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Irrigation Water Suitability in the Southern Gombe State Irrigated Fadama Lands of Nigeria

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Abstract:

Irrigation water from irrigated Fadama lands of Southern Gombe State, namely Tudu Bilhri, Ayaba, Geleugu, Pamadu Shongom, Tula wange and Dogon Ruwa where investigated to ascertain their current quality status. The pH of irrigation waters is slightly alkaline with overall range mean of 8.2-11.3 (mean 9.8), TDS (values in mg/l) mean 286, EC (values in Uscm) mean 140, SAR mean 0.15 and RSC mean -2.25. This result suggests low salinity and sodicity hazard. Concentration of basic cations (values in Mg/L⁻¹) low to moderate in Ca⁺⁺ ranged 1.26-4.22 (mean 2.7), moderate to high in Mg⁺⁺ and K⁺ range 0.23-2.40 (mean 1.00) and range 0.13-5.73 (mean 0.72), respectively. When TDS, EC and SAR of irrigation waters are considered, they are safe for irrigation purposes.

Keywords: Water Suitability, SAR, RSC, salinity, sodicity hazard

1. Introduction

Irrigated agriculture is dependent on an adequate water supply of usable quality. Water quality concerns have often been neglected because good quality water supplies have been readily available. The situation is now changing in many areas. Intensive use of nearly all good quality supplies means that new irrigation projects and old irrigation projects seeking new or supplemented supplies must rely on lower quality and less desirable sources. To avoid problems when using these poor-quality water supplies, there must be sound planning to ensure that the quality of water available is put to the best use. (FAO, 2010).

Conceptually, water quality refers to the characteristics of a water supply that will influence its suitability for a specific use i.e. how well the quality meets the needs of the user. Quality is defined by certain physical, chemical and biological characteristics. Even a personal preference such as taste is a simple evaluation of acceptability. In irrigation water evaluation, emphasis is placed on the chemical and physical characteristics of the water and only rarely are any other factors considered important (FAO, 2010).

Over the years, farmers practicing the irrigated farming complained repeatedly of declining crop yields presumably due to deterioration in water qualities. But no systematic efforts were made to ascertain this contention Fadama User's Association (FUA). This project was an attempt in this direction with the following objectives: To assess the current water quality status as well as potential threat, it any for irrigation.

2. Materials and Methods

2.1. Study Area

Southern zone of Gombe state located between latitude 9°30' and 12°N and longitude 8°45' and 11° 45' E of the Green Wich Meridian. It lies within the North East region of Nigeria, Southern zone shares boundaries with Adamawa and Taraba states to the South and Bauchi state to the West. The selected fadama farms location for the study are Dogon Ruwa, Gelengu, Pamadu Shongom, Tudu Bilhiri and Tula-wange of Gombe state shown in map 1.

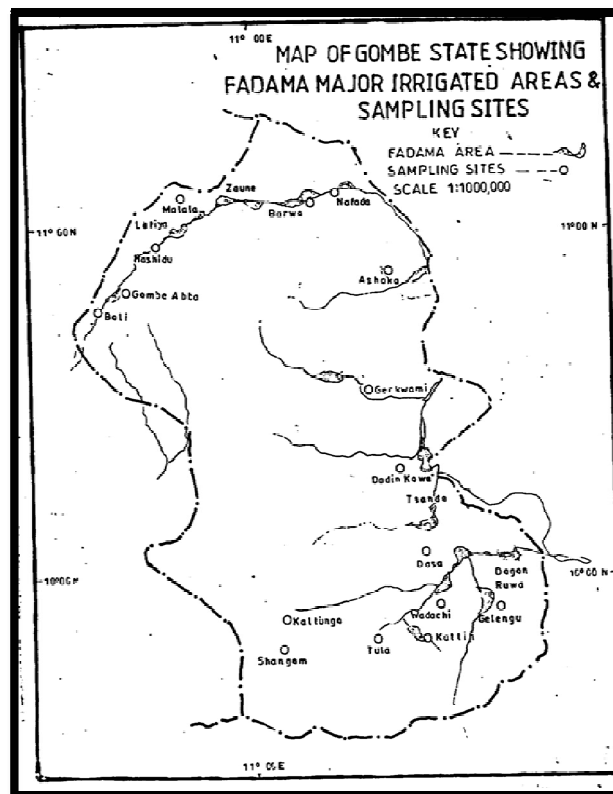


Figure 1: Map of Sampling Spot

2.2. Sampling

Twenty-four water samples from streams and tube wells used for irrigation were collected, four (4) samples each from the study area location. Samples were collected in a clean 2-liter plastic container provided with a cap.

2.3. Water Analysis

Water samples were analyzed following the procedures presented by Chopra and Kanwar (1991). Total Dissolved Solid (TDS) was determined by evaporation and drying method. The pH and EC were read at 25°C on pH meter and Conductivity meter, respectively. Calcium and magnesium were estimated by EDTA and read on spectrophotometer, while potassium and sodium by flame photometry.

Carbonate and Bicarbonate were obtained by volumetric titrated method. Residual Sodium carbonate (RSC) and Sodium absorption Ratio (SAR) were calculated as follows

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

And

$$SAR = \frac{Na^+}{\frac{\sqrt{Ca^{++} + Mg^{++}}}{2}}$$

3. Data Analysis

Data obtained were analyzed using descriptive statistical analysis. Co-efficient of Variance (CV) was used to test for dispersion of data using S.P.S.S. (25) (2017) statistical package.

