Effect of Land use Types on Soil Properties within Federal College of Education Kontagora, Niger State, Nigeria

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Abstract
The impact of land use on soil properties was investigated for five (5) land use types (old orchard, sole beans farm, sole maize farm, soya beans farm and uncultivated land). From each of the identified land use types, samples of soil were collected from depths of 0–15 cm and 15–30 cm, prepared and analyzed in the laboratory for soil properties. The upper layer of the soils (that is, 0–15 cm) had relatively higher organic carbon content than the 15–30 cm depth, although not significantly different between the land use types as well as with depths. The results also revealed that there were no significant differences between the land use types in the contents of NO_3-N, NH_4-N, Fe, texture, pH, Ca and Na whereas soil properties such as total-N, available phosphorus, Mg and K were significantly different in the soils of the different land use types. The soils were all loamy sand by textural classification. Hence, it was recommended that that conventional tillage operation should be discontinued on the lands that are used for cultivation of crops to avert the risks of erosion because of the loose nature of the soils. Also, the adoption of appropriate management practices such as manure application can help to improve the soil texture and enhance the soils' retentive capacities.

Key Words: *Land use types,Soil degradation, Soil properties, Sustainability*

1.0 Introduction

Land use is one of the main drivers of many processes of environmental change, as it influences basic resources within the landscape, including the soil resources (González *et al*., 2014). Poor soil management can rapidly deteriorate vast expanse of land, which frequently becomes a major threat to rural subsistence in many developing and developed countries. Conversely, impact of land use changes on soil can occur so unnoticed that land managers hardly contemplate initiating ameliorative measures. Knowledge and understanding of soil properties and processes ensures that appropriate remediation or reclamation practices of disturbed or damaged soils are put in place.

Nutrient mining and soil degradation are presently considered as problems in arable farms (Ande and Onajobi, 2009). The cropping system may lead to erosion and leaching of soil nutrients which in turn adversely affect the physico-chemical properties of the soil. Land use change is also known to be an important factor controlling soil organic matter storage. Haghighi e*t al.* (2010) stated thatchanges in land use can significantly affect soil properties such that the conversion of natural pasture to dry land farming alters soil properties that negatively affect soil productivity and erodibility. The capacity of soil to function can be reflected by measured soil physical, chemical and biological properties, also known as soil quality indicators (Shukla *et al.*, 2006). Soil properties that can be changed in a short time by land use dynamic are considered as soil quality indicators (Carter *et al*., 1997). For evaluation of soil quality, it is desirable to select indicators that are directly related to soil quality.

Sustainability and food security are the main thrusts of modern agricultural production, particularly for the developing countries. According to Turner *et al*. (2007), an orientation towards sustainability always has been a constitutive element of land system science. Pursuing these parameters as indices of development involves systematic understanding of several facets of production processes which rely so much on the soil, that has been adjudged the most basic of all natural resources (Babalola, 2000; Lal, 2015). Agricultural production places too much burden on the soil such that degradation of all sorts may result. The extent of degradation varies from site to site; from one production system to another; as well as from one management practice to the other. Generating soil information associated with land use types practiced in an environment is essential as a means of determining the impact of such systems on the soil. It will also be predictive of management options that can ensure agricultural sustainability and fostering food security. The malignant neglect of soils by farmers in any environment has most often led to yield reduction and at times, outright losses. As Lal (2015) stated, soil degradation is a 21st century global problem that is especially severe in the tropics and sub-tropics. Farmers in these regions –most especially in Africa do not take proactive (concerted) efforts to tackle manageable situations when they are still at small scale.

In addition to negatively impacting on agronomic production, soil degradation can also dampen economic growth especially in countries where agriculture is the engine for economic development (Scherr, 2001). This was the case as experienced in Kontagora and its environs in the year 2016 particularly and even in subsequent years (2017 and 2018 farming seasons), where beans yield obtained by farmers was an utmost bewilderment after luxuriant growth gave hope of bumper harvest but turned around the other way-people projecting fifteen bags, rarely got five bags. Curiosity surrounding such poor yields from beans and other cropsinformed the need for examination of soil properties of some lands under different usage in Federal College of Education Kontagora land mass. Hence, the objectives of this study were to:

i. Identify and describe the various land use systems in Federal College Education Kontagora Main Campus.
ii. Determine physical and chemical properties of the soil under different land uses.
iii. Establish the relationship between selected properties of soils under different land use systems.

