International Journal of Novel Researches in Science, Technology & Engineering
Vol. 8 No. 2 December, 2025
EISSN 3115-6193
www.oasisinternationaljournal.org

INVESTIGATION OF PHYSICAL PROPERTIES OF SOIL AT OKE-OYI PHASE II IRRIGATION SCHEME FOR AGRICULTURAL PRODUCTION

by

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Abstract

Irrigation applications have impacts on the soil physical characteristic properties and these impacts may be negative on soil, crop and groundwater quality. This could be as a result of the quality of water used, method of application and the nature of the soil viz the physical composition of the soil. Soil quality analysis at phase II of the irrigation scheme was carried out in the study area. Twenty sampling points were considered from different locations of the irrigation scheme. Soil samples were collected using soil auger at the depths (0-20 cm, 20 - 40cm and 40 – 60cm) of the crops planted on the field making a total of 60 samples. A random sampling method was used and the soil samples were taken to the laboratory for physical analysis. Physical analysis results showed that the soil of the study area was sandy loam; the available soil moisture contents obtained for East, West, South and Northern side of the study area were 1.08%, 1.05%, 1.12% and 1.09%, respectively. The values of infiltration capacities (K) obtained were generally high and varied from 0.00956cm/s to 0.0104cm/s. Therefore, there is need for proper monitoring of the soil condition of the irrigation scheme in order to prevent further deterioration since reduction in crop yields have been observed from 2011 to 2013 growing period.

Keywords: Physical Properties, Soil, Irrigation Scheme & Agricultural Production

Introduction

Global drive for sustainable agriculture systems involves optimizing agricultural resources to satisfy human needs and at the same time maintain the quality of the environment and conserving natural resources (FAO, 1998). The success of soil management to achieve productivity and maintain soil fertility depends on the understanding of how the soil responds to agricultural use and practices (Negassa and Gebrekidan, 2004).

There is a rapid expansion of irrigation schemes in Nigeria due to increase in population and hence the need for additional food supply. The needs to feed and improve the standard of living of the ever-increasing human population led to introduction of the irrigation schemes. This has facilitated the cultivation of the same land twice or more in a year and has improved the farmer's standard of living economically. There is a rapid expansion of irrigation schemes in Nigeria due to increase in population and hence the need for additional food supply (Maina *et al.,* 2012).

Irrigation farming has increased in Nigeria in the recent times. The possible reason for this is the increased awareness from the Fadama project jointly funded by World Bank, Federal Government and State Governments. The benefit of irrigation in Nigeria is not limited to food supply alone but it also serves as a source of income and employment during the slack period of rain-fed agriculture (Dauda *et al.,* 2009).

The continuous use of soil for irrigation activity without careful quality assessment and monitoring can affects the crops potential yield, creates adverse effect on the soil physical properties, fertility and sustainable productivity (Adejumobi *et al.,* 2014). Some soil properties are good indicators of soil quality as they contribute to biological, physical and chemical properties of the soil.

It is therefore necessary that since soils of various irrigation schemes have been observed to be adversely affected by irrigation practices, the soil of Oke-Oyi Phase II Irrigation Scheme needs to be monitored to ensure sustainability and deal with fluctuations in the scheme soil physical quality.

Description of the Study Area

Oke-Oyi Irrigation Scheme of the Lower Niger River Basin Development Authority (LNRBDA) is situated at Ilorin-East LGA of Kwara State, Nigeria. Oke-Oyi is the head quarter of Ilorin East Local Government Area of Kwara State which is about 25 km away from Ilorin town along old Ilorin-Jebba Road. The irrigation project site is located between the latitude; 08° 37.322' N and 08° 37.781'N, and Longitude; 04° 45.893'E and 04° 46.027'E of Greenwich Meridian (LNRBDA, 2012).

The total surface area of the irrigation project site is 50 hectares of land which was divided into Phase II (30ha) and Phase III (20ha). Phase II which is the study area was used for cultivation of arable crops such as Okra, Maize and Rice with surface area of 12.5ha, 10ha and 7.5ha respectively. It is a small-medium irrigation scheme and basin irrigation system was used to supply water to the field from the rectangular weir located at the adjacent side of the scheme as shown in Figure 1.

