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# RIVER WATER QUALITY ASSESSMENT AND ITS SUITABILITY FOR IRRIGATION PURPOSE

**[*1]Adegbola Gbolagade Adeyemi, [2]Soyewo Luke Temitope, [3]Odey Bernard Ogbor, [2]Ajani Adeyemi Babatunde[d]**

[1]Southern Guinea Research Station-Forestry Research Institute of Nigeria, Mokwa, Niger State, Nigeria.
[2]Forest Conservation and Protection, Forestry Research Institute of Nigeria (FRIN), Ibadan, Nigeria.
[3]Trial Afforestation Research Station-Forestry Research Institute of Nigeria (FRIN), Afaka-Kaduna State, Nigeria.

[*]Corresponding author's email: adeyemi.adegbola9@gmail.com

**ABSTRACT**
Irrigation water quality refers to water suitability for agricultural purpose. Good water quality has the possibilities to allow maximum yield of crops under good soil and water administration practices. Ikose River water which they are using for irrigation purposes by the rural communities was evaluated for its quality. Water samples were collected in dry as well as rainy season into sterilized, labelled bottles and were transported in ice pack to laboratory for analyses. Results were pH range of 6.36-6.43, calcium ($Ca^{2+}$) 23-25 mg/L, magnesium ($Mg^{2+}$) 8-12 mg/L, potassium ($K^+$) 2.40–2.50 mg/L, sodium ($Na^+$)1.74-1.90 mg/L, bicarbonate ($HC0_3^-$) 200-230 mg/L-, phosphate ($PO_3$-P) 0.10-0.12 mg/L, electrical conductivity (EC) is within 0.06 mg/L, Nitrate ($NO_3$-N) 0.04–0.42 mg/L, sulphate ($SO_4^{2-}$) 24-25 mg/L, total dissolved (TDS) 28.70-30.20 mg/L for the dry season and the pH ranged from 7.01-7.03, ($Ca^{2+}$) 45-48 mg/L, ($Mg^{2+}$) 24-18 mg/L, ($K^+$) 4.20–4.30 mg/L, ($Na^+$) 2.12-2.14 mg/L, ($HCO^-_3$) 350-360 mg/L, ($PO_3$-P) 0.19-0.20 mg/L, (EC) is within 0.11 mg/L, ($NO_3$-N) 0.10-0.11 mg/L, ($SO_4^{2-}$) 38.00-39.00 mg/L, (TDS) 54.50-54.60 mg/L for the rainy season. The samples analyzed were within the recommended standard limits set for irrigation water quality. The water quality indicators MAR, 29.4; SAR,0.08; SSP,3.78; KR,0.04; PS, 0.46; PI, 92.95; RSC,1.46; TH, 101.5 for dry season and MAR, 36.11; SAR, 0.06; SSP, 2.03; KR, 0.02; PS,0.28; PI, 54.94; RSC, 1.36; TH, 224.5 for rainy season were under safe limits.

**Keywords**: dry season, irrigation, rainy season, water quality

## INTRODUCTION

Water plays a vital role in human life and is an essential natural resource that plays an important role in supporting irrigation and economic growth. The consequence of climate change, speedy growth of population coupled with extension of urbanization and industrialization combined with improper sanitation management have leads to the increase in the river water contamination (Tsado *et al*., 2014; Al-Isawi *et al.*, 2016). The knowledge of irrigation water quality is important to soil conservation and maximum agricultural productivity. Surface water quality is the physical, biological and chemical characterization of surface water, which measures its suitability for human and animal consumption, irrigation and other uses. The quality of water body is assessed using several physical, chemical and biological parameters, in fact, values of these parameters are harmful to crop if they exceed certain threshold values (APHA 2005). According to FAO statistics, 20% of the land is irrigated but produces 40% of the crops Tiri *et al*. (2018).

However, the total water amount on earth is about 1.35 billion cubic kilometers. About 97.1 per cent has been locked into oceans as saltwater. Ice sheets and glaciers have arrested 2.1 per cent. Only 0.2 per cent is the fresh water present on the earth, which can be used by human for different purposes. Remaining 0.6 per cent is in underground form Status Report (2007). The qualities of these water bodies vary widely depending on the location and environmental factors Tay (2007).