2.0 Materials and Methods

2.1 Experimental site

The research was carried out in Federal College of Education Kontagora where the predominant land uses are for agriculture and construction. Kontagora is Located in the guinea savanna on longitude 5.47^0E and latitude 10.40^0N. The climate of Kontagora is characterized by mono peak rainfall regime with long dry and short heavy rainfall that lasts for about six months or less (Encyclopedia Britannica, 2017). It is located at an elevation of 335 meters above sea level. The soils here areof the Ku and Ya series (Nuhu, 1983). It is also important to note that the estimated land area of Federal Collage of Education Kontagora campus is 447.906 hectares (Federal College of Education Kontagora Works Department, 2017) but this reasonably large area of land has no soil map rather rely on farmers' abilities in taking managerial strides for the soil.

Kontagora town is one of thecollectionpoints for cotton and peanuts (groundnuts). In addition to these cash crops, Kontagora enjoys considerable local trade in sorghum, millet, cowpeas, tobacco, beans, shea butter, gum arabic, kola nuts, sorghum beer, brass wares, gold artifacts, locally dyed and woven cotton cloth, cattle, goats, chickens, and guinea fowl. The people of Kontagora are engaged mainly in agriculture.

2.2 Research procedure

Five (5 different land use types were identified and described in relation to prominent features found in Federal College of Education Kontagora Campus and geographic location. Soil samples were collected from ten points at depths of 0-15cm and 15-30cm from each land use types using the soil auger. Soil samples from a particular depth for any of the land use types were bulked, prepared by air drying and sieved through a 2 mm mesh. This gave rise to twenty (20) samples. Then, prepared soil samples were analyzed in the laboratory for soil properties (organic matter content, total nitrogen, N-forms, exchangeable bases, available phosphorus, texture/textural class, pH and Iron content).

2.3 Laboratory analytical procedures for soil properties determination/data collection

In the laboratory, organic content was determined by the wet oxidation technique of Walkley and Black (1934); exchangeable bases were extracted using 1N Neutral ammonium acetate. Contents of K and Na in extract were determined with the flame photometer whereas contents of Mg and Ca were determined by EDTA titration. The total N content of the soil was evaluated by employing the micro-Kjeldahl technique as modified by Jones (2001) while NO_3-N and NH_4-N were determined by the steam distillation technique using 0.01M Calcium chloride as extracting solution (Houba*et al*., 2000) and later Kjeldahl distillation (Anon., 1994).

Available phosphorus was determined by extraction techniques of Bray and Kurtz (1945); pH was determined electronically using the pH meter at 2:1 soil: $CaCl_2$ solution ratio; texture was determined by the hydrometer procedure (Jones, 2001), then, textural classes were determined with the textural triangle; iron (Fe) in soil samples was extracted by EDTPA extraction procedure and content of Fe wasmeasured with Atomic Absorption Spectrometer (Jones, 2001; Mgbonu, 2009).

2.4 Statistical analysis

Data obtained on various parameters were analyzed using SPSS (Levesque, 2007). Standard Error of Means (SEM) was used to separate the means where there are statistical significant differences.

3.0 Results

3.1 Land use types identified in the area of study

Five systems of agricultural land use were identified. These include:

i. Sole maize farm (SMF): This is the students' demonstration farm of the Department of Agricultural Education found at back of Lecture Hall I of the Department (that is Southward of Department of Agricultural Education Lecture Hall I. The land has been used for over five years for sole maize production. In the production of maize fertilizers such as NPK 15:15:15 and Urea as well as herbicides such as atrazine are usually applied to the land.

ii. Old orchard (O.O.): This is located at the back of the Department of Agricultural Education laboratory. In the orchard, the following species of trees such as mango, cashew, neem tree, oil palm are farmed. The old orchard has been there for over ten (10) years in the Department of Agricultural Education, Federal Collage of Education Kontagora, Niger state without being use for any other purpose.

