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Assessment of Water Quality Used for Irrigation: Case Study of Josepdam Irrigation Scheme

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Abstract**—**The aim of irrigation is to recharge the available water in the soil. Quality of irrigation water is essential for the yield and quality of crops produced, maintenance of soil productivity and protection of the environment. The analysis of irrigation water arises as a need to know the impact of irrigation water on the yield of crops, the effect, and the necessary control measures to rectify the effect of this for optimum production and yield of crops.

This study was conducted to assess the quality of irrigation water with its performance on crop planted, in Josepdam irrigation scheme Bacita, Nigeria. Field visits were undertaken to identify and locate water supply sources and collect water samples from these sources; X1 Drain, Oshin, River Niger loop and Ndafa. Laboratory experiments were then undertaken to determine the quality of raw water from these sources.

The analysis was carried for various parameters namely; physical and chemical analyses after water samples have been taken from four sources. The samples were tested in laboratory. Results showed that the raw water sources shows no salinity tendencies with SAR values less than 1me/l and Ecvaules at Zero while the pH were within the recommended range by FAO, there are increase in potassium and sulphate content contamination in three of the location. From this, it is recommended that there should be proper monitoring of the scheme by conducting analysis of water and soil in the environment, preferable test should be carried out at least one year to cover the impact of seasonal variations and to determine the physical and chemical analysis of the water used for irrigation at the scheme.

Keywords**—**Irrigation, Salinity, Raw water quality, Scheme.

I. Introduction

IRRIGATION water use includes all water artificially applied to farm, orchard, pasture, and horticultural. Irrigation water quality is a key environmental issue faced by the agricultural sector as well as it is very important for every agricultural use, passing through such activities as irrigation to livestock watering, from safe household family drinkable water on farms, etc. Agricultural water sources may be of poor quality because of natural causes or contamination and often require improvement before it is acceptable for a given use [1].

Irrigation water quality can affect all irrigation crop, fruit, and vegetable production. All ground and surface waters contain dissolved mineral salts of various kinds and quantities. A laboratory analysis will provide information on irrigation water quality. Most irrigation water analyses include: Sodium Adsorption Ratio (SAR); total dissolved solids as measured by electrical conductivity of the water concentration of specific anions, especially bicarbonate, chloride, and sulfate; concentrations of specific cations, especially sodium, magnesium and calcium; and pH value of the water [2].

Quality of irrigation water is an important consideration in any appraisal of irrigation schemes and especially in the saline or alkaline conditions in irrigated areas. Irrigation water quality could have a profound impact on crop production; low quality water for irrigation can impose a major environmental constraint to crop productivity. All irrigation water contains dissolved mineral salts, but the concentration and composition of the dissolved salts vary depending on the water source [3]. It therefore becomes necessary that since various schemes have been observed to be adversely affected by irrigation water quality which affect the crop yield, irrigation water quality of Josepdam irrigation scheme needs to be monitored to ensure sustainability and deal with fluctuations in the schemes water quality. This study was thus conducted to monitor the water quality with particular focus on the chemical properties under both surface and sprinker irrigation method of the scheme in 2013 as the year under consideration. The method of irrigation commonly used on this scheme is Basin surface and sprinker irrigation for the production of sugar cane.

II. Materials and Methodology

A. Location of Study Area

Josepdam Sugar Company, irrigation scheme is located in Bacita, a town 120 km north of, Ilorin the Kwara State capital and on the south bank of River Niger in Edu Local Government Area of Kwara State (Fig. 1). The town lies in the Guinea Savannah region, latitude 09°5’ N and Longitude 04°56’ E, at an altitude 76 m above sea level and a population of 50,000 people.

The sources of water supply for the irrigation schemes are Rivers Niger, Oshin and Ndafa. The major river that supplies water for irrigation to the farm is River Niger which carter for 80% of the irrigation water required, Oshin River carters for 15% and the remaining 5% by Ndafa River. River Niger supplies the water needed for surface irrigation and the overhead irrigation systems while Oshin and Ndafa River supplies just for the surface irrigation alone [4].

Water samples were collected from four sources namely: X1 Drain, Oshin, River Niger loop and Ndafa these were analysed for chemical properties. At each sampling point, two (2) samples of 100ml were taken using Sterilized Marcatney bottles for the purpose of water analysis identification. The sample bottle was submerged and allowed to fill without allowing air to mix with the sample. The bottle was

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completely filled and held submerged until the cap is firmly in place. The water samples were kept in bottles that have been soaked for 24 hours in HNO3 solution to kill any microbes. The bottles were labeled accordingly, sealed refrigerated and taken to the laboratory within 24hrs of collection for analysis [5].