It has been documented in literature that wastewater can only be of good quality and suitable for irrigation when both the water quality indices (Morari and Giadini, 2009; Al- Isawi *et al*., 2015) and irrigation water quality variables (Bauder *et al.*, 2011; Tsado *et al.*,2014) are within the recommended standard by the authorized government agencies respectively.

Meanwhile, suitability of surface water for irrigation purposes depends upon the salinity, conductivity, and hardness of water, unfortunately, these parameters are increasing due to the poor sanitation, dumping of waste products and sewage into the river channels and diffuse contamination originating from intensive irrigated agriculture Saidi *et al*. (2009). Unfortunately, in many areas of the world, especially developing countries including Nigeria, it is difficult to obtain a steady source of water for agricultural uses.

Several researchers have also reported that river waters with standard quality indices and their consecutive recycle in irrigation led to increase in soil quality and good crop yield productions (Qadir *et al.*, 2007; Tsado *et al*., 2014), while reverse was the case particularly in poor river waters quality for irrigation (Danazumi and Bichi 2010; Al-Isawi *et al.*, 2016). Therefore, quality and quantity of surface water is a dynamic process that has equal important, but both varies from place to place and season to season Omran *et al*. (2014).

Recently, it has been realized that the interaction between the physico chemical properties of the soil and the irrigation water is also a very important parameters in evaluating the suitability of water for irrigation and in water management. Therefore, the main purpose of this research work is to evaluate the suitability of Ikose river in Ogbomoso, Ogbomoso on water resources quality for irrigation purpose by appropriate parameters and indices and hence to ascertain its suitability for irrigation purpose.

## MATERIALS AND METHODS

### Study area

Ikose River is located on the north part of Ogbomoso land in Oyo state. Ogbomoso located on Latitude 8° 10' N and Longitude 4° 10' E, about 342 m above the mean sea level, southwest Nigeria. The study area has a bimodal rainfall pattern, with rainfall peaks in the months of June and September and break in August, with mean annual rainfall of approximately 1200 mm while the mean maximum temperature was not above 33°C and minimum temperature not below 16°C. The relative humidity of the area is not less than 80% between the months of April-November while it is low between December-March when dry wind (harmattan) blows from the northeastern part of the country Olaniyi (2006). Ikose River is along Ogbomoso- Igbeti road in Oyo state.

### Sample collection and analysis

Ikose River was visited as early as 7:00 am for samples collections for analyses. Sampling were collected and taken to laboratory for the analysis of physiochemical properties. This research work conducted in November, 2018 for the dry season and July, 2019 for the rainy season. In order to get accurate results, during each sampling, twelve replicates of water samples were collected in sterilized labelled bottles. After sampling, the bottles were marked, sealed and taken to the laboratory in ice-packed container for further analyses.

The water quality indicators that were analyzed were: EC, $Ca^{2+}$, $CO_3$, $HCO^-_3$, $K^+$, $Mg^{2+}$, $Na^+$, pH, $PO_3$-P, $SO_4$, $NO_3$-N $Cl^-$ and TDS (All analyses were done according to APHA (2005) standard method. The concentrations of $Na^+$, $Ca^{2+}$ and $Mg^{2+}$ were used to quantify the sodium adsorption ratio (SAR) according to the equation:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+}+Mg^{2+}}{2}}} \quad (1)$$

Where $Na^+$ is sodium concentration, meq/L; $Ca^{2+}$ is calcium concentration, meq/L; $Mg^{2+}$ is magnesium concentration, meq/L

### Water samples analysis

Water sample analysis of Ikose river in Ogbomoso were done for the major and minor ions ($Na^+$, $K^+$, $Ca^{2+}$ and $Mg^{2+}$) and anions ($NO_3$, $CO_3$, $HCO_3$, $SO_4^{2-}$ and $PO_4^{2-}$) and other chemical parameters (SAR, SSP, RSC, PI, KR, MAR, TH and PS) have also determined using standard empirical formulas. Beside this, measurements of pH, EC, TDS were done on the spot by means of a mercury thermometer and digital pH meter. The samples were then carefully sealed, labeled and taken for analysis. Chemical analyses were performed in the laboratory using Atomic Absorption Spectrophotometry for cations and conventional titration for anions Chopra and Kanwar (1980).

