ASSESSMENT OF IRRIGATION WATER QUALITY IN THE NORTH CENTRAL AREA OF NIGERIA

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1. INTRODUCTION

In most parts of the world, good quality water is becoming an increasingly scarce resource and therefore limiting agriculture development in many regions and countries of the world. The water development problem therefore consists of transferring water from the high supply season to the high demand season. In the past, building new physical systems to harness additional water resources has been the standard approach. However, with increasing demand for water by non-agricultural users, greater emphasis is now being placed on the need to improve the effectiveness of exiting irrigation systems (Chancellor and Hide, 1996).

Globally, efficient and sustainable management of water resources is increasingly becoming a policy objective. The consumptive needs of water call for its judicious allocation to the various sectors of our economy, namely industry, commerce and agriculture. However, horticultural practice consumes a lot of water and so there is the need for efficient use of water for optimum agricultural production. Effective crop water use entails that an appropriate amount of water is applied to a cropping area that is divided and optimally allocated to the different crops (Alatise and Fapounda 1999). Several works (Ngambeki and Idachaba 1995; Bakker, 1998; Meinzen and Bakker, 2001; Rosegrant *et al.*, 2002a) have shown that improved access to irrigation with proper management contributes to rapid socio-economic growth, food security, increased crop yield, improved agriculture and farm income. Irrigation has helped boost agricultural yields and outputs, stabilize food production and prices with resultant increased demand for irrigation water to meet food production requirements. The relationship between the total quantity of water applied and the yield of a specific crop is a complicated one which Upton (1997) agreed may vary in frequency and intensity.

Great deal of finance is being invested in agriculture each year to create and keep a favourable plants-moisture and nutrient status in soils. Further rise in the efficiency of this investment can be achieved by improving the scientific basis, developing a precise estimation of the soil moisture impact on crop yield formation and creating a practical technology for irrigation scheduling. A reliable and suitable irrigation water supply can result in vast improvements in agricultural production and assures the economic vitality of the State. Most local farmers, today, largely depend on irrigated agriculture to provide the basic needs of their society and enhance the security of their people in terms of food production.

The need to understand water management from a river basin perspective has been recognized for many years, and attempts have been made to translate this understanding into action. Some of these attempts have been successful, and many others fail. Within the past few years, there has been a resurgence of interest in regional authorities and basin councils, reflecting increased recognition that it is impossible to effectively manage water resources without considering management in a basin context (Molden 1997).

Much of the irrigation development is small-scale and this involves smallholder families who typically irrigate plots ranging in sizes from 0.1ha to 5.0ha. Water-use-efficiency in small holder irrigation schemes is in the range of 30 to 60% leaving a substantial room for improvement (Chancellor and Hide, 1996). This, therefore, gives a rough estimate of between fifteen to twenty percent of the world total cultivated land under irrigation practice, (FAO, 1996). The total irrigation potential of the country (Nigeria) as a whole is about 3.14 million hectares where 1.0 million hectares are used for public irrigation projects and 2.04 million hectares for formal fadama irrigation projects (Gateway to Land and Water Information, 2002). Only about 4% of the cultivated land area within the north central area of Nigeria today is under irrigated practice, which accounts for about 28% of food production (MANR, 2003). As irrigation development is crucial to ensuring food security in both the short and long terms; small-scale irrigated production will have to supply an increased amount of food with less water in the future.

The aim of this study is to determine the salinity level of a of the major stream in the north central area of Nigeria and to compare the results obtained with that of the Food and Agricultural Organization quality standards for the slated parameters, for crops grown around the area and using the results obtained to Improve the soil condition around the area, by determining the methods of preventing the buildup of salts in the soil.

2. METHODOLOGY

Kolo stream is found in Niger state, North central area of Nigeria, located on 9^0 36^I 52.03^{II}N and 6^0 34^I 19.90^{II}E. The stream is used for domestic, agricultural and industrial purposes, but the major use of the stream is for irrigation of crops grown around its banks.

Five water samples were collected from the stream during the dry season. Sample pretreatment was carried out at sample collection points to ensure that physical and chemical changes do not occur in the samples during the time the sample were collected and after the sample containers had been filled and capped (ASTM, 2006b).

Sterilized bottle containers were used to collect water and soil samples from the study area. The samples were given a pre-treatment of being stored in an air conditioned room with temperature not more than 25°C which to reduce microbial activities. The Palin test method was used to determine the pH value of the sample of water collected. The dayside and Iron test was used to determine the quantity of chlorine present within the samples collected. Hardness test was carried out to determine the amount of $CaCO_3$ in the water (Chukwu and Musa, 2008).

3. RESULTS AND DISCUSSION

Comprehensive water studies are essential for the successful management of irrigated farm areas. Periodic water test needs to be undertaken to confirm what is available in the water bodies in terms of nutrients and what is required as supplement to meet the nutritional requirements of specific crops. This approach ensures that residual nutrient after plant up-take is enhanced with an equal reduction in concentration that eventually contaminates the environment.

For us to achieve the drive of increase food production throughout the world, it is imperative to evaluate irrigation water quality together with the soil that will be irrigated as low quality irrigation water might be hazardous to the crops that will be planted, the various types of soil within the irrigation field. During the wet/rainy season, normal cultivation operations such as tilling, ploughing, ridging and harrowing cannot be carried out. In some cases, the free water may rise above the surface of the land, making the cultivation operations impossible; thus, such lands become swampy in nature.

