

ASSESSMENT OF SOIL AND WATER QUALITY OF TOMAS IRRIGATION PROJECT AREA

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ABSTRACT

The quality assessment of soil and water resources of the Tomas irrigation project was carried out. This is to ascertain the management practices that are currently being used so as to identify resources for increase production under the irrigation scheme. For over a decade fertilizer application in the irrigation process may likely temper with the natural structure of the soil and water properties that call for periodic study like this. The soil which is mostly sandy and water sample were taken from irrigated site. Both field and laboratory method were systematically carry out in sampling and analysis of the result. The soil was low in water holding capacity and suitable for sprinkler irrigation system. The result also revealed that the chemicals properties of water show that the water is moderately saline and low sodium percentage with low soluble salt. While the pH value of the soil has been observed, this found to be suitable for most of the crops grown in the area. The water of Tomas dam was therefore discovered to be suitable for irrigation without any danger on the soil properties for crop production.

KEYWORDS: Irrigation, water quality, soil sample, saline soil and crop production

INTRODUCTION

Population growth is particularly high in developing countries like Nigeria. This means that Nigeria in particular and developing countries in general have challenge in meeting the millennium development goal of food security. They can overcome this challenge by increasing import of food, where possible. Research estimated that in the coming decades about 80-90% of the required increase need to be realized on existing cultivated land and about 10-20% on newly reclaimed land. (Tanko 2013). To achieve this very good and efficient irrigation system has to be employed.

Irrigation management is basically to apply the correct amount of water at the correct frequency to supply water needs for plant, and additional water would be waste as it would leach below the rooting zone (Bauder 2013). Crop production under irrigation system is widely adopted in modern farming, this is an attempt to ensure adequate and sustainable food production to meet the local needs and as a means of revenue generation through exportation of products.

To achieved this noble objectives adequate understanding and good management of the soil and water resources is very important, because soil generally serves as a medium through which plants used to absorb nutrient for their growth and development, water use for irrigation is usually applied to the soil surface irrigation, the water gradually infiltrate in to the soil and wets the crop rooting zone. The growth of crop under irrigation condition is subject not only to consideration of timing and quantity of supplies but also to quality factors (David 2002). Irrigation water contains small quantity of dissolves salt some of which are plant nutrients. These salts should, however be present only in low concentration; high concentration of these salts can even lead to salt accumulation in the soil.

Depending on the quality and quantity of the irrigation water, crop type and the nature of soil, water application in the form of irrigation may also lead to serious soil erosion (Olu 1991). Another biological feature, which has important economics implication, is that there are limits to the time for which crops can tolerate a saturated soil; ideally an irrigated area should be protected against periodic flood damage. Another wide spread problem is the water logging which may be caused by a number of factors, including flooding, this becomes more serious where there has been a general rise in the level of ground water table. This often serves as a consequence of increased seepage following the development of large-scale irrigation. (Ahmad et al 1992)

A great problem to consider is that of fertilizer application during the irrigation process, where if care is not taken in the application techniques it may lead to hinder the fertility of the soil moreover pest and disease control may affect some of the important organism in the soil which are responsible for the decomposition.

The call for this study is that irrigation water contains small quantities of dissolved salts (Carruthers 1985) and artificial addition of water to soil in form of irrigation brings about some physical and chemical changes which may lead to a series of soil problems such as water logging, salinity, erosion and many more.

MATERIALS AND METHODS

Location and description of the study area

The Thomas irrigation project is located between 12° 08' N and 12° 14' N of latitude and longitude 8° 12' E and 8° 20' E in the northern part of Kano state, it lies about 40 km north of Kano city in Makoda Local Government along Kano Daura road.

Data collection methods

Field method

This involved the collection of soil and water samples. The materials used include soil auger, paper bags, plastics bottle, hand shovel. Ten sample of each soil and water are representatives of the soil in the area, by taken note of topographical sequence and variation.

Statistical analysis

The sample of soil and water taken were subjected to analysis of variance using the 5% level of significant for the study to have 95% confidence using analysis of variance (ANOVA) by automatic process call Genstat which is a comprehensive statistic system which offers ease-of-use for the novice user through a windows menu interface, and this is to estimate the fact play by various factors in total variances.

Procedure for soil and water sampling

The soil auger was driven into the soil to depth of 15, 20, and 25 cm; and this will enable to employ statistical techniques to find out if there is significant difference between different depths of the soil sample .The soil taken was carefully emptied in to the paper bag and labeled for easy identification. The water samples were also collected at different location of the dam and canals to the plastic bottle and labeled accordingly.

