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SOIL QUALITY ASSESSMENT OF DIFFERENT LAND USE TYPES IN SABONGIDA TAKAI NORTHEAST, NIGERIA

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Abstract

Soil quality assessment is imperative in determining the level of soil potential in order to ensure sustainable land use practices. The determination of the soil quality of Sabongida Takai Northeast Nigeria is essential hence it is an agrarian area. A free survey technique was used to cite profile pit on each of the four land use types selected for the study. The profile pits were sampled base on horizon differentiation and the samples were subjected to routine and special laboratory analyses. Generated data were statistically analyzed using one-way analyses of variance. Soil qualities were determined using Amacher soil quality index. The result indicated that sand fraction had the mean of 80.40 %, 79.55 %, 77.47 % and 56.80 % for the soil under dump site, farm site, residential site, and wetland site. The pH was high while total nitrogen, Mg, Na, K, total exchangeable acidity, Pb, and Cd were low according to the ratings of USDA NRSC soil quality index. The organic carbon was moderate at the dump site and farm site while it was low at the residential site and wetland site. Hence, the need to embark in soil management practices that will sustain the soil quality is imperative.

Key words: *assessment, horizon, profile pit, land use, soil quality, survey*

INTRODUCTION

Soil quality declination has been severe and on a widespread in most agricultural regions of the developing countries of the world [29]. Soil erosion and nutrient depletion are widely considered to be a significant soil degradation factors undermining the livelihoods of substances farmers in the developing world [35]. The result obtained from the assessment of soil quality will determine the kind of soil management practices which will be adopted in order to sustain or enhance the soil as the case may be for future use.

According to [19] soil quality is the inherent ability of a soil to function within an ecosystem boundary to sustain biological productivity, maintain air and water quality, and support human habitation and health. Soil quality consists of the diverse areas covering the inherent capacity of the soil for crop growth, and the dynamic part influenced by the soil user or manager [8, 33]. The physical, chemical, mineralogical and biological properties of soil determine the soil quality. However, individual soil properties alone may not be sufficient for the assessment of soil quality [3]. [39] stated that soil properties depend on the soil nutrient pools and reserves, which are altered by land use practices.

Soil quality decline also results in a reduction in global agricultural productivity, economic growth, and a healthy environment. Soil quality decline is caused by improper land use type, intense and erosive rainfall, steep terrain, deforestation, nutrient depletion, complete removal of crop residues, crop production with low levels of nutrient inputs, lack of adequate soil conservation practices, population pressure and overgrazing. In Nigeria, non-sustainable use of land has resulted in massive land degradation and soil infertility [13, 40]. Agricultural producing region such as Sabongida Takai in Taraba State, the use of chemical fertilizers and pesticides for the sake of optimal production has been a practice over decades. According to [5, 10], the socioeconomic and political issues such as land tenure, capital, and infrastructural development have hastened the decline of soil quality. Soil quality data is important for appropriate decision making regarding sustainable land use practices. However, individual soil properties alone may not be sufficient for the assessment of soil quality. [15] stated that the assessment of soil properties is a basis for describing and understanding the status and qualities of the essential nutrients in soils. The assessment of soil physico-chemical properties helps agriculturist and other land users to understand the potential status of the soils.

Several researchers [1, 27] have reported on poor soil quality in most regions of Nigeria which are as a result of physical, chemical, mineralogical and biological properties. The decline in soil quality has a serious impact on soil physical, chemical and biological properties, especially, bulk density, infiltration, organic matter content, porosity and aggregate stability resulting in soil compaction and erosion [28, 32]. In Nigeria, there have been unregulated deforestation and intensive use of land for all kinds of land utilization type irrespective of the agricultural qualities of the soils or the environmental impact of these uses. [16] stated that soil quality assessment is imperative as the soil is a critically important component of the Earth's biosphere, supporting food production and environmental quality. There is a need to sustain food security and the quality environment through the use of proper soil management practices and policies. There is an increase in demand for information relating to soil conditions, their current status, level of degradation, changes due to land use types and management practices and suitable conservation practices to ensure sustainable and optimal land utilization. This would be ascertained through detailed soil quality assessment [20].