iii. Sole bean farm (SBF_a): The beans farm is located south-east ward beside the uncompleted Green House of the Department of Agricultural Education of the Federal College of Education Kontagora. The land was used for beans production for only one season before the soil samples were collected but has been put to other crops production such as maize, groundnut and guinea corn mixture. Pesticides such as magic plus and target star were applied to the beans for maintenance purposes.

iv. Uncultivated land (UCL): The land is located at the back of Fine and Applied Arts Department of Federal Collage of Education, Kontagora, Niger state. The land is situated at the North-West ward of Fine and Applied Arts Department. However, for the past 10 to 15 years the land has been used for sculptural display and animal grazing with grasses growing seasonally.

v. Soya beans farm (SBF_b): This land is located at the back of Child Development Centre of Home Economics Department of Federal Collage of Education, Kontagora, Niger state. The land is situated at the North side of the Child Development Centre. In the production of soya beans, the land was ploughed, harrowed and ridges were constructed by the use of tractors and also herbicides such as gramazole was used for effective weed control. However, the land has been used for about 2 to 3 years for soya beans production with similar maintenance being carried out.

3.2 Organic matter content of the soils under the land use types

The organic carbon content in the 0-15cm depth of the soils ranged from 2.21 to 4.26gkg^{-1} and for the 15-30cm depth of the soil under different land uses, organic carbon ranged from 1.62 to 2.35gkg^{-1}. The obvious indication is that the upper layer of the soil (that is, 0-15cm depth) had higher organic carbon content than the 15-30cm depth. On average, the 0-15cm depth of the soils under different land use systems had about 46.91% higher organic carbon content than the 15-30cm depth. However, statistically, there was no significant difference ($P \leq 0.05$) in organic carbon content between both the two depths and the different land use types. Table 1 shows the content of organic matter in the soils.

Table 1 Organic carbon content in different land use types

Depth(cm)	O.O	SBF_a	SMF	SBF_b	UCL	LS
0-15cm	4.26	3.09	2.21	2.65	2.31	NS
15-30cm	1.91	2.35	2.18	1.62	1.81	NS
LS	NS	NS	NS	NS	NS	

O.O: Old orchard; SBFa: Sole Beans Farms; SMF: Sole Maize farm; SBFb: Soya Beans Farm; UCL: Uncultivated land; LS: Level of Significance; NS: Not Significant.

3.3 Contents of total N and N-Forms in the soils

Total N content was between 0.057 % (570 $mgkg^{-1}$) and 0.073 % (730 $mgkg^{-1}$) with mean content of 0.0626 % (626 $mgkg^{-1}$) for the 0 – 15 cm soil depth, and between 0.057 (570 $mgkg^{-1}$) with mean content of 0.0612 % (612 $mgkg^{-1}$) for the 15 – 30 cm soil depth. On average, the 0 – 15 cm soil depth had relatively higher total N content, however, there was no significant difference between the two soil depths on the total N content but total N content was significantly different between the land use types ($P \leq 0.05$) with the sole maize farm recording the highest value while the soya bean farm had the lowest total N content (Table 2a).

Table 2a Total N content (%) in different land use types

Depth(cm)	O.O	SBF_a	SMF	SBF_b	UCL	Means	LS
0 – 15	0.063	0.050	0.070	0.057	0.073	**0.0626**	**NS**
15 – 30	0.065	0.053	0.075	0.050	0.063	**0.0612**	**NS**
Means	0.064^{ab}	0.0515^{b}	0.0725^{a}	0.0535^{ab}	0.0635^{ab}		

O.O: Old orchard; SBFa: Sole Beans Farms; SMF: Sole Maize farm; SBFb: Soya Beans Farm; UCL: Uncultivated land; LS: Level of Significance; NS: Not Significant.

For the N-forms, NO_3-N was between 94.4 and 134.7 $mgkg^{-1}$ for the 0 – 15 cm soil depth where the value of the NO_3-N content was between 77.20 and 123.30 $mgkg^{-1}$for the 15 – 30 cm soil depth. NO_3-N content did not differ significant between the soil depths as well as between the land use types (Table 2b). Again, the other form of N (that is, NH_4-N) was between 410.30 and 622.70 $mgkg^{-1}$ in the 0 – 15 cm soil depth and, 455.70 and 668.8 $mgkg^{-1}$ in the 15 – 30 cm soil depth. NH_4-N content did not differ significantly between the soil depths as well as between the land use types (Table 2c). The content of NO_3-N was relatively higher in the 0 – 15 cm soil depth while NH_4-N was relatively higher in the 15 – 30 cm soil depth.

