 with value 7.1 and 1.9mg/l, respectively. All samples conformed to the WHO standard of 150mg/l. The Electrical conductivity values ranges from 95–154 us/cm. All samples conformed to the WHO standard of 1000us/cm.

The DO value ranged from 4.35–8.7mg/l. The lowest and highest value are at point 4 and clear well. All samples conformed to the WHO and NSDWQ standard. Total coliform ranges from 0–100cfu/ml. Clear well and point 1 to 6 shows no growth of total coliform while raw water shows the presence of coliform recorded as 100cfu/ml. The WHO does not allow coliform while NSDWQ allows 10 number of total coliform. Clear well, Point 1–6 conform to WHO and NSDWQ standard while the raw water exceeds the permissible limit of NSDWQ standard. Biological oxygen demand ranges from 0.95–3.8mg/l. Point 5 and raw water shows the lowest and highest value (3.8mg/l). There is no specific limit for WHO standard while NSDWQ limit was 10 mg/L. All samples conform to the permissible limit of NSDWQ.

The Calcium value ranged from 2.55–11.35mg/l. Point 5 and 2 show the lowest value and highest value. All samples are within the range of WHO and NSDWQ standard of 200 and 75mg/l, respectively. Water containing calcium at concentration below 60mg/l is soft, between 60–120mg/l is moderately hard, 120–180mg/l is hard and more than 180mg/l is very hard. The Magnesium value ranged from 0.065–0.64mg/l. Point 2 and 4 shows the lowest and highest value. All samples are within the range of NSDWQ and WHO standard of 0.2 and 150 mg/l, respectively.

The Lead value ranged from 0.0mg/l to 0.0435mg/l. clear well, raw water, point 1,2,3,4 and 5 shows that there is no presence of lead at that particular point while point 6 shows the presence of lead (0.0435mg/l). All the clear well, raw water, point 1–5 does not exceed the range of W.H.O and NSDWQ standard of 0.05 and 0.01mg/l, respectively. Water sample at point 6 has Lead content value of (0.0435mg/l). Which exceed the standard of both WHO and NSDWQ. This may be as a result of a chemical reaction occurs in plumbing materials that contain lead. This is known as corrosion – dissolving or wearing away of metal from the pipes and fixtures.

The Iron content in the water sample ranged from 0.063 to 0. 225 mg/clear well, raw water, point 1–point 5 show the lowest value (0.063) while point 6 shows the highest value (0.225). All samples are within the range WHO and NSDWQ standard. This may be due to eroding lead from the pipe. All pipes that contain lead, might be due to household plumbing fixture, welding solder and pipe fitting sold style pipe. The pipes should be replaced where heavy concentration of lead was detected. There is no Cadmium value in all samples in this study. All samples are within the range WHO and NSDWQ standard.

## 4. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were reached from this study:

- The water available from Ogbomoso water works for consumption satisfies the safe potable water criteria except at sampling point 6
- Point 6 has lead concentration higher than NSDWQ standard. Calcium, magnesium, Cadmium, and iron are still within the permissible concentration limits.

Recommendations from the study:

- Piping system for point 6 should be checked and replaced to prevent lead contamination.
- Water at the clear well should be properly treated before been distributed to various houses to prevent heavy metal contamination.

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