Although many works have been done on soil quality assessment of different land uses on soil properties and fertility around the world, yet little or nothing is done on soil quality in the study area. This facilitated this research work with the view of assessing the extent of soil quality as influenced by different land uses so as to guide the farmers and other land explorers. However, this study was to assess soil quality under different land use types in Sabon Gida Takai, Taraba State.

MATERIALS AND METHODS

Study area

The study was carried out in four different land use types located in Sabon Gida Takai in Gassol local government area of Taraba State North-east, Nigeria. The study area lies between latitude, 7^o 31' N and 8^o 4' N and longitude 10^o 25' E and 11^o 45' E. Sabon Gida Takai is in tropical continental with an annual rainfall range 866 – 1047 mm [25]. The average annual atmospheric temperature is about 34.22 ^oC [25].

The study area is a rural community characterized by low to medium level of inputs based farmers. The major farmer produce are yam (*Dioscorea spp*), cassava (*Manihot esculenta Crantz*), melon (*Citrus valgaris*), rice (*Oryza sativa*), maize (*Zay mays*), sorghum (*Sorghum bicolor*), millet (*Pennisetum glaucum*), groundnut (*Arachis hypogeae*), and beans (*Cowpea spp*). Sabon Gida Takai lies along the Benue River and such its hydrology is influenced by the Benue River.

Study sites

The land use types consist of the Residential site, Farm site, Dumpsite, and Wetland site.

The dump site (landfill) is a site for the disposal of domestic waste of all kinds' waste materials. Landfills have been the most common method of waste disposal in the study area.

The farm site is an area of land which is set aside for the cultivation of annual crops which is the basic facility in food production in the study area. Various types of crops such as melon (*Citrus valgaris*), maize (*Zay mays*), okra (*Abelmosschus esculenta*), groundnut

(*Arachis hypogeae*), and yam (*Dioscorea spp*) are been cultivated here.

The wetland site of the study area is seasonally saturated with water. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydra soil. The wetland is basically used for rice production.

The residential site consists of private, industrial and commercial areas. Housing varies significantly between and through residential areas. These include private house, multi-family residential and single unit mobile houses.

Field study

A reconnaissance survey was conducted to map out the sites and to take into account the features within the area. Subsequently, a free survey technique was employed in citing soil profile pit on each of the land use types. However, samples were collected on each profile pit base on horizon differentiation as described by [31]. A total of 13 soil samples were collected. The collected soil samples were subjected to routine and special laboratory analyses.

Laboratory analyses

The particle size distribution was determined by the hydrometer method described by [14]. Soil pH was determined using 1:2.5 soil–water ratio using a pH meter [38]. Organic carbon was determined by wet digestion method [24]. Total nitrogen was determined by the micro-Kjeldahl digestion technique [7]. Available phosphorus was determined using Bray l method [26]. Exchangeable acidity was determined by the method described by [23]. Exchangeable bases were determined by neutral ammonium acetate procedure buffered at pH 7.0 [37]. Cation Exchange Capacity was determined using neutral ammonium acetate leachate method described by [36].

Statistical analysis

One-way analysis of variance (ANOVA) was used to compare the pedons under different land uses. Separation of the means of the soil properties of the pedons was performed using the least significant difference (p<0.05). However, the analyses were done using Genstat version 17th edition.

Soil quality assessment

Soil quality was determined using a direct approach as the result of the collected soil samples were placed in a quality index by matching soil characteristics with the soil quality index. Soil quality was estimated following the approach of [2] as indicated in Table 1. The estimation of the degree of soil quality was based on chemical and micronutrient parameters of the soil under the land use types.