Table 2b NO_3-N content ($mgkg^{-1}$) in different land use types

Depth(cm)	O.O	SBF_a	SMF	SBF_b	UCL	LS
0 – 15	134.7	94.7	134.3	94.4	116.6	NS
15 – 30	79.3	77.2	86.8	87.8	123.3	NS
LS	NS	NS	NS	NS	NS	

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; NS means Not Significant.

Table 2cNH_4-N content ($mgkg^{-1}$) in different land use types

Depth(cm)	O.O	SBF_a	SMF	SBF_b	UCL	LS
0 – 15	505.1	410.3	509.3	468.7	622.7	NS
15 – 30	515.5	455.7	668.8	456.6	537.2	NS
LS	NS	NS	NS	NS	NS	

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; NS means Not Significant.

3.4 SoilpH of land under different uses

The pH of the soils under the identified land use systems ranged from 5.8 to 6.3 for the 0-15cm depth of soil, whereas for the 15-30cm depth of the soil, the pH was at the range of 5.7 to 6.0.On average, the old abandoned orchard (O.O) had relatively the highest pH of 6.05 while the uncultivated land (UCL) had the lowest pH value of the 5.8. The analysis of variance for the pH values of the soils showed that there is no significant difference ($P \leq 0.05$) between depths of soil as well as between the different land use systems. The results of pH values and distribution for the soils are shown in Table 3.

Table 3 pH values of soils under different land use systems

Depth	O.O	SMF	SBFa	SBFb	UCL	Mean
0-15	6.3	5.9	6.0	5.8	5.9	5.98
15-30	5.8	5.9	6.0	6.0	5.7	5.88
Mean	6.05	5.9	6.0	5.9	5.8	

O.O means Old orchard; SMF means Sole Maize farm; SBF_a means Sole Beans Farm; SBF_b means Soya Beans Farm; and ULC means Uncultivated Land.

3.5 Available P content of the soils

The available P content was significantly different between the soil depths as well as between the land use types. Meanwhile, available P content was between 22.30 and 40.70 $mgkg^{-1}$ for the 0 – 15 cm soil depth and between 21.30 and 42.00 $mgkg^{-1}$ for the 15 – 30 cm soil depth (Table 4).

Table 4 Available P content of soils under different land use systems

Depth(cm)	O.O	SBF_a	SMF	SBF_b	UCL	Means	LS
0 – 15	36.70	40.70	25.00	22.30	34.00	31.74	*
15 – 30	42.00	40.70	21.30	26.30	39.30	33.92	*
Means	**39.35^b**	**40.70^a**	**24.15^d**	**24.30^d**	**36.65^c**		

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; NS means Not Significant.

3.6 Exchangeable calcium and magnesium contents of the soils

The values of the contents of Calcium (Ca) and Magnesium (Mg) were at the ranges of 1.0 to 2.00$cmolkg^{-1}$ and 0.20 to 1.20$cmolkg^{-1}$ respectively. For all the land use systems, the contents of Ca and Mg decreased with depth but the old orchard have highest content of Ca while the soya bean had the highest Mg content on the average. While no significant difference was established for Ca content for depths and land use systems; Mg content in the soils under different land use systems differed significantly, even between the depths within a land use system. The results of Ca and Mg contents are summarized in Tables 5 and 6 respectively.

Table 5 Ca contents ($cmolkg^{-1}$) of the land use systems

Depth	**Land Use Systems**					
(cm)	**O.O**	**SBF_a**	**SMF**	**SBF_b**	**UCL**	**LS**
0-15	2.00	1.60	1.40	1.40	1.80	NS
15-30	1.40	1.40	1.40	1.00	1.20	NS
Means	1.70	1.50	1.40	1.20	1.50	
LS	NS	NS	NS	NS	NS	

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; NS means Not Significant.

