The Effect of Land Uses on some Hydrological Properties of a Tropical Ultisol
― A Case Study of Ihiagwa in Imo State of Nigeria ―

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1. Introduction

As human population grows, there is the need to bring more lands into cultivation in order to produce more food. This has resulted in more pressure on land for so many kinds of agricultural land-uses. According to FAO (1976), land-uses means the use to which the land is subjected to. This calls for land use planning among various land uses. In the topical ultisol, soil hydrological properties are among the major soil properties of importance to land use planning. Soil hydrological properties will provide information necessary for water management and conservation strategies under various land uses. The objective of this study is to evaluate the effect of three land uses on some hydrological properties of the soil.

2. Materials and Methods

The experiment was conducted within the premises of Federal University of Technology (Ihiagwa) Owerri (lat. 40-50 N, Longitude 7 E). The three major types of agricultural land-uses practiced in the area; (1) continuous cropping (site A), (2) Bush fallow (site B), and (3) Plantation farming (site C) were selected for the experiment. One profile pit (1m x 1m x 1m) was dug in each site. From each pit, soil sample was collected at intervals; 0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm, and 80-100 cm depths to determine soil properties which will become relevant later in the study. Infiltration experiment was conducted in situ in each of the site by the use of the double ring infiltrometer.

3. Results and Discussions

Soil properties relevant to the study are presented in Table 1. The bulk density (B_d) ranges from 1.36 to 1.49 g/cm^3, 1.34 to 1.49 g/cm^3 and 1.25 to 1.5 g/cm^3 for sites A, B, and C respectively. There was no definite downward trend of bulk density for site B and C profiles but in site A, bulk density increased steadily with depth and this is inline with the work of Babalola (1978). However, site C profile had lower bulk density values in the top 0-60cm of the profile. Organic matter (OM) decreased with depth in the three sites. Figure 1 shows OM profile for the three sites. This trend will have effect on the infiltration capacity and hydraulic conductivity of the sites. Site C had higher hydraulic conductivity (Ks) than site B which is also higher than Site A. Figure 2 shows Ks versus OM curve. Figure 3 shows the infiltration rate versus

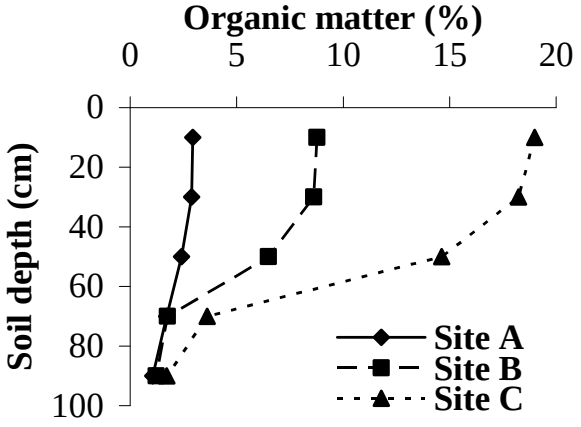

Fig.1 Organic mater (OM) profile.

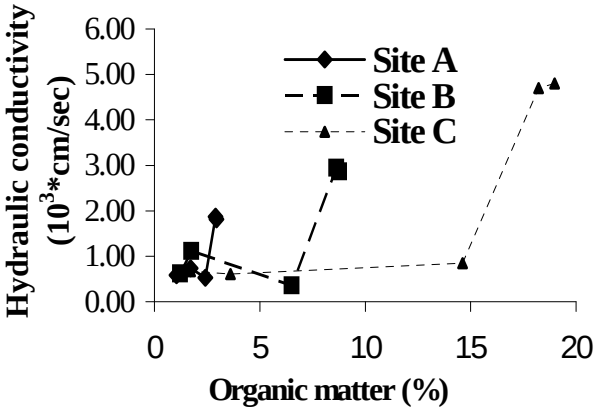

Fig.2 Hydraulic conductivity vs OM.

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cumulative time curve for sites A, B, and C. Site C had the highest infiltration rate followed by site B while site A had the least rate. Table 2 shows that the hydraulic conductivity of the different sites is strongly and significantly related to OM content of the soil than to bulk density.

Table 1 Soil properties

Sites	Soil Depth (cm)	Textural Class	B_d (g/cm^3)	OM (%)	Porosity (%)	Hydraulic Conductivity (cm/sec)
A	0-20	Sand	1.36	2.94	48.7	1.81×10^{-3}
	20-40	Sand	1.32	2.89	50.2	1.87×10^{-3}
	40-60	Sand	1.36	2.41	48.7	5.24×10^{-4}
	60-80	Sand	1.49	1.72	43.7	7.33×10^{-4}
	80-100	Sand	1.49	1.05	43.8	5.86×10^{-4}
B	0-20	Sand	1.34	8.77	49.4	2.87×10^{-3}
	20-40	Sand	1.34	8.63	49.4	2.95×10^{-3}
	40-60	Sand	1.26	6.50	52.5	3.62×10^{-4}
	60-80	Sand	1.49	1.74	43.8	1.12×10^{-3}
	80-100	Sand	1.46	1.22	44.9	6.24×10^{-4}
C	0-20	Sand	1.30	18.99	50.9	4.80×10^{-3}
	20-40	Sand	1.25	18.23	52.8	4.70×10^{-3}
	40-60	Sand	1.28	14.62	51.7	8.50×10^{-4}
	60-80	Sand	1.50	3.61	43.4	6.10×10^{-4}
	80-100	Sand	1.40	1.72	47.2	6.70×10^{-4}

Table 2 Table of coefficient of correlation (r), coefficient of determination (r^2), and tabulated and calculated t value at 0.05 significance level

Soil Variables	Site A				Site B				Site C			
	r	r^2	t_{tab}	t_{cal}	r	r^2	t_{tab}	t_{cal}	r	r^2	t_{tab}	t_{cal}
OM	0.97	0.94	3.18	6.86	0.92	0.85	3.18	4.20	0.93	0.87	3.18	4.47
B_d	0.87	0.75	3.18	3.01	0.19	0.04	3.18	0.34	0.73	0.54	3.18	1.85

4. Conclusion

Soil properties were investigated for three land uses. Organic matter content of the soil was observed to change with changes in land use than any other soil property investigated. Hydrologic properties were also observed to be affected by changes in land use. Hydraulic conductivity of the three land uses were found to be correlated to soil properties. However, hydraulic conductivity was found to be more correlated to organic matter content than to other soil properties. It is only organic matter that is significantly related to hydraulic conductivity for the three experimental sites. Hence, the observed changes in the soil hydraulic conductivity over the three land uses can be attributed to the effect of land use on soil organic matter content.

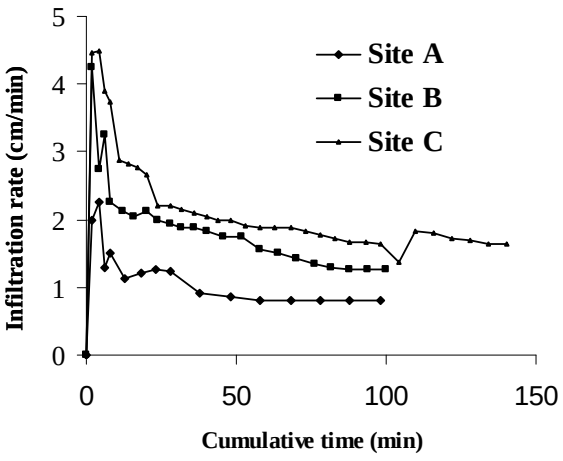

Fig. 3 Infiltration curve.

References

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