Table 1.Soil quality ratings

Soil Properties	High	Moderate	Low	Very Low
pH	3.01 – 4.0	4.01 – 5.5	5.51 – 6.8	7.21 – 7.5
Organic Carbon (%)	>5	1 – 5	<1	
Total Nitrogen (%)	>0.5	0.1 – 0.5	<0.1	
Av.P (mg/kg)	>30	15 – 30	<15	
Na (cmol/kg)	>15	≤15		
K (cmol/kg)	>5	1 – 5	<1	
Mg (cmol/kg)	>5	0.05 – 5	<0.05	
Ca (cmol/kg)	>10	1.1 – 10	0.1	0.01
Al (cmol/kg)	>1	0.1 – 1	<0.1	
Zn (mg/kg)	>10	1 – 10	<1	
Cd (mg/kg)	>0.5	0.1 – 0.5	<0.1	
Pb (mg/kg)	>1	0.1 – 1	<0.1	

High= 2, Moderate= 1, Low= 0, Very Low= -1
Source: Adapted from Amacher *et al.* (2007) [2].

RESULTS AND DISCUSSIONS

The soil physical properties as shown in Table 2 indicated that sand fraction had a mean of 80.40 %, 79.55 %, 77.47 % and 56.80 % for the pedon under dump site, farm site, residential site, and wetland site. The sand fraction distribution of the study area could be associated with parent material and climatic factors. This agreed to the finding of [18] in soils of Northeast Nigeria. Sand fraction for the pedon under the dump site differed significantly ($p< 0.05$) with that of the pedon under the wetland site while sand fraction for the pedon under the dump site had non-significant difference with the pedon under the farm site and residential site. The silt fraction for the pedon under wetland site differed significantly ($p< 0.05$) with that of the pedon under farm site and residential site while it had a non-significant difference with the pedon under dump site.

Clay fraction had a mean of 14.0 %, 14.0 %, 17.0 % and 24 % for the pedons under dump site, farm site, residential site, and wetland site. However, clay fraction had a non-significant difference among the land-use types. The silt-clay ratio of pedons under dump site, farm site, and residential site were higher than 0.15 which is an indication that the soil is formed from new parent material hence the silt-clay ratio for wetland site is < 0.15. However, [4] stated that soil with silt-clay ratio < 0.15 are derived from old parent material and are highly weathered. According to [21], soils that are highly weathered are easily degraded. Silt-clay ratio of the pedon under wetland site differed significantly ($p< 0.05$) with that of the pedon under the farm site and it had non-significant difference with the silt-clay ratio of the pedon under dump site and residential site.

Table 2. Soil physical properties of the studied sites

Horizon	**Depth (cm)**	**Sand (%)**	**Silt (%)**	**Clay (%)**	**TC**	**SCR**
DUMP SITE (coordinate: 8°20.14′ N and 10°26.19′ E; elevation: 178.4 m)						
A	0–13	83.8	6.2	10.0	LS	0.62
AB	13–27	84.8	5.2	10.0	LS	0.52
BA	27–45	86.8	3.2	10.0	LS	0.32
Bt1	45–65	83.8	3.2	13.0	LS	0.25
Bt2	65–97	67.8	5.2	27.0	SCL	0.19
Mean		**81.40[a]**	**4.6[ab]**	**14.0**		**0.38[ab]**
FARM SITE (coordinate: 8°19.93′ N and 10°26.17′ E; elevation: 181.8 m)						
A	0–13	86.8	4.2	9.0	LS	0.47
AB	13–37	85.8	5.2	9.0	LS	0.58
Bt1	37–59	78.8	8.2	13.0	LS	0.63
Bt2	59–88	66.8	8.2	25.0	SCL	0.33
Mean		**79.55[ab]**	**6.45[a]**	**14.0**		**0.50[a]**
RESIDENTIAL SITE (coordinate: 8°19.99′ N and 10°26.15′ E; elevation: 179.5 m)						
A	0–25	84.8	5.2	10.0	LS	0.52
AB	25–51	84.8	4.2	11.0	LS	0.38
Bt	51–112	62.8	7.2	30.0	SCL	0.24
Mean		**77.47[ab]**	**5.53[a]**	**17.0**		**0.38[ab]**
WETLAND SITE (coordinate: 8°19.77′ N and 10°26.19′ E; elevation: 176.8 m)						
A	0–50	56.8[b]	1.2[b]	24.0	SCL	0.05[b]
LSD(0.05)		**23.58**	**4.098**	**20.96[NS]**		**0.3928**