### Data analysis

The results obtained were subjected to descriptive statistics to determine the minimum, maximum, mean, standard deviation and coefficient of variation of the pooled data, irrespective of sampling points and sampling period. Raw data and computed water quality indicators was subjected to analysis of variance (ANOVA) and means were separated by using Fisher`s least significant difference (LSD) test at 5% level of probability. All analyses were performed by using SPSS (v. 20) and Grapher (version 10.0) software. The analytical results were compared with the standard specification Salifu, *et al*. (2017).

### Residual sodium carbonate (RSC)

The residual sodium carbonate was calculated simply by subtracting the quantity of $Ca^{2+} + Mg^{2+}$ from the sum total of carbonates and bicarbonates determined separately in a given sample and expressed in meq/L. Thus,

$$RSC = (CO_3^{2-} + HCO_3^-) - (Ca^{2+} + Mg^{2+}) \quad (2)$$

### Sodium adsorption ratio (SAR)

Sodium adsorption ratio was calculated using the formula equation 3. The concentrations of $Na^+$, $Ca^{2+}$ and $Mg^{2+}$ were used to determine the sodium adsorption ratio (SAR)

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+}+Mg^{2+}}{2}}} \quad (3)$$

Where, $Na^+$ is sodium concentration, meq/L; $Ca^{2+}$ is calcium concentration, meq/L; $Mg^{2+}$ is magnesium concentration, meq/L.

### Soluble sodium percentage (SSP)

Wilcox (1955) has proposed classification scheme for rating irrigation water on the basis of soluble sodium percentage (SSP). The SSP was calculated by using following formula:

$$SSP = \frac{Na \times 100}{Ca+Mg+Na} \quad (4)$$

Where, the concentration of ions is expressed in meq/L.

### Permeability index (PI)

The permeability index was calculated by the following formula:

$$PI = \frac{Na+\sqrt{HCO_3}}{Ca+Mg+Na} \times 100 \quad (5)$$

Where, all the values are in meq/L.

### Kelly's ratio (KR)

Kelly's ratio was calculated by using the following expression:

$$KR = \frac{Na^+}{Ca^{2+}+Mg^{2+}} \quad (6)$$

Where, concentrations are expressed in meq/L

### Magnesium adsorption ratio (MAR)

Magnesium adsorption ratio was calculated by using the following expression:

$$MAR = \frac{Mg^{2+} \times 100}{Ca^{2+}+Mg^{2+}} \quad (7)$$

Where, concentrations are expressed in (%)

### Total hardness (TH)

Total hardness was calculated by using the following expression:

$$TH = \left\{ \left( 2 \times \frac{Ca^{2+}}{40} \right) + \quad \left(2 \times \frac{Mg^{2+}}{24}\right) \right\} \times 50 \quad (8)$$

Where, concentrations are expressed in mg/L

### Potential salinity (PS)

$$PS = Cl^- + \sqrt{SO^{2-}} \quad (9)$$

Where, concentrations are expressed in meq/L

## RESULTS AND DISCUSSIONS

The analyzed physicochemical qualities of Ikose River water were as indicated in table 1.

Bicarbonate brings about a change in soluble sodium percentage, hence regulate sodium hazard. Bicarbonate in the studied River water ranged within 200 mg/L to 230 mg/L having mean values of 213.33 mg/L, in dry season while in the rainy season ranged from 350 mg/L to 360 mg/L, having mean values of 356.67 mg/L and the maximum bicarbonate permissible limit is 620mg/L (FAO (1989), therefore, the values are within permissible limit. It has no traced of carbonate due to the pH of the water.