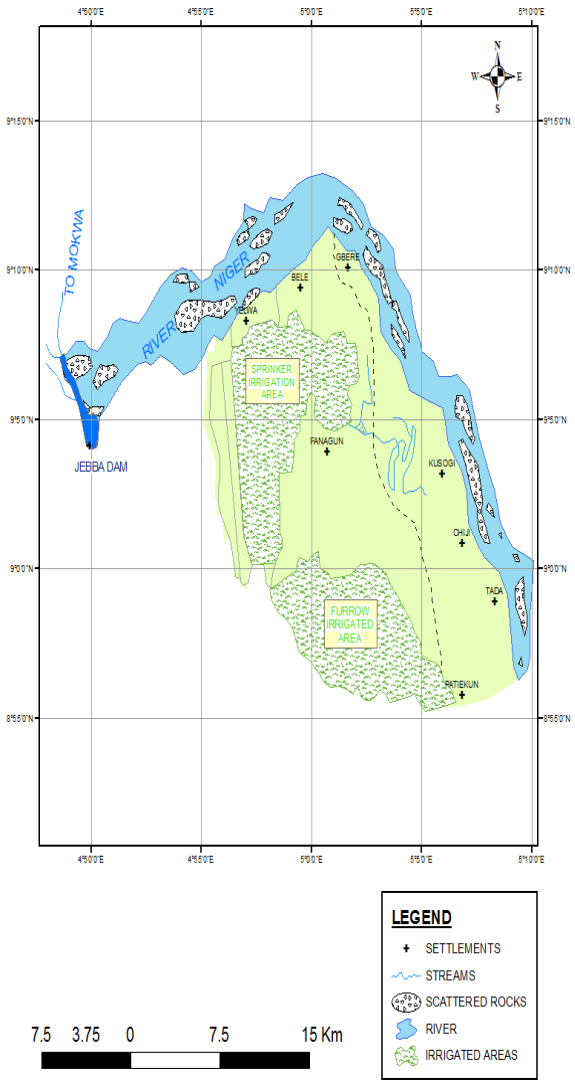

Fig. 1 Location Map of Josepdam Irrigation scheme

III. Results and Discussion

Irrigation water used in Josepdam is of high quality, having effect on soil quality and crop yield is not certain. The pH values for four sampling points of the irrigation scheme is in normal to neutral range (pH = 6.5-8.5), Fig. 2. The current result shows no present of electrical conductivity, which shows no traces of EC. Since the result show no effect of EC, the water is suitable for irrigation with respect to the electrical conductivity. The SAR content (Fig. 3) of all the four water sources ranges (0.2-0.38 me/l) this indicated that the sodium level is not high enough to cause sodium hazard; there will be no reduction in infiltration rate [6]. SAR in Josepdam scheme water is suitable for irrigation with respect to the FAO recommended range which means there is no salinity tendency, there are little traces of chloride (Fig. 4) in all four water sources (0.01me/l) which is negligible,

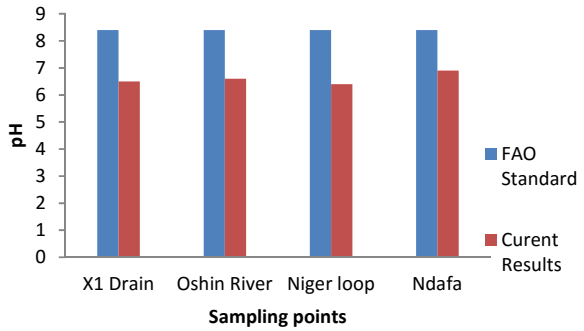

Fig. 2 Current pH level compared with the FAO

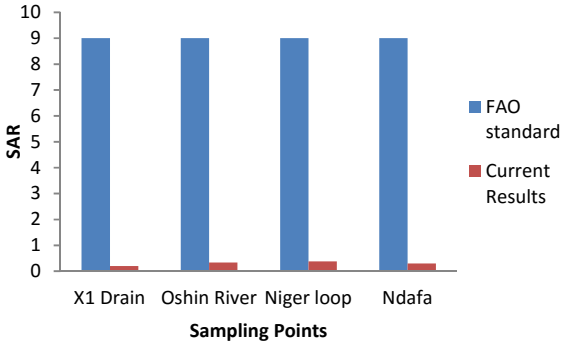

Fig. 3 Current concentration SAR compared with the FAO

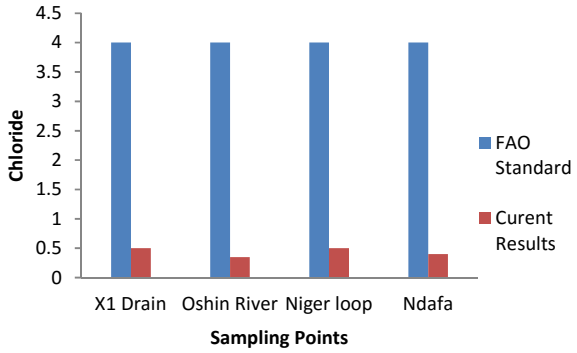

Fig. 4 Current concentration of Chloride compared with the FAO

Sulphate ions in irrigation water have fertility benefits as stated by [7]. The current result (Fig. 5) shows large increase (19.74-21.81me/l) in sulphate content in all the four water sources in the scheme, two of these sources are above the recommended range by [8]. This result indicated that only two (Ndafa and Niger loop) out of the four sources are suitable for irrigation without any hazardous effect on the soil and crop planted.