TC= textural class, SCR= silt clay ratio, LS= loamy sand, SCL= silt clay loam, [NS]= not significant, LSD= least significant difference

Source: Own results.

The soil pH (Table 3) was slightly acidic in all the pedons of the land uses. The soil pH had no significant difference among the pedons of the land-use types. The soil pH level could be associated with anthropogenic activities and the nature of parent material. The organic carbon content of pedons under the dump site and farm site was moderate while that of the pedon under the residential site and wetland site was low according to the ratings [22] and [12]. The organic content differed non-significantly among the pedons under the land-use types. However, total nitrogen had non-significant difference among pedons of the land-use types. The available phosphorus of the pedons was high at the dump site, moderate at the residential site and wetland site and low at the farm site when compared with the rating of [11]. The high available phosphorus at the dump site could be attributed to the activities of organic matter content deposit. Available phosphorus for the pedon under the dump site differed significantly ($p < 0.05$) with that of the other pedons of the land-use types while available phosphorus for the pedon under farm site, residential site, and wetland site differed non-significantly. The carbon-nitrogen ratio had a mean of 20.58 for the pedon under the dump site, 7.81 for the pedon under the farm site, 2.58 for the pedon under the residential site, and 0.81 for the pedon under the wetland site. The carbon-nitrogen (C:N) differed non-significantly among pedons of the land-use types. According to [6], if C:N exceeds 25:1 this will result to N deficiency thereby reducing the rate of organic matter decomposition hence the microbes do not have sufficient N to sustain their life.

Table 3. The results of soils pH, organic carbon, total nitrogen, available phosphorus, Calcium nitrogen ratio under the studied sites

Horizon	Depth (cm)	pH (H_2O)	OC (%)	TN (%)	Av.P (mg/kg)	C:N
DUMP SITE (coordinate: 8°20.14′ N and 10°26.19′ E; elevation: 178.4 m)						
A	0–13	5.65	6.67	0.15	97.76	44.46
AB	13–27	5.15	3.72	0.21	92.24	17.71
BA	27–45	6.3	3.49	0.09	124.22	38.78
Bt1	45–65	6.65	0.12	0.10	54.76	1.20
Bt2	65–97	6.75	0.12	0.16	58.07	0.75
Mean		**6.10**	**2.82**	**0.14**	**85.41^{a}**	**20.58**
FARM SITE (coordinate: 8°19.93′ N and 10°26.17′ E; elevation: 181.8 m)						
A	0–13	6.55	2.43	0.22	8.49	11.05
AB	13–37	6.6	1.24	0.17	0.37	7.29
Bt1	37–59	6.5	2.17	0.18	0	12.06
Bt2	59–88	6.65	0.17	0.2	0	0.85
Mean		**6.58**	**1.50**	**0.19**	**2.21^{b}**	**7.81**
RESIDENTIAL SITE (coordinate: 8°19.99′ N and 10°26.15′ E; elevation: 179.5 m)						
A	0–25	6.65	0.81	0.23	8.09	3.52
AB	25–51	6.75	0.17	0.14	14.7	1.21
Bt	51–112	6.45	0.57	0.19	12.13	3.00
Mean		**6.62**	**0.52**	**0.19**	**11.64^{b}**	**2.58**
WETLAND SITE (coordinate: 8°19.77′ N and 10°26.19′ E; elevation: 176.8 m)						
A	0–50	6.00	0.17	0.21	11.76^{b}	0.81
LSD$_{(0.05)}$		**1.147^{NS}**	**4.818^{NS}**	**0.1012^{NS}**	**48.64**	**34.64^{NS}**