Table 6 Mg contents ($cmolkg^{-1}$) of the land use systems

Depth	**Land Use Systems**						
(cm)	**O.O**	**SBF_a**	**SMF**	**SBF_b**	**UCL**	**SEM**	**LS**
0-15	0.80	1.00	0.60	1.20	1.00	0.087	**
15-30	0.60	0.80	0.20	0.80	0.80	0.087	**
Means	0.70	0.90	0.40	1.00	0.90		
SEM	0.087	0.087	0.087	0.087	0.087		
LS	**	**	**	**	**		

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; NS means Not Significant; ** means highly significant at P≤0.05.

3.7 Potassium and sodium distribution in soils under the land use systems

The content of K in the land use system varied between 0.03 and 0.11cmolkg^{-1}, whereas the content of Na was between 0.09 and 0.14cmolkg^{-1}. The difference in the contents of K and Na is between 24.43 and 66.67% (that is, Na is at least 24.43% higher than K in the land use systems on average but not more than 66.67% higher). For K content in the soils, significant difference was exhibited between the land use systems but not between depths. For Na content, no significant difference exists between the land use systems as well as with depths. Tables 7 and 8 show the results of the contents of K and Na in the soils under the various land use systems respectively.

Table 7 K content in soils of the land use systems

Depth			**Land Use Systems**			
(cm)	**O.O**	**SBF$_a$**	**SMF**	**SBF$_b$**	**UCL**	**LS**
0-15	0.05	0.11	0.06	0.03	0.06	NS
15-30	0.04	0.10	0.04	0.03	0.03	NS
Means	0.045	0.105	0.05	0.03	0.045	
SEM	0.0091	0.0091	0.0091	0.0091	0.0091	
LS	**	**	**	**	**	

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; LS means level of significance; NS means Not Significant; ** means highly significant at P≤0.05.

Table 8 Na content in soils of the land use systems

Depth			**Land Use Systems**			
(cm)	**O.O**	**SBF$_a$**	**SMF**	**SBF$_b$**	**UCL**	**LS**
0-15	0.10	0.13	0.13	0.09	0.11	NS
15-30	0.11	0.14	0.10	0.10	0.09	NS
LS	NS	NS	NS	NS	NS	

O.O means Old orchard; SMF means Sole Maize farm; SBFa means Sole Beans Farm; SBFb means Soya Beans Farm; and ULC means Uncultivated Land; LS means level of significance; NS means Not Significant.

3.8 Iron (Fe) content and clay proportion of the soils

The iron content of the soils did not differ significantly both with depth and between the land use types. Also, clay content did not show significant difference with depth as well as between the land use types. However, the old orchard has a relatively higher content of Fe than the other land use types. Tables 9 and 10 contain the results of the Fe and clay contents of the soils under the different land use types respectively.

3.9 Silt and sand fractions of the soils

Although the proportion of silt in the soils decreased with depth for the old orchard, sole beans farm and uncultivated land but increased with depth for the soils under the sole maize farm and soya beans farm, there was no significant difference in the content of silt amongst the land use types as well as between depths. With depth, sand content was not significantly different but between the land use types, significant difference in sand content existed. Relatively, the soya beans farm had the highest content of sand whereas the uncultivated land had the least content of sand. The results of the proportion of silt and sand in the soils are shown in Tables 11 and 13.

Table 9 Fe content(gkg^{-1})of the soils under different land use types

LUT/Depth	O.O	SBF_a	SMF	SBF_b	UCL	LS
0-15cm	7.00	5.10	3.80	3.80	4.70	NS
15-30cm	6.80	4.10	2.90	3.30	3.40	NS
LS	NS	NS	NS	NS	NS	

LUT: Land Use Type; O.O: Old orchard; SBFa: Sole Beans Farms; SMF: Sole Maize farm; SBFb: Soya Beans Farm; UCL: Uncultivated land; LS: Level of Significance; NS: Not Significant.

Table 10 Clay content (gkg^{-1}) of the soils under different land use types

LUT/Depth	O.O	SBF_a	SMF	SBF_b	UCL	LS
0-15cm	85	85	85	95	60	NS
15-30cm	85	95	95	85	125	NS
LS	NS	NS	NS	NS	NS	

LUT: Land Use Type; O.O: Old orchard; SBFa: Sole Beans Farms; SMF: Sole Maize farm; SBFb: Soya Beans Farm; UCL: Uncultivated land; LS: Level of Significance; NS: Not Significant.

