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Assessment of the Quality of Irrigation Water at the Badeggi and Edozighi Irrigation Schemes

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Abstract: ***A field study was conducted atthe Badeggi and Edozighi irrigation Schemes located at Lat, 9° 06 N, Long.5° 59' E; and Lat.9° 0.525'N, Long 5° 5.900'E respectively, in the Southern Guinea Savanna of Nigeria to assess the quality of irrigation waters. The results obtained from the chemical analysis of the waters, have shown that the total dissolved solids (TDS) in the Badeggi irrigation water ranged from 480 and 524.80 mg/l. The Edozighi irrigation water had lower concentration of dissolved solids with values that ranged between 224.0 and 332.80 mg/l. The sodium adsorption ratio (SAR) Which relates the sodium content with the dicationiccations calcium and magnesium ranged between 2,83 and 3.8 mg/l at the Badeggi irrigation scheme and 0.25 and 0.35 mg/l at Edozighi respectively.The results indicate that the quality of irrigation water at the Badeggi irrigation scheme is classified as moderate while that of Edozighi is classified as good according to FAO standards.***

Keywords: Assessment, quality, irrigation water

1. Introduction

Natural sources of fresh water for irrigation are rivers, lakes, streams, dams and groundwater. Water is the most important input required for plant growth in agricultural production. Irrigation water quality refers to its suitability for use. Goodirrigation water quality has the potential to allow maximum yield of crops under good soil and water management conditions. However, poor quality of irrigation water may cause salinity of soil and toxicity to the plant. This will result in impaired growth and reduce yields, unless special management practices are adopted to maintain or restore maximum soil production. Knowledge of irrigation water quality is critical to understanding management for a long-term productivity. Irrigation water quality is evaluated based upon total salt content, sodium and specific iron toxicities. Salt affected soils develop from a wide range of factors, including soil types, field slopes and drainage, irrigation system type and management, fertilization and manuring practices and other soil and water management practices.

All irrigation waters contain dissolve salts which dissociate into ions. Ions are electrically charged particles made up of individual elements or combination of elements which are taken up by the plant roots. In the majority of irrigation waters these ions are quite diluted, but in low quality waters can be significant. The addition of fertilizer to irrigation waters increases the concentration of positively charged ions (cations) and negatively charged ions (anions).

In agriculture, water quality is related to its effects on soil, crops and management necessary to compensate problems linked to water quality. It is very important to note that all problems of soil degradation like salinity, soil permeability, toxicity, etc. can be related to irrigation water quality [1]..

Total salt concentration of irrigation water should not be used as single criteria to prevent its use in irrigation. Even water with considerable high salt concentration can be used for irrigation without endangering soil productivity, provided selected irrigation management could take into account all other factors affecting crop production. The key point is how to maintain existing salt balance in plant root zone [1].

The objective of this study is to assess quality of irrigation water in the two irrigation schemes to serve as a data bank for future references.

2. Materials and method

Water samples were collected at the Badeggi and Edozighi irrigation schemes. The samples were collected in clean PVC plastic bottles at four different points as follow; in the reservoir (dam), primary canal, secondary canal and distributary channels in the farm. They were properly labeled filtered with Whatman paper to remove particles and were analyzed immediately, the samples that were not analyzed the same day were kept in a refrigerator for analysis the next day. The analysis was done using Atomic Absorption Spectrometer (AAS) for cations, EDTA titration for anions, pH meter and electrical conductivity meters.

Sodium Adsorption ratio (SAR) was calculated from the formula:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{(Ca^{2+} + Mg^{2+})}{2}}} \quad \ldots\ldots 3.9$$

Total dissolved Solids (TDS) was calculated from the following relationship:

ECw (dS/m or mmho/cm) = TDS (ppm or mg/l) /640
ECw x 640 when ECw is < 5 dS / m or
ECw x 800 when ECw> 5 dS / m

3. Results and discussions

The results of water analysis (Tables 1 and 2) of the two irrigation schemes have shown that pH of water samples at the Badeggi irrigation scheme were generally alkaline in reaction with pH values ranging from 6.9 and 7.3 with a mean of 7.15.

Conversely, water samples in theEdozighi irrigation scheme were generally acidic in reaction with pH values varying between 6.08 and 6.9. The results have indicated that using the pH scale asan index, the water samples of the two irrigation schemes are within the acceptable limits of the World standard 6.5 – 8.4 [2].

In a similar study in the Northern Guinea savanna of Nigeria,Saddiq [3] observed no great variations in the quality of the waters sampled. The pH was generally alkaline in reaction with the water at Lamurde having the least pH of 7.95 and the highest was recorded at Yola with a value of 8.64. He concluded that waters from lakes and ponds seemed to have higher pH values than tubewells and boreholes.