Since plant roots happen to come within the capillary fringe, water is continuously evaporated by capillarity. Thus, a continuous upward flow of water from the water table to the land surface gets established. With this upward flow, the salts which are present in the water also rise towards the surface, resulting in the deposition of salts in the root zone of the crops. The concentration of these salts present in the root zone of crops has a corroding effect on the roots, which reduces the osmotic activity of the plants and checks plant growth (Chukwu and Musa, 2008).

The results of the physical water analysis shown in Table 1 indicate that all the 5 samples had their pH value within the international permissible limit of between 6.5 and 8.5, Electrical Conductivity (EC) was in the range of 131 and 867mg/L, while the turbidity values ranged between 40 and 48 (MTUc) which were higher when compared with the international permissible limit of 25 MTUc. This may be as a result of contributing wastewater from the various communities along the stream and also the type of geological formation (rock/soil) available within the area. Water should not contain any settleable suspended solids and should be clear although clear water is not necessarily fit for human consumption. Turbidity, should, if possible should be less than 5 units with a maximum desirable level of 25 units (Pickford, 1977). For irrigation of cultivated land downstream of pollution sources, the most important water quality parameter is the Total Dissolved Solids (TDS), which seriously affects crop growth by causing plasmolysis of plant cells (Pescod, 1977). A total TDS level greater than 1500 mg/L may well reduce crop yields. Measurements of the Total Dissolved Solids in this study are below this limit. These values are however, within the stream standard limit suitable for irrigation where there are salt resistant crops, good drainage, proper water management and low sodium absorption ratio (Pescod, 1977). It is reported that the maximum Suspended Solids content of many tropical rivers ranges between 2860 mg/l and 10,000 mg/l (United Nations, 1953; Reid, 1956). The values of 1754–3860 mg/L TSS measured for the study are below this range.

From Table 2, the main effect of salinity is taste if used for domestic activities but if used for irrigation purpose, the concentration of these salts present in the root zone of crops has a corroding effect on the roots, which reduces the osmotic activity of the plants and checks plant growth. Salinity present in the form of magnesium which ranged between 0.23 and 0.52 mg/L was within the permissible limit of 0.5 mg/L except for sample 1 which was slightly higher than the internationally acceptable value while sulphate had a range of values between 456 and 633 mg/L which can have a laxative effect (Pickford, 1977). Salinity shows the level of sodium chloride in the Total Dissolved Solids. A high value of TDS is an indication of pollution and the higher the salinity the greater the level of pollution. Sample 1 of sodium cation was within the international limit of 18 mg/L while the others samples had their values more than the internationally recommended figure. All the values of chloride ion were less than recommended value; samples 1, 2 and 5 of the nitrate were off the international limits while potassium had a range of between 214 mg/L – 335 mg/L.

4. CONCLUSION

It can therefore, be concluded from the chemical analysis carried out on the water samples that most of the surface water supplies for irrigation purposes are of satisfactory quality, though some basic pretreatment needs to be carried out to reduce some of the salt contents. The results also showed that the study area may be subjected to the problem of salinity which may prompt the fear of water logging of the farm land. Hence, regular water analysis should be conducted as done in this study, to be able to check the rate of salt build up within the soil and consequently the water.

5. REFERENCES

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Table 1: Results of Physical Parameters of the Kolo stream during the dry season

Sample No	pH	EC (mg/L)	Turbidity (MTU_c)	TSS (mg/L)	TDS (mg/L)	TS (mg/L)	Appearance	Colour (TCU_b)	odur	Taste
1	8.0	867	40	1754	1130	1184	Not clear	26	objectionable	sipid
2	8.2	681	46	2757	1342	1399	Not clear	14	objectionable	sipid
3	8.2	131	41	3860	1343	1403	Not clear	94	objectionable	Insipid
4	7.9	560	48	2957	1272	1329	Not clear	17	objectionable	Sipid
5	8.0	475	43	1859	1303	1258	Not clear	19	Objectionable	Insipid
IPL	6.5-8.5	NA	25	10000	1500	4000	NA	5	NA	NA

EC - Electrical Conductivity; TSS – Total Suspended Solids; TDS – Total Dissolved Solids; TS – Total Solids; IPL – International Permissible Limit (WHO, 1971; FAO,1996); NA – Not Available

Table 2: Results of Chemical Parameters of the Kolo stream during the dry season

Sample No	Total Iron	Sulphate (mg/L)	Chloride (Cl_2)	Lead (mg/L)	Sodium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Phosphate (mg/L)	Nitrate (mg/L)	Potassium (mg/L)
1	0.72	456	502	0.149	15	191	0.521	78	51	335
2	0.77	633	328	0.186	325	817	0.443	79	71	302
3	0.70	490	339	0.230	29	290	0.230	82	33	214
4	0.73	526	390	0.188	83	188	0.398	90	50	284
5	0.74	597	461	0.328	90	873	0.425	80	98	297
IPL	1.0	400	1000	0.05	18	150	0.5	NA	50.1	NA