**Table 1: Descriptive statistics of the river water parameters for irrigation**

| Parameters | Dry season | | | | | Rainy season | | | | | Irrigation standard (MPL) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Mean | Cv(%) | SD | Min | Max | Mean | Cv(%) | SD | |
| $HCO_3^-$ | 200 | 230 | 213.3 | 7.16 | 15.28 | 350 | 360 | 356.7 | 1.62 | 5.77 | 620 |
| $NO_3$-N | 0.04 | 0.42 | 0.17 | 130.3 | 0.22 | 0.10 | 0.11 | 0.10 | 2.95 | 0.00 | 10 |
| $SO_4^{2-}$ | 24.00 | 25.00 | 24.67 | 2.34 | 0.58 | 38.00 | 39.00 | 38.33 | 1.51 | 0.58 | 960 |
| $PO_3$-P | 0.10 | 0.12 | 0.11 | 9.09 | 0.01 | 0.19 | 0.20 | 0.19 | 2.98 | 0.01 | 2 |
| $Ca^{2+}$ | 23.00 | 25.00 | 24.00 | 4.17 | 1.00 | 45.00 | 48.00 | 46.33 | 3.30 | 1.53 | 400 |
| $Mg^{2+}$ | 8.00 | 12.00 | 10.00 | 20.00 | 2.00 | 24.00 | 28.00 | 26.00 | 7.69 | 2.00 | 61 |
| $Na^+$ | 1.74 | 1.90 | 1.82 | 4.40 | 0.08 | 2.12 | 2.14 | 2.13 | 0.47 | 0.01 | 400 |
| K+ | 2.40 | 2.50 | 2.43 | 2.37 | 0.06 | 4.20 | 4.30 | 4.23 | 1.36 | 0.06 | 2 |
| pH | 6.36 | 6.43 | 6.40 | 0.59 | 0.04 | 7.01 | 7.03 | 7.02 | 0.16 | 0.01 | 6.0-8.5 |
| Cl- | 7.50 | 9.00 | 8.25 | 7.59 | 0.62 | 12.00 | 14.00 | 12.67 | 9.12 | 0.62 | 1065 |
| EC | 0.06 | 0.06 | 0.06 | 0.00 | 0.00 | 0.11 | 0.11 | 0.11 | 0.00 | 0.00 | 3 |
| TDS | 28.70 | 30.20 | 29.50 | 2.56 | 0.75 | 54.50 | 54.60 | 54.53 | 0.11 | 0.06 | 2000 |

All parameters measured in mg $L^{-1}$, except EC (dS $m^{-1}$) and pH. (no unit); TDS: Total dissolved solid; EC: Electrical conductivity; TH: Total hardness; Min.: minimum; Max.: maximum; SD: standard deviation; CV: coefficient of variation; MPL: Maximum permissible limit; Irrigation standard: Salifu *et al*. (2017).

The mean and maximum Nitrate nitrogen ($NO_3$-N) concentration in the studied water is 0.17 mg/L and 0.42 mg/L, for dry season while 0.10 mg/L and 0.11 mg/L, in rainy season respectively. This values fall below the maximum limit of 10mg/L recommended for irrigation purposed by FAO (1989). The low level of $NO_3$-N concentration in the water could be attributed to a low percentage of cropland within the study area that indicates lower nitrogen based fertilizer were used. This lends credence and confirms the assertion of Wick *et al*. (2012) and Keeney *et al.* (2014) who observed a similar trend. Nitrogen is a major nutrient needed by the plant, its abundance is desired in irrigation water; though low concentration of it (as in the water studied) does not make the water unfit for irrigation. Moreover, the result was not conform with some reported data in the literature Morrison *et al.* (2001), also, the reverse was the case in some studies reported elsewhere with recorded values within the range found in the present study (Tsado *et al*., 2014; Al-Isawi *et al*., 2016). The possible reason for the contradicting values could be attributed to the composition of the wastewater constituents; organic and inorganic substances entering the river Morrison *et al*. (2001).

Sulphates ($SO_4^{2-}$) are naturally occurring in surface waters. However, discharges from industries as well as atmospheric precipitation could add significant quantities to surface waters Khudair (2013). The concentrations of $SO_4^{2-}$ in the studied water ranged from 24 mg/L to 25 mg/L with a mean value of 24.67 mg/L in dry season and was 38 mg/L to 39 mg/L with a mean value of 38 mg/L in rainy season (Table 1). These values was within the maximum limit of 960 mg/L Salifu *et al*. (2017), however, indicating no threat.