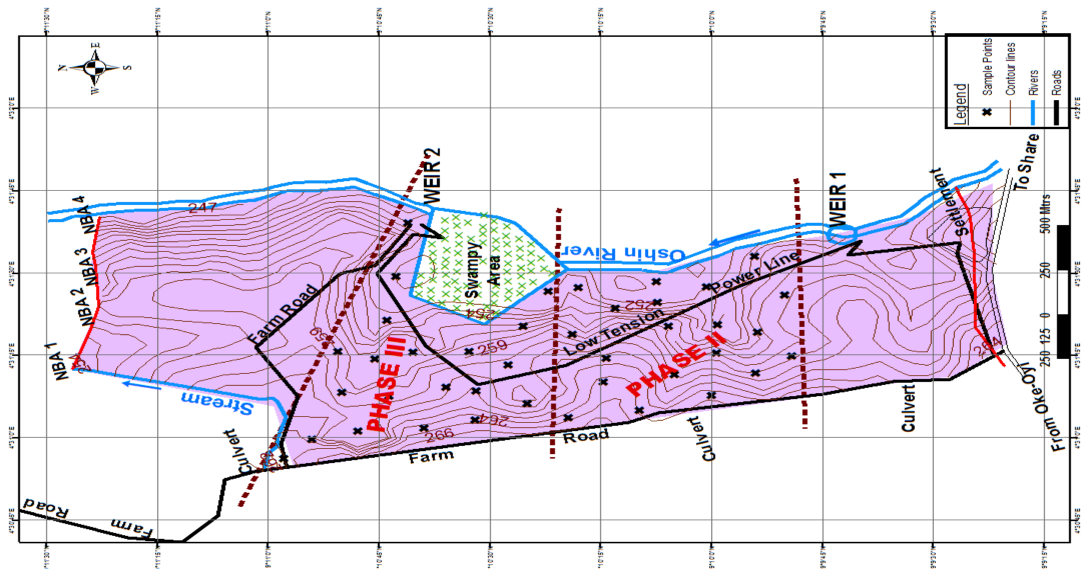

Figure 1: Map of Oke-Oyi Irrigation Scheme showing the Soil Sampling Points
Source: LNRBDA, 2012

Soil Sampling Method

Twenty sampling points were considered from different locations of the scheme. Soil samples were collected using soil auger at the rooting depths of 0-20cm, 20-40cm and 40-60cm which correspond with the rooting depth of crops in the field. Random sampling approach by following a zig-zag pattern across the field was used in collecting soil samples at different sampling points in labeled polythene bags (Hussain *et al.,* 2017).

Soil Analysis Methods

The following methods were employed for physical analysis:

(i) The particle size analysis was done by hydrometer method, employing sodium hexametaphosphate [Na $(HPO_4)_6$] calgon as the dispersing agent.

(ii) The available soil moisture content was determined by oven drying method.

(iii) Infiltration capacity tests were carried out one after the other in the north, south, east and west side of the study area. One location was determined in each side. Infiltration test was done by digging 10cm by 10cm by 10cm pit at each location. Water volume of 250cm^3 was poured into the pit and the time in second was taken and recorded for water transmission into the soil. This was repeated four times at each location. A multiple regression model (R= 0.773) relating infiltration capacity to proportion of sand as used by Joseph *et al.* (2014) was employed. Thus:

$$K = 0.1\,sand + 0.076\,silt - 0.089 \quad (1)$$

Where,

K = infiltration capacity (m/day)

Results and Discussion

The parameters evaluated for soil physical properties include soil texture, infiltration capacity and available moisture content. Results of the soil particle size analysis revealed that soil in the study area is sandy loam, using textural classification triangle chart. This indicates that the soil is generally very light-textured with sand percentage averaging more than 75% and loam is 25%. The particle size distribution of the soils is shown in Table 1. Therefore, the soils appear moderately suitable for irrigation, but may be drought prone.

Table 1: Average soil particle size distribution

S/N	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Textural class (USDA)
1	0-20	71	12	17	Sandy Loam
2	20-60	69	16	15	Sandy Loam
3	60-100	76	12	12	Sandy Loam

The values of infiltration capacities (K) were generally high and varied from 0.00956cm/s to 0.0104cm/s. According to Shoeneberger *et al.* (2002), a coarse sandy soil with (K) value of 10^{-2} cm/s would have enormous infiltration capacity of nearly 10m/day while a fine loam soil with a (K) value of 10^{-4} cm/sec would have only about 10 cm/day. The soils in the study area were dominantly sandy loam texture and show high transmission of water and moderate water holding capacity, well drained and suitable for irrigation (FAO, 1994).

The available soil moisture contents obtained is low for East, West, South and Northern side of the study area. The low percent of soil moisture ranged from 1.05 to 1.12% and it is an indication that enough moisture is not readily available to support plant growth which may reduce crop yield. The field capacity, permanent wilting point and available water content are called the soil moisture characteristics. Soil moisture content is a portion of water which is easily extracted by the plant and it is about 75% of available water in the soil (FAO, 1985).

The fertility status of the soils under irrigation in the study area is low and highly variable (Okalebo *et al.,* 1993). This is because the contents of the entire soil nutrients relating to soil fertility are very low and varies highly. The low soil fertility condition being experienced at the study area can be improved upon through better soil management and controlled agricultural practices (Gbadegeshin and Oriola, 2004).

Conclusion

The particle size distribution of the soils in the study area indicates that the soil is generally very light-textured with sand percentage averaging more than 75% and loam is 25%. The soil is predominantly sandy loam and has high value of infiltration capacity with low soil moisture content. Generally, the analysis indicated that there is need for proper monitoring of the soil condition in the study area in order to prevent further deterioration.

Recommendations

The following recommendations were drawn from conclusions:

i. Efficient production output, organic manure should be applied in appropriate proportion to stabilize and correct nutrient deficiency in the soil.
ii. Periodical test has to be conducted to ascertain any changes in values obtained.
iii. Careful selection of crop and management alternatives is required if full yield potential is to be achieved.

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