Table 11 Silt content(gkg^{-1})of the soils under different land use types

LUT/Depth	O.O	SBF_a	SMF	SBF_b	UCL	LS
0-15cm	80	70	50	40	100	NS
15-30cm	70	40	60	50	50	NS
LS	NS	NS	NS	NS	NS	

LUT: Land Use Type; **O.O:** Old orchard; **SBFa:** Sole Beans Farms; **SMF**: Sole Maize farm; **SBFb**: Soya Beans Farm; **UCL**: Uncultivated land; LS: Level of Significance; NS: Not Significant

Table 12 Sand content (gkg^{-1})of the soils under different land use types

LUT/Depth	O.O	SBF_a	SMF	SBF_b	UCL	LS
0-15cm	835	845	865	865	840	NS
15-30cm	845	865	845	855	825	NS

LS	*	*	*	*	*
SEM	4.35	4.35	4.35	4.35	4.35

LUT: Land Use Type; **O.O:** Old orchard; **SBFa:** Sole Beans Farms; **SMF**: Sole Maize farm;**SBFb**: Soya Beans Farm; **UCL**: Uncultivated land; LS: Level of Significance; NS: Not Significant; *: significant at $p \leq 0.05$.

3.10 Relationship between soil properties

The relationship between properties of soil examined revealed r value of between -0.003 and 0.902. However, only seven (7) out of the ninety-one (91) relationships, representing 7.7 % of the relationships were significant (Table 13).

Table 13 Relationship between soil properties under different land use patterns

	C	T-N	N-N	A-N	pH	A-P	Ca	Mg	K	Na	Fe	Clay	Silt	Sand
Org. C	1	-0.083	0.394	-0.202	0.670*	0.181	0.831**	0.263	0.321	0.055	0.594	-0.211	0.355	-0.162
T-N		1	0.396	0.902**	0.098	-0.287	0.310	-0.540	-0.343	-0.199	-0.014	-0.181	0.431	-0.283
N-N			1	0.165	0.363	-0.051	0.439	0.106	-0.150	-0.156	0.136	-0.009	0.309	-0.364
A-N				1	0.044	-0.327	0.175	-0.562	-0.398	-0.349	-0.203	-0.116	0.413	-0.379
pH					1	-0.181	0.532	-0.233	0.083	0.077	0.340	-0.395	0.309	-0.003
A-P						1	0.270	0.208	0.484	0.351	0.610	0.073	0.300	-0.439
Ca							1	0.189	0.340	0.133	0.661*	-0.505	0.725*	-0.288
Mg								1	0.183	-0.046	0.147	-0.154	0.047	0.109
K									1	0.876**	0.175	-0.258	0.111	0.218
Na										1	0.111	-0.314	-0.033	0.458
Fe											1	-0.367	0.567	-0.293
Clay												1	-0.668*	-0.218
Silt													1	-0.564
Sand														1

$r_{0.05}$ = 0.632, $r_{0.01}$ = 0.765; T-N = Total nitrogen; N-N = Nitrate nitrogen; A-N = Ammonium nitrogen; A-P = Available phosphorus

3.11 Discussion

The trend in land uses identified is an indication of the predominant occupation of the people in the area, that is, an agrarian society. It is perceivable that nitrogen occurred more in NH_4-N form than in the NO_3-N form. This is indicative of the common practice of excessive use of N-fertilizer which eventually could not be converted to the NO_3-N form via nitrification, possibly due to lower population and or lesser activities of the nitrifying bacteria. The values of soil pH place the soils in the moderately to slightly acidic classes (USDA, 1993) and corroborating results of Tsado (2014). Hence, the soils are liable to acidification if not used with caution with respect to indiscriminate fertilizers application without expert advices and recommendations. The decrease of the exchangeable bases with depth reflects the trend in organic carbon content, which is an indirect estimation of organic matter content of the soils. It is well known that organic matter is usually a sink for plant nutrients and as such, would have held more exchangeable bases in the soil depth where its content is higher. Findings of the research with respect to organic matter content corroborate Aminu *et al.* (2013) report that organic matter contents of soils under different land use types was statistically similar. They further stated that despite the statistical similarities of organic matter content of the soils, the Virgin land and Residential area had the highest. The relatively high organic matter content of Virgin land was attributed to continuous deposition of litter with little or no soil disturbance over time while continuous cultivation may have caused the relatively low organic matter in soils of the farmland.