Phosphate ($PO_3$-P) in irrigation water are more of fertility issue, however high levels of $PO_3$-P in the water sources is not desirable, as it is an indication of eutrophication of surface water bodies Davis *et al.* (2001). Although, the total phosphate concentration of the Ikose River during dry season ranged from 0.10 mg/L to 0.12 mg/L with a mean value of 0.11 mg /L; and in rainy season ranged from 0.19 mg/L to 0.20 mg/L with a mean value of 0.19 mg /L; (Table 1).

When excess nitrogen and phosphorus are transported to surface water, they cause eutrophication and elevated algal Davis *et al.* (2001). Waters with elevated N can also cause quality problems in crops such as barley and sugar beets as well as excessive vegetative growth in vegetables, thus delaying fruit setting and maturity Bauder *et al.* (2014).

High concentrations of $Ca^{2+}$ and $Mg^{2+}$ ions in irrigation water will cause increase in soil pH, leading to reduction in the availability of phosphorous to plants Al-Shammri *et al.* (2005). According to Khodapanah *et al.* (2009), water containing $Ca^{2+}$ and $Mg^{2+}$ above 400 mg/L and 61 mg/L respectively, are not suitable for irrigation. The observed concentrations of these elements was not more than 25 mg/L and 12 mg/L for $Ca^{2+}$ and $Mg^{2+}$ in dry season, 48 mg/L and 28 mg/L in rainy season respectively, this indicated that none of the samples exceeded the threshold value.

Sodium ($Na^+$) content is another major indicator when evaluating irrigation water quality, however, its concentrations ranged from 1.74 mg/L to 1.90 mg/L with a mean value of 1.82 mg /L during the dry season and was 2.12 mg/L to 2.14 mg/L with a mean value of 2.13 mg/L in rainy season; The range and mean values were less than 400 mg/L Salifu *et al.* (2017), indicating no restriction of use. Irrigation water with high sodium ($Na^+$) content could cause the displacement of exchangeable cations, such as $Ca^{2+}$ and $Mg^{2+}$, from the soil clay minerals, which would be replaced by $Na^+$ Matthess *et al.* (1982) stated that soils saturated by sodium peptize and they lose their permeability, leading to decrease in fertility and their suitability for cultivation.

The potassium concentrations in the study water in dry season have a minimum, maximum and mean of 2.40 mg/L, 2.50 mg/L and 2.43 mg/L and 4.20 mg/L, 4.30 mg/L and 4.23 mg/L in rainy season respectively; the maximum concentration in dry season and minimum, maximum and mean in rainy season exceeds the threshold value of 2 mg/L. Inorganic fertilizers containing at least one of three basic nutrients; nitrogen, phosphorus, and potassium, are widely used in the study area to replenish crop and soil nutrients. Half to one- third of this fertilizer are absorbed by the crop and the remaining becomes residual in the soil and may join water body (Tomer and Burkart, 1998; Taiwo, 2016). Potassium is both an important fertilizer and common rocks constituent, high concentration of potassium ion found in the water could have been induced by leachates from agricultural fertilizer as observed by Falowo *et al.* (2017) or dissolution of rock constituent. A major concern of high potassium concentrations in irrigation water is its deleterious effects on soil hydraulic properties, which has negative impacts on infiltration, water availability and plant growth Oster *et al.* (2016).

The observed pH values ranged from 6.36 to 6.43, with the mean values of 6.40 in dry season while pH values ranged from 7.01 to 7.03 with the mean value of 7.02 in rainy season, both are tolerable to crops and within World Health Organization (WHO) limits. The water is good for irrigation use. The mean pH values indicated that the rivers did not have alkaline. Although, application of irrigation water with pH outside the threshold could cause nutritional disparity or lead to toxic ion build up in the soil (Ayers *et al*., 1985).