OC= organic carbon, TN= total nitrogen, Av.P= available phosphorus, C:N= calcium nitrogen ratio, ^{NS}= not significant, LSD= least significant difference
Source: Own results

According to the ratings of [22] as indicated in Table 4, Ca and Mg content was very low and low, respectively; Na content was high-very high while K content was very high for pedon under the land-use types except for the wetland site where it was moderate. The Na content was predominant than other basic cations in all the pedons under the land-use types except for wetland site where Ca content dominates the pedon. The Mg, Na, and K had a non-significant difference among the pedons under the land-use types. However, Ca content for the pedon under dump site and wetland site differed significantly ($p < 0.05$) with that of the pedon under the farm and residential land use types. The effective cation exchange capacity (ECEC) had a mean of 11.12 cmol/kg for the pedon under the dump site, 12.47 cmol/kg for the pedon under the farm site, 16.80 cmol/kg for the pedon under the residential site, and 12.49 cmol/kg for the pedon under the wetland site. However, ECEC (Table 4) differed significantly among the pedons under the land-use types. The calcium-magnesium ratio had a mean of 1.29, 1.23, 1.26 and 1.67 for the pedons under dump site, farm site, residential site, and wetland site, respectively. The Ca:Mg is <3 which indicates that the soils are infertile as described by [22] for tropical soils.

Table 4. The results of soils Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Total exchangeable bases and Effective cation exchange capacity under the studied sites

Horizon	Depth (cm)	Ca (cmol/kg)	Mg (cmol/kg)	Na (cmol/kg)	K (cmol/kg)	TEA (cmol/kg)	ECEC (cmol/kg)	Ca:Mg
DUMP SITE (coordinate: 8º20.14′ N and 10º26.19′ E; elevation: 178.4 m)								
A	0–13	0.87	0.65	2.17	1.41	2.4	7.50	1.34
AB	13–27	0.87	0.67	4.35	1.66	4.0	11.55	1.29
BA	27–45	0.89	0.69	5.22	1.99	1.6	10.39	1.29
Bt1	45–65	1.09	0.7	4.35	1.53	2.4	10.07	1.56
Bt2	65–97	0.78	0.81	8.70	4.60	1.2	16.09	0.96
Mean		**0.90[b]**	**0.70**	**4.96**	**2.24**	**2.3[b]**	**11.12**	**1.29[ab]**
FARM SITE (coordinate: 8º19.93′ N and 10º26.17′ E; elevation: 181.8 m)								
A	0–13	0.78	0.63	0.96	0.36	2.0	4.73	1.24
AB	13–37	0.78	0.64	0.96	0.36	4.8	7.54	1.22
Bt1	37–59	0.79	0.64	6.52	1.29	12.0	21.24	1.23
Bt2	59–88	0.82	0.66	4.35	2.56	8.0	16.39	1.24
Mean		**0.79[b]**	**0.64**	**3.20**	**1.14**	**6.70[a]**	**12.47**	**1.23[b]**
RESIDENTIAL SITE (coordinate: 8º19.99′ N and 10º26.15′ E; elevation: 179.5 m)								
A	0–25	0.86	0.64	6.52	2.43	6.4	16.85	1.34
AB	25–51	0.88	0.66	0.91	0.33	8.8	11.58	1.33
Bt	51–112	0.82	0.73	8.70	3.71	8.0	21.96	1.12
Mean		**0.85[b]**	**068**	**5.38**	**2.16**	**7.73[a]**	**16.80**	**1.26[b]**
WETLAND SITE (coordinate: 8º19.77′ N and 10º26.19′ E; elevation: 176.8 m)								
A	0–50	1.27[a]	0.76	1.22	0.44	8.8[a]	12.49	1.67[a]
LSD$_{(0.05)}$		**0.1943**	**0.1182[NS]**	**7.261[NS]**	**3.329[NS]**	**6.56**	**13.57[NS]**	**0.3834**

TEA= total exchangeable acidity, ECEC= effective cation exchange capacity, [NS]= not significant, LSD= least significant difference
Source: Own results.