4. Results and Discussion

4.1. Quality Status of Irrigation Water

4.1.1. Total Dissolved Solid in Water

The irrigation water in southern zone of Gombe State contained low TDS except at Ayaba that is at the tolerable level. Most of the irrigation water in the southern zone of Gombe state contained TDS < 1000 Mgl⁻¹ except at Ayaba that the irrigation water contained 1620 Mgl⁻¹. They were rated as fresh and found good for irrigation purposes. Considering limit criteria set by Todd (1980), FAO (1994).

4.1.2. pH of Water

pH of water use for irrigation in southern zone of Gombe state are slightly Alkaline (Table 1). Food and agricultural organization (FAO, 1994) and (Ayers and Wescot, 1994). Cited pH range of 6.5-8.5 to be considered as normal range for irrigation water.

4.1.3. Electric Conductivity (EC)

Electric conductivity which is the measure for salinity hazard, in the study areas (values in Us/cm) of Gombe state, indicate EC < 360, higher value in Ayaba EC up to 800 Us/cm in the southern zone of Gombe state Table 1. This reveals that the water is good and safer for irrigation considering conditions cited by FAO (1994); Todd (1980) and Richard (1954).

4.1.4. Sodium Absorption Ratio (SAR)

Table 2. Shows sodium absorption ratio of waters in the southern zone of Gombe state irrigated fadama lands as low and free from sodicity hazard. This conforms to standard set by FAO, (1985). Of < 3 as none, 3-9 as low to moderate and >9 as severe, so also Richard (1954). Consider SAR < 10 as low sodium water.

4.2. Basic Cation Concentration in Water

The concentration of basic cation in irrigation waters of the southern zone of Gombe state can be regarded low to medium Ca⁺⁺, medium to high Mg⁺⁺ and medium to high K⁺, when compared to degree for restriction for use set by Esu, (1991). For 2-5 medium Ca⁺⁺, .3->1 for medium to high Mg⁺⁺ and >.30 for high K⁺. The concentration of basic cation in waters could be the reason for the slightly high in pH of water.

4.3. Conclusion

The irrigation water parameters TDS range 40-1620 (mean 286), Ec range 20-800 (mean 140), SAR range 0.55-0.27 (mean 0.15) and RSC range -1.98-2.98 (mean -2.48) in the study areas can be considered as low salinity and low sodicity which is safe for irrigation for now.

S/NO	Description of Sampling Spot	Number of Samples	pH Range Mean	Ec Range Mean	TDS Range Mean	SAR Range Mean	Rsc Range Mean
	Southern Zone						
1.	Ayaba	4	9.30-10.96 10.14	20-800 360	45-1620 731	0.13-0.22 0.19	-1.17-2.47 - 1.94
2.	Wange Tula	4	8.62-10.40 9.53	40-220 105	90-430 212	0.10-0.16 0.12	-0.99-3.51 - 2.27
3.	Dogon Ruwa	4	8.84-10.23 9.67	20-280 100.00	40-550 200.0	0.06-0.15 0.16	-0.92-4.58 - 2.98
4.	Gelengu	4	9.94-10.31 10.12	60-240 120	130-490 347	0.04-0.18 0.16	-0.9-2.88 - 2.14
5.	Tudu Bilhri	4	8.25-9.31 9.04	20-200 110	40-420 228	0.07-0.22 0.14	-5.19-198 - 2.18
6.	Pamadu Shongom	4	9.31-11.34 0.66	80-140 90	120-282 180	0.08-0.22 0.04	-1.25-3.82 - 2.75
	Total STD Error C.V (%)	24	8.25-11.34 (9.86) 0.16 0.8	20-800 (140) 34.54 113	40-1620 (286) 132.11 154	0.55-0.27 (0.15) 0.95 42	-1.94-2.98 (- 2.48) 0.32 -68

Table 1: Ph, EC (Us/cm⁻¹), TDS (Mg/L⁻¹), SAR and RSC in Irrigation Waters of Southern Gombe State

S/NO	Description of Sampling Spot	Number of Samples	K+ Range Mean	Na+ Range Mean	Ca++ Range Mean	Mg++ Range Mean
	Southern Zone					
1.	Ayaba	4	0.24-0.72 0.49	0.19-0.28 0.24	1.26-2.31 1.98	0.72-2.40 1.37
2.	Dogon Ruwa	4	0.29-1.23 0.57	0.16-0.24 0.20	1.86-3.45 2.55	0.23-1.75 1.04
3.	Gelengu	4	0.18-0.93 0.48	0.11-0.22 0.17	1.87-2.93 2.27	0.23-1.75 0.89
4.	Pamadu Shongom	4	0.18-1.84 0.85	0.14-0.22 0.19	1.75-3.45 2.54	0.70-1.45 1.10
5.	Tudu Bilhri	4	0.46-0.69 0.59	0.12-0.21 0.15	2.14-4.22 3.22	0.67-1.49 0.99
6.	Wange Tula	4	0.13-5.73 1.61	0.09-0.22 0.16	2.13-2.85 2.62	0.59-1.30 0.91
	Total STD Error C.V (%)	24	0.13-5.73 (0.72) 0.25 52	0.09-0.28 (1.19) 0.01 28	1.26-4.22 (2.71) 0.14 27	0.23-2.40 (1.00) 0.10 45

Table 2: Exchangeable Basic in Irrigation Water of Southern Gombe State (Values in Mg/L⁻¹)

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