The laboratory analysis

Soil analysis

Soil samples collected were air dried and passed through a 2mm sieve so as to removed any foreign particles inside the sample as the soil sample collected were analyzed for the following properties Soil PH, particles size analysis, electrical conductivity, organic carbon % and, available phosphorus

Procedure

Soil PH

- I. 20 grams of air dry soil is weight in to some beaker
- II. Some of distilled water was added and then stirred for 5 minute and it was allowed to stay for 30 minute
- III. The PH meter was switch up and standardize with buffer in PH 4 and 7
- IV. Re stir of the soil sole, for second time and electrode of the PH was inserted and reading is being recorded

Particle size analysis

By hygrometer method

- i. Weight out 75 gram of the soil sample in to 200ml plastic bottle

- ii. Add 10 ml of 0.03 solution of calgon in to the bottle and 100 ml distilled water and into the shaking machine for 30 min.
- iii. Transfer the soil solution in to 1 liter measuring cylinder and wash the content properly into the cylinder with distilled water and top the cylinder to make 1000 cm mark with water
- iv. Cover the mouth of the cylinder with your palm hand and invert the cylinder upside down for seven times
- v. Gently drop the hydrometer in the solution and take the reading after 40 second and also note the temperature
- vi. Allow the soil solution to stand for 2 hrs and take the reading in the same manner but without shaking

Electrical conductivity

- I. Weight out 200g of air dry soil in to a 50 mil beaker
- II. Add 50 mil distilled water and stir for 5 minute and allow to stay without standardizing the meter
- III. Re stir the soil in and insert the electro of PH meter and record the reading unit of E.C in us/cm/ohms

Organic carbon

Walkly and black method

- i. Weight 1 gram of soil into 250 ml flask, reduce the weight of soil if the soil is very rich in organic matter
- ii. Add 10 mil of 1NK2CR2O7 using pipette and then swirl the flask gently to disperse the soil
- iii. Rapidly add 10 ml of concentrated H2SO4 from a measuring cylinder and source for 1 minute again if color turns greenish reduce the amount of soil taken to half
- iv. Add 100ml of distilled water to the flask, let say 100l
- v. Filter the suspension using a fast filter paper if suspension is cloudy
- vi. Add 5 drop of indicator
- vii. Titrate with ferrous ammonium sulphate solution with a white back ground change in color;- blue-green-dark-green-red
- viii. Mark blank determination in same manner but without soil.

RESULTS AND DISCUSSION

Physical properties of the soil

The only physical property of the Tomas soil that has been observed and determined is the particle size distribution. The result obtain for 10 sample at different location is presented in table 1

Table 1 physical properties of Thomas soil

Treatment	Depth (cm)			S.E
	15	20	25	
Sand	90.51	90.61	91.12	1.94
Silt	4.94	5.95	5.30	0.91
Clay	4.34	3.85	3.93	1.13
L.S	N.S	N.S	N.S	

Means were separated at ≤ 0.05 means bearing the same letters are not significantly different N.S = No sig. diff

From the result of the particle size distribution analysis presented in the table it is clearly observed that the soil in Thomas irrigation project are mostly sandy of low water holding capacity and marginally suitable for gravity method of irrigation, this attributed to the work of (Dorberman2002)

Chemical properties of Thomas soil

The chemical properties of the soil such as PH, organic matter content, electrical conductivity and available phosphorus were observed and the results are as follows

Table 2 chemical properties of Thomas soil

Treatment	Depth (cm)			S.E
	15	20	25	
pH	7.240	7.160	7.100	0.0999
E.C us/cm	0.004	0.0021	0.0021	0.002143
Available phosphorous	125.7	114.5	105.1	15.38
Organic matter	0.229	0.223	0.187	0.280
L.S	N.S	N.S	N.S	

Means were separated at $p \leq 0.05$ means bearing the same letters are not significantly different ie N.S= No significant differences

Soil pH

The acidity or basicity of irrigation water is expressed as pH (< 7.0 acidic; > 7.0 basic). The normal pH range for irrigation water is from 6.5 to 8.4 (Waskom 2013). From the result presented above it was observed that the PH values range from 7.10 to 7.24 and this show that the soil in the Thomas irrigation project are slightly acidic to slightly alkaline in reaction. This may attribute the nature of the soil that is found to contain a high proportion of sand particles. This attribute of the soil is capable of rendering the soil more porous with attendant effect of leaching of exchangeable bases from the plough layer of the soil (Bauder 2013).