The significantly higher contents of Mg and K in the sole beans farm (SBF_a) but lower content of Ca could be attributed partly to the likely higher quality of liter of the crop which decomposed easily and added more Mg and K to the soil, and partly to the utilization of Ca for fruit and seed formation. Ca is generally essential for fruit and seed formation, although Mg and K usually complement Ca in such functions (McCauley and Clain, 2009) but Mg and K can only be resorted to when Ca is deficient in the soil. There was no significant difference in Ca content, however, the old orchard showed relatively higher Ca content which could be due to long period the orchard was left unused but differences between the other land use systems is due to the quality and ease of decomposition of the liters, thereby, adding Ca to the soils.

Sodium (Na) content did not differ significantly because it is not an essential plant nutrient and the main source is from the weathering of the rocks (parent materials) which are the same for the land use systems. The trend of soil pH is more or less due to buffering effect of organic matter. For the organic matter content in the soils, it is expected that it should be higher in the upper layer (0-15 cm depth) than the lower layer (15-30 cm depth) because the addition of organic matter to soil is through the upper layer.

Also, trend in other soil properties examined is an indication of the parent material from which the soils on which the land-use types were practiced formed. The soils are formed from the same parent material, that is, felspathic sandstone or siltstone (Akinyosoye, 2016). Hence, the Fe, clay, silt and sand contents did not differ significantly between the land use types. The implication is that the geology and of course, the parent material has played prominent role in ensuring that these properties were statistically similar for the soils. The slight differences associated with depth can be attributed to the content of organic matter in the soils which were responsive to differences in the management practices undertaken in the various soils. The soil textures were generally found to be loamy sand.

The striking revelation from the established relationships are reflected in the significant values of r for organic carbon vs Ca-content, silt vs Ca-content and Ca-content vs Fe-content with value of 0.831^{**}, 0.725^{*} and 0.661^{*} respectively; in addition to the non-significant relationships of clay-content vs Ca-content, silt vs Fe-content and organic carbon vs Fe-content with r value of -0.505, 0.567 and 0.594 respectively. These clearly point out that significant amount of Ca is held in the organic portion of the soils; however, the inorganic bound Ca is mainly found in the silt fraction of the soil solids; meanwhile Fe is also substantially found in these forms. Hence, organic matter plays very important roles in the availability of these elements in these soils by moderating pH of the soils to favourable ranges.

4.0 Conclusion

The research evaluated the effect of land use types on the exchangeable bases (Ca, Mg, K and Na) of soil. Five land use types were identified as abandoned old orchard, sole-maize farm, soya-bean farm, sole-beans farm and uncultivated land in Federal College of Education Kontagora and described. Soil samples were taken at random from ten points at depths of 0-15cm and 15-30cm from each land use type. For any depth of each experimental unit (land use type), collected soil samples were bulked, prepared and used for laboratory analysis to determine the contents of selected soil properties.

The results revealed that land use types significantly affected Mg and K contents but Ca and Na as well as organic carbon and pH did not differ significantly among the land use types. Generally, the soil properties showed a decreasing trend with increase in depth of the soils under the different land use types.Land use types can vary tremendously within a landscape but the geology and management practices undertaken on the soils may have effects on soil properties. Based on the findings of this research, it can be concluded that the land use types practiced did not significantly affect the texture, iron and organic matter contents of soils within the landscape of Federal College of Education Kontagora.

5.0 Recommendations

Based on the findings of this research, the following recommendations are made:

1. The application of manure such as cattle dung (which is highly available in the area) to the soils can help improve their textures in order to enhance nutrient retention as well as serve as buffer to unwanted pH distortion.
2. Minimum to zero tillage should be practiced on the soils to avoid the risk of soil erosion because the soils are loose and continuous conventional tillage practice will increase the risks of erosion.
3. Soil properties associated with different land use types and how they change should always be determined for the purpose of developing appropriate management practices.

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