**Suitability of Ikose river water in Ogbomoso for irrigation**

Magnesium content of water is very important criteria in determining irrigation water quality. In most of the water, calcium and magnesium maintain a state of equilibrium. Too much content of magnesium in water use for irrigation will negatively affect crop yields as the salinity of the soils increases Joshi *et al.* (2009). The values of the magnesium adsorption rate of the water sampled in this study varies from 29.4% to 36.11% (Table2) from dry to rainy season, the value gotten shown that it is below the maximum limit of 50% (table 3 ) Ayers and Westcot (1985). The water is therefore considered acceptable and suitable for irrigation. However, high magnesium adsorption ratio usually have negative effect to soil when it exceeds 50%.

The Kelly's ratio of unity or less than one is indicative of good quality of water for irrigation whereas above one is suggestive of unsuitability for agricultural purpose due to alkali hazards Karanth (1987). Kelly's ratio values of greater and less than unity describes the sampled water as being not suitable and suitable for irrigation respectively (table 4) Sundaray *et al*. (2009). From these figures, both in dry season as well as rainy season were observed to be 100 per cent good. The area has good quality water for irrigation purposes due to non-alkali hazards in the water.

**Table 2: Descriptive statistics of the water quality indices for irrigation**

| Parameters Indicator | Quality Rate Dry season | Rainy season |
|---|---|---|
| MAR | 29.4 | 36.11 |
| KR | 0.04 | 0.02 |
| PS | 0.46 | 0.28 |
| PI | 92.95 | 54.94 |
| SAR | 0.08 | 0.06 |
| RSC | 1.46 | 1.36 |
| TH | 101.5 | 224.5 |
| SSP | 3.78 | 2.03 |
| EC | 0.06 | 0.11 |
| TDS | 29.50 | 54.53 |

Magnesium absorption ratio, %, KR: Kelly's ratio, meq/L; PS: Potential salinity, meq/L; PI: Permeability Index, meq/L; SAR: sodium adsorption ratio, meq/L; RSC: Residual sodium carbonate, meq/L; TH: Total hardness, mg/L; SSP: Soluble sodium percentage, meq/L; EC: Electrical conductivity dS/m and Total dissolved solid (Source: Authors Fieldwork, 2021)

Potential salinity (PS) is an important parameter for assessing the suitability of water for irrigation uses, the water samples from the study river shown 0.46 meq/L in dry season and 0.28 meq/L in rainy season. This indicated that the water samples from the study area is good for irrigation purposes in both dry and rainy season and on soil of low permeability and on class I (Table 4). PS means chloride concentration plus half of the sulfate concentration Doneen (1961).

**Table 3: Summary of sampling point delineation under different limits (Meq/L)**

| SAR | Class | PI | Class |
|---|---|---|---|
| <10 | Excellent | <25 | Unsuitable |
| 10 – 18 | Good | 25 – 75 | Good |
| 18 – 26 | Fair | >75 | Excellent |
| >26 | Unsuitable | | |
| **KR** | **Class** | **SSP** | **Class** |
| < 1 | Good | < 50 | Safe |
| >1 | Unsuitable | > 50 | Unsuitable |
| **MAR** | **Class** | **RSC** | **Class** |
| < 50 | Acceptable | < 1.25 | Suitable |
| >50 | Non-acceptable | 1.25- 2.50 | Doubtful |
| | | >2.50 | Unsuitable |

SAR: sodium adsorption ratio; Mg/Ca: Magnesium-calcium ratio; KR: Kelly's ratio; SSP: soluble sodium percentage; PI: permeability index; RSC: residual sodium carbonate. MAR: Magnesium adsorption ratio (%)
Source: (Adhikary and Dash, 2012; Kerala,2014; Boateng et al., 2016

**Table 4: Classification of irrigation water based on potential salinity (Meq/L)**

| Class of water/soil characteristics | Class I | Class II | Class III |
|---|---|---|---|
| Soil of low permeability | < 3 | 3-5 | >5 |
| Soil of medium permeability | < 5 | 5-10 | >10 |
| Soil of high permeability | < 7 | 7-15 | >15 |

Source: Doneen (1961)

The Permeability Index (PI) values > 75 meq/L indicates excellent quality water for irrigation. If the PI values are between 25 meq/L and 75 meq/L, it indicates good quality of water for irrigation. However, if the PI values are less than 25 meq/L, it shows unsuitable nature of water for irrigation (Table 3). Permeability Index (PI) of water is a function of sodium, calcium, Magnesium and carbonate in the soil (Vasanthaiviger, 2010; Stewart and Hielsen, 1990). Based on this assessment, the water samples from this location indicate good quality of water in dry season as well as wet season, therefore suitable for irrigation purposes.