Table1. Chemical analysis of Badeggi irrigation water

	Concentration values (mg/l)									
Samples	Na	K	Ca	Fe	Mg	HCO_3	pH	ECw	TDS	SAR
Bad 1	1.58	0.27	2.18	0.00	13.20	48.27	6.90	0.82	524.80	3.60
Bad 2	2.12	0.30	1.96	0.00	14.65	43.54	7.30	0.75	480.00	2.83
Bad 3	1.53	0.24	1.74	0.00	13.26	46.39	7.20	0.78	499.20	3.55
Bad 4	1.54	0,23	1.53	0.00	11.68	38.51	7.20	0.80	512.00	3.80
Mean	1.69	0.26	1.85	0.00	13.20	44.18	7.15	0.79	504.00	3.44.

Table 2. Chemical analysis of Edozighi irrigation water

	Concentration values (mg/l)									
Samples	Na	K	Ca	Fe	Mg	HCO_3	pH	ECw	TDS	SAR
Edo 1	0.13	0.49	0.69	0.00	22.25	32.68	6.93	0.43	275.00	0.25
Edo 2	0.13	0.50	1.20	0.00	12.37	25.81	6.08	0.52	332.80	0.32
Edo 3	0.13	0.51	1.20	0.00	8.64	12.45	6.71	0.40	256.00	0,35
Edo 4	0.14	0.52	1.52	0.00	15.82	24.31	6.20	0.35	224.00	0.30
Mean	0.13	0.50	1.52	0.00	14.77	23.81	6.50	0.42	271.00	0.30

There was a variation in the total dissolved solids (Tables 1 and 2). The total dissolved solids(TDS) in the Badeggi irrigation water ranged from 480 and 524.80 mg/ l with a grand mean of 504.00 mg / l . The Edozighi irrigation water had lower concentration of dissolved solids with a value that ranged between 224.00 and 332.80 mg / l with a grand mean of 271.75 mg /l. The result indicated that the quality of irrigation water at the theBadeggi irrigation scheme was moderate (450-2000 mg/l) according to standard evaluation [4]. While the quality of irrigation water at Edozighi was classified as good (< 450 mg/l).

In another study conducted in the Northern Guinea savanna, Ibrahim [5] reported values of TDS ranging from 102 – 208 mg/l while evaluating water quality of Wurno irrigation project. Similarly, Ishaku and Matazu [6] reported TDS values of 30 – 650 mg/l in the water resources of Numan. Total dissolved solids of 1816.50 – 5145 mg/l were reported by saddiq et al. [7] while analyzing water samples in Bauchi.

There was also a variation in calcium and magnesium concentrations in the irrigation waters of Badeggi and Edozighi irrigation schemes. Calcium and magnesium concentrations varied between 1.53 – 2.18 and 11.68 – 14.65 mg/l respectively in Badeggi. While the concentrations of calcium and Magnesium in the Edozighi irrigation water ranged between 0.69 – 1.52 and 8.64 – 22.25 mg/l respectively (Tables 1 and 2).

The sodium adsorption ratio (SAR) which relates the sodium content with the dicationiccations calcium and magnesium ranged from 2.83- 3.80 mg/l at the Badeggi irrigation project and 0.25 to 0.35 mg/l at the Edozighi irrigation project. Saddiq et al. [8] recorded similar values. Much higher values were recorded in the Northern Guinea savanna with values ranging from 5 – 8.60 mg /l. Mandel and Shiftan[9] reported that all SAR values of less than 10 could be safely used on all types of soils. The SAR values recorded in the two irrigation schemes were within standard safe minimum limits of 10 set by Food and Agricultural Organization [10]..

Saline conditions restrict or inhibit the ability of plants to take up water and nutrients, regardless of whether the salinity is caused by irrigation water or soil water which has become saline because of additions of salty water, poor drainage or shallow water table [11].

4. Conclusion

Irrigation water quality alone is not enough to evaluate potential salinity hazard which may be confronted under irrigated agriculture. It is not possible to classify different qualities of irrigation water with clear cut boundaries, and therefore, one must consider, plant soil, climatic conditions as well as existing agronomic and irrigation practices in a given region in the final evaluation of water quality. Agronomist and irrigation specialists should advice farmers for appropriate management practices to overcome potential salinity hazard if the quality of available water would pose any problem. Water quality criteria should be used as a guideline to define appropriate management practices in irrigated agriculture to maintain existing soil productivity with the benefits of high crop yields under irrigation.

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