Electrical conductivity

The electrical conductivity of the soil varies from 0.002 to 0.004 mm/hos/cm which means the low electrical conductivity of the soil may be due to low concentration of soluble salts in the upper part of the soil layer

Organic matter content

The organic matter content presented in table 2 has shown that the organic matter percent

ranges from 0.187 to 0.280 by standard. This is considered to be medium low. This level of organic matter in the soil may be attributed to the wash soil received from the upland; soil lying along streams is relatively higher in organic matter partly because of the poor drainage system or the wash soil they received from the uplands. Over time clay soil with good organic matter may improve soil structure, supporting a deeper rooting zone (David 2012)

Statistic analysis has also shown that there is a positive relationship between the organic and the clay content of the soil. This result is in agreement with the finding of Denmead (1988) who concluded that increase in clay content is accompanied by an increase in the organic matter content of soil

Properties of the water sample

The entire water sample collected where analyzed for pH, Electrical conductivity EC and Exchangeable bases

The result of the analysis can be seen as follows

Chemical composition of Thomas dams water

Table 3 chemical composition of Thomas dam water

Treatment	Location			S.E (±)
	L1	L2	L3	
pH	5.7	6.6	6.5	0.088
Exchangeable bases				
Ca+	0.50	0.45	0.40	0.0042
Mg+	0.90	0.80	0.75	0.009
Na+	0.10	0.10	0.12	0.003
K+	0.01	0.01	0.01	0.044
Electrical Conduct. E.C	0.04	0.05	0.04	0.0053
Sodium Absorb Ratio	0.20	0.25	0.20	0.006
L. S	N.S	N.S	N.S	

Means were separated at $p \leq 0.05$ means bearing the same letters are not significantly different i.e. N.S= No significant differences

pH

From the result presented in the table it clearly indicated that the PH of the water sample range from 5.7 to 6.5. This means that the water is moderately acidic to slightly acidic.

Exchangeable bases

The result show that calcium range from 0.40 to 0.50 mille equivalent/liter, magnesium 0.45 to 0.90, sodium 0.10 to 0.12 mille equivalent/liter and potassium concentration was 0.01 meq/liter in all the samples analyzed.

It will be observed from this result that ca and mg were the most predominant cat ions in the water samples.

Another important characteristic of these is the predominance of calcium ions will contract the negative effect of sodium in the development of stable soil structure.

The low concentration of potassium ion may be attributed to the increase in calcium and magnesium ions. (Bray et al 1945) Statistical analysis has also shown a negative correlation

Electrical conductivity

The electrical conductivity of the water ranges from 0.03 to 0.06 mhos/cm. this low electrical conductivity may be as a result of concentration as soluble salts in the water.

On the basis of the united state soil salinity laboratory (USSSL) 1984 the water is of low salinity and sodium content. According to this classification, the water can be used on all soil for irrigation without any danger.

CONCLUSION

Effective farming manage irrigation system in Thomas irrigation project can only be achieved with the development of appropriate technology that are simple and inexpensive .

Irrigation is profitable venture that if properly embarked upon using the appropriate new technologies will ensure adequate food production all the year round (Stagman1981). The involvement of the farmers in the maintenance culture of the soil and water resources will enhance the sustainability of community irrigated agricultural production and given up towards achieving the desire food security for the rural farmers.

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The result obtained on the soil and water samples have shown that the in Thomas irrigation are mostly of sandy (course texture). This invariably means that the soil will be of low water holding capacity and only marginally suitable for gravity method of irrigation. Going by this finding sprinkle irrigation would suitable if not for economic fact. The PH of soil has been observed to be suitable for most of the crop that are grow in the area

The chemical properties of the water have also clearly showed that the water is moderate salinity and low sodium percentage the water contains low soluble salts as indicated by the result of the electrical conductivity. The Thomas dam water is therefore found to be suitable for irrigation without any danger on the soil properties.

The research also show that the condition of the soil is changing considering the nature of the soil at free irrigation and post irrigation from non saline to saline soil. Most of the farmers plots are in terrace areas that is the main reason why farmers are engage in gravity flow method.

RECOMMENDATIONS

- I- In order to improved the soil quality efficient and regulation of water supply should be adequately observe to avoid frequent water logging problem
- II- Active farmer participation in operation and maintenance is required, farmers should be taught to release a given flow within a field turnouts. This may required intensive extension work

For effective management of water it is essential to consider the following

- 1- Control water logging of soil by leveling the land to given shape to promote surface drainage and used of organic manure.
- 2- Control level of water table through grading.
- 3- Improve irrigation scheduling by applying water as and when required only.
- 4- Attention should also be focused on the efficient management of the soil to avoid the occurrence of erosion, leaching, water logging etc.
- 5- Avoid the used of saline water.

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