Available Zn (Table 5) was very low among the pedons under the land-use types according to the rating of [9]. The available Zn was low compared to the findings of [34] in soils of Northeast Nigeria. However, available Zn of the pedon under the farm site differed significantly ($p < 0.05$) with that of the pedons under dump site, residential site, and wetland site. However, available Zn had non-significant difference among the pedons under the dump site, residential site, and wetland site.

The available Pb (Table 4) ranged from 0.001 – 0.003 mg/kg among pedons of the land-use types. The available Pb and available Cd were within the tolerable limit recommended by [41]. Available Pb and Cd had non-significant difference among pedons under the land-use types.

Available Cr ranged from 0.008 – 0.018 mg/kg among pedons under the land-use types. The available Cr was below the tolerable limit for soil as recommended by [41]. The available Cr of the pedon under wetland site differed significantly (p <0.05) with that of pedons under dump site, farm site, and residential site.

The soil quality index (Table 1) as designed by [2] was used to determine the quality of soil as influenced by the land use types.

The pH (Table 6) of the horizons of each pedon under the land use types was moderate except for the AB horizon of the dump site pedon that was high. However, the A horizon of the pedons under each land use type is suitable for many plant species when compared with the rating of soil quality index [2].

Table 5. Selected Heavy metal Properties of the studied sites

Horizon	Depth (cm)	Zn (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	Cr (mg/kg)
DUMP SITE (coordinate: 8º20.14′ N and 10º26.19′ E; elevation: 178.4 m)					
A	0–13	0.023	0.008	0	0.024
AB	13–27	0.024	0.002	0	0.020
BA	27–45	0.024	0.002	0	0.016
Bt1	45–65	0.026	0.002	0	0.012
Bt2	65–97	0.023	0.001	0	0.018
Mean		**0.024[b]**	**0.003**	**0**	**0.018[a]**
FARM SITE (coordinate: 8º19.93′ N and 10º26.17′ E; elevation: 181.8 m)					
A	0–13	0.031	0.001	0.001	0.012
AB	13–37	0.030	0.002	0	0.010
Bt1	37–59	0.028	0.001	0	0.008
Bt2	59–88	0.031	0.001	0	0.010
Mean		**0.030[a]**	**0.001**	**0.00**	**0.010[a]**
RESIDENTIAL SITE (coordinate: 8º19.99′ N and 10º26.15′ E; elevation: 179.5 m)					
A	0–25	0.024	0.002	0.001	0.014
AB	25–51	0.022	0.001	0	0.009
Bt	51–112	0.024	0.002	0	0.012
Mean		**0.023[b]**	**0.002**	**0.00**	**0.012[a]**
WETLAND SITE (coordinate: 8º19.77′ N and 10º26.19′ E; elevation: 176.8 m)					
A	0–50	0.022[b]	0.001	0.0009	0.008[b]
LSD(0.05)		0.003163	0.004775[NS]	0.00098[NS]	0.0083

Source: Own results.