The waters having SAR values less than 10 meq/L are considered excellent, 10meq/L to 18meq/L as good, 18 meq/L to 26 meq/L as fair, and above 26 meq/L are unsuitable for irrigation use USDA (1954). In this work, the SAR values are lesser than 10 meq/L for the samples taken in dry and rainy season, therefore it is graded as excellent for irrigation use (Table 3). SAR is a measure of tendency of sodium (Na) ion to displace $Ca^{2+}$ ion in the irrigation water soil Al-Tabbal and Al-Zboon (2012).

The Residual Sodium Carbonate (RSC) did not exceed value of 2.5 meq/l in dry and rainy season; the water is generally suitable for irrigation. If the value of RSC is between 1.25 meq/l and 2.5 meq/l, the water is doubtful (Table 4) while a value less than 1.25 meq/l indicates safe water quality Cuena (989). In this respect, it is evident from (Table 3), that, RSC values in dry season as well as rainy season are less than 1.25meq/l indicates safe water quality, suggesting that, the study location are under safe limit for irrigation use.

Total hardness simply means the sum of calcium and magnesium. The values of total hardness in dry season was 101 mg/L and 224 mg/L in rainy season. Where the maximum value is below the prescribed limit for irrigation water of 712 mg/L set by (FAO, 1989). The low values of total hardness are probably due to the presence of alkaline earth ions ($Ca^{2+}$ and $Mg^{2+}$) of weak acids ($HCO_3^-$ and $CO_3^-$) and strong acids (Cl-, $SO_4^{2-}$ and $NO_3$) (Roy *et. al.*, 2018; Rao et. *al.*, 2012). Therefore, low alkalinity values reflect immature hydrochemistry of surface water during seepage and hypodermic flow Demetriades (2011). The water sample was classified as hard water during dry season and very hard in rainy season.

Wilcox (1955) has proposed classification scheme for rating irrigation waters on the basis of soluble sodium percentage (SSP). The values of SSP less than 50 meq/l indicate good quality of water and higher values (i.e. > 50 meq/l) shows that the water is unsafe for irrigation USDA (1954). From these figures, it is observed that, 100 per cent of the water in dry season as well as rainy season has good quality water and safe for irrigation purposes.

Electrical conductivity in this study for irrigation water quality, it values ranged within 0.06dS/m with a mean of 0.06 dS/m in dry season and within 0.06 dS/m with a mean of 0.06 dS/m in rainy season (Table 1); The sample falls within the standard irrigation water categories as the maximum limit for irrigation water was prescribed as 3dS/m (Table 1), thus, the water is suitable for irrigation use in terms of EC and TDS.

Too much of salts of calcium, magnesium, sodium and potassium present in the irrigation water maybe delicate and injurious to the plants. However, they reduced the osmotic activities of the plants and may avert sufficient aeration. The salt concentration in water of Ikose river in Ogbomoso ranged from 28.70 mg/l to 30.20mg/l with a mean of 29.50 mg/l for dry season and ranged from 54.50 mg/l to 54.60 mg/l with a mean of 54.53 mg/l in rainy season (Table 1); the higher concentration is below the permissible limit of the standards 2000mg/l FAO (1985), also according to irrigation water quality classification by (Ayers *et al*., 1985), the values fall within permissible limit for irrigation (< 450mg/l) and they had no restriction. The value of the coefficient of variation was 2.56 mg/L, indicated that the TDS of water in the study area varied.

## CONCLUSION

Based on this study, Ikose River water in Ogbomoso were examined for its quality and its suitability for irrigation. It is found suitable for irrigation purposes, and appropriate management measures are suggested to safeguard the quality of this resource and could be used on almost all soils.

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