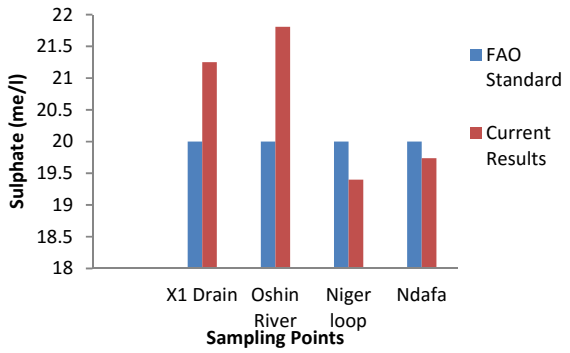

Fig. 5 Current concentration of Sulphate compared with the FAO

Boron concentration in the water sources ranges (0.19-0.32me/l). Reference [8] recommends that boron less than 0.7me/l as suitable for irrigation, therefore current results indicated that all the four water sources are suitable for irrigation (Fig. 6).

Potassium concentration was present in all the four water sources, Three out of the four water sources in the current data shows high concentration (2.10-3.40mg/l) of potassium except X1 drain (1.90mg/l), which fall within the recommended potassium range (Fig. 7). Potassium concentration increases making three water sources unsuitable for irrigation. Adequate care must be taken to keep potassium level at minimum range as recommended by FAO. Clearly, monitoring of impact on water regime had not been carried out since the Niger loop concentration would have been contained before shooting up to 3.40 mg/l a rather dangerous level for production. Currently 75 percent of the sources are not suitable for irrigation in terms of potassium concentration.

Comparing this research with the earlier research of Ojediranon water quality assessment [9], there were increase in the concentration of sulphate and potassium while nitrate and pH level has decreased, as shown in Tables I and II. High sulphate level indicated that more sulphate may have been washed into the sources from agricultural lands in which heavy doses of fertilizers may have been applied over the past 18 years. Decrease in nitrate may have been due to effects of utilisation/absorption of nitrates by agricultural lands upstream of the scheme.

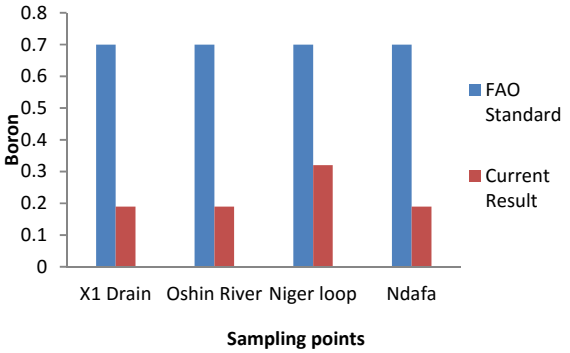

Fig. 6 Current concentration of Boron compared with the FAO

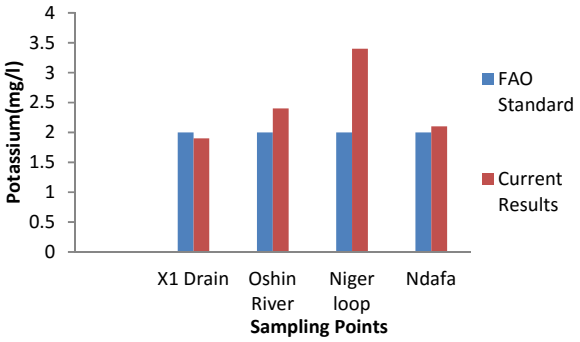

Fig. 7 Current concentration of potassium compared with the FAO

TABLE I
PAST AND CURRENT PH RANGE AND POTASSIUM CONTENT OF WATER SOURCES IN JIS

Water Sources	[8] me/l	[9] me/l	Current Data me/l	[8] mg/l	[9]) mg/l	Current data mg/l
	pH Range			Potassium		
X1 Drain	6.5-8.4	7.15	6.5	10	2.5	1.75
Oshin River	6.5-8.4	7.10	6.60	10	2.6	3.00
Niger loop	6.5-8.4	7.10	6.40	10	2.43	1.50
Ndafa	6.5-8.4	6.90	6.90	10	2.59	1.25

TABLE II
PAST AND CURRENT SULPHATE AND NITRATE LEVELS OF WATER SOURCES IN JIS

Water Sources	[8] me/l	[9] me/l	Current Data me/l	[8] me/l	[9] me/l	Current data me/l
	Sulphate			Nitrate		
X1 Drain	20	0.10	21.25	5	2.73	0.58
Oshin River	20	0.16	21.81	5	3.40	0.57
Niger loop	20	0.11	19.40	5	2.61	0.85
Ndafa	20	0.10	19.74	5	3.40	0.61

IV. CONCLUSION

Perhaps earlier monitoring of irrigation water quality on the scheme would have ameliorated this negative effect. Constant environmental auditing of the scheme would have exposed this deterioration in water quality due to sulphate level. With two water sources becoming unsuitable for irrigation it means a shortfall in quality and likely negative effect on crop productivity.

ACKNOWLEDGMENTS

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