Table 6. Soil quality rating of the studied pedons

Horizon	Depth (cm)	pH H_2O	OC %	TN %	Av.P (mg/kg)	Ca (cmol/kg)	Mg (cmol/kg)	Na (cmol/kg)	K (cmol/kg)	TEA (cmol/kg)	Zn (mg/kg)	Pb (mg/kg)	Cd (mg/kg)
DUMP SITE (coordinate: 8º20.14′ N and 10º26.19′ E; elevation: 178.4 m)													
A	0 –13	0	2	1	1	-1	1	1	1	1	0	1	1
AB	13–27	1	1	1	1	-1	1	1	1	1	0	1	1
BA	27–45	0	1	0	1	-1	1	2	1	1	0	1	1
Bt1	45–65	0	0	1	1	0	1	1	1	1	0	1	1
Bt2	65–97	0	0	1	1	-1	1	2	1	1	0	1	1
Mean		**0**	**1**	**1**	**1**	**-1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**
FARM SITE (coordinate: 8º19.93′ N and 10º26.17′ E; elevation: 181.8 m)													
A	0–13	0	1	1	1	-1	1	1	1	1	0	1	1
AB	13–37	0	1	1	0	-1	1	1	1	1	0	1	1
Bt1	37–59	0	1	1	0	-1	1	2	1	2	0	1	1
Bt2	59–88	0	0	1	0	-1	1	1	1	1	0	1	1
Mean		**0**	**1**	**1**	**0**	**-1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**
RESIDENTIAL SITE (coordinate: 8º19.99′ N and 10º26.15′ E; elevation: 179.5 m)													
A	0–25	0	0	1	0	-1	1	2	1	1	0	1	1
AB	25–51	0	0	1	1	-1	1	1	1	1	0	1	1
Bt	51–112	0	0	1	1	-1	1	2	1	1	0	1	1
Mean		**0**	**0**	**1**	**1**	**-1**	**1**	**2**	**1**	**1**	**0**	**1**	**1**
WETLAND SITE (coordinate: 8º19.77′ N and 10º26.19′ E; elevation: 176.8 m)													
A	0–50	0	0	1	1	0	1	1	1	1	0	1	1

OC= organic carbon, TN= total nitrogen, Av.P= available phosphorus, TEA= total exchangeable acidity
Source: Own results.

The organic carbon (Table 6) content of the horizons of the pedons under the dump site and the farm site were mostly moderate except at the A horizon of dump site pedon where it was high. The organic carbon content of Bt2 horizon of the farm site pedon, the residential site, and the wetland site were low when compared with the USDA soil quality index. Anthropogenic activities and land management practices can result in a decrease in organic carbon level [30, 42]. The total nitrogen content (Table 6) of the horizons of the pedons under the land use types was moderate except for the BA horizon of dump site pedon where it was low. Available phosphorus was moderate across the horizons of pedons of the dump site and wetland site. However, available phosphorus was moderate at the A horizon and low in other horizons of Farm site pedon while, it was low at the A horizon and moderate at other horizons of residential site pedon. The Ca content was deficient in all the horizons of the pedons under the land use types. Ca depletion has been identified as a threat to soil sustainable productivity [17]. The Mg, K, and total exchangeable acidity were moderate across the horizons of the pedons under the different land use types. The total exchangeable acidity was moderate and as such could affect Al-sensitive plants as suggested by [22]. The Na content was moderate across the A horizon of the pedons except for that of the residential site that was high. Available Zn was low while available Pd and Cd were moderate across the horizons of each pedon under the land use types. The availability of Zn, Pb, and Cd as indicated in Table 6 was not a threat to the soil and its environment. However, Zn, Pb, and Cd become more available as pH increases. Hence, the pH levels of soil are not suitable to enhance the availability of the metallic cations.

CONCLUSIONS

The soil quality indicates that the soil pH is suitable for most land use practices. The organic carbon, total nitrogen, and available phosphorus were predominantly moderate and as such require some soil management practices to enhance their availability in soil. The Na content was moderate hence requires proper management in order to avert the occurrence of soil salinity. The available Zn, Pb, and Cd are no threat to underground water and also the crops that were grown within the area. The overall rating indicated that the soils of Sabon Gida Takia have moderate quality. However, practices that will enhance soil biodiversity, soil nutrient pool, alleviation of acidification and decreasing of salinization should be encouraged. These could be achieved through; incorporation of organic matter into the soil, use of non-acidic fertilizer, use of liming material as the need arises, and application of pesticides as recommended.

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