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# ASSESSMENT OF SOIL PROPERTIES AS AFFECTED BY FOUR LAND USE TYPES IN EGBEADA, SOUTH - EAST NIGERIA

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***Abstract***

*The study was conducted to ascertain the influence of four land use types [plantain plantation (PP), cassava farm (CF), whistling pine forest (WPF) and fallow land (FL)] on soil properties of Egbeada in South-east, Nigeria. Stratified sampling technique was used in the collection of soil samples from the land-uses. Composite samples were collected from each land-use for routine and selected special laboratory analyses. Data generated were analyzed statistically using analysis of variance. Sand particles had a mean of 85.20 %, 85.80 %, 83.60 % and 78.80 % for soils under PP, CF, WPF, and FL, respectively. The pH($H_2O$) had mean of 6.35, 6.42, 5.36 and 5.81 soils under PP, CF, WPF, and FL while organic matter had mean of 2.94 % for PP and FL, 1.47 % for CF and 2.79 % for WPF. However, available Zn of the studied soils had mean of 8.7 mg $kg^{-1}$, 6.8 mg $kg^{-1}$, 5.3 mg $kg^{-1}$ and 4.9 mg $kg\text{-}^{1}$ in decreasing order of fallow land > whistling pine forest > plantain plantation > cassava farm, respectively. The organic matter under soils of cassava farm differed significantly (P = 0.05) with that of plantain plantation, whistling pine forest, and fallow land. The available Zn and Cu differed non-significantly among soils of the various land-uses. However, the result obtained from the study indicated that the different land-uses have affected the soils at a various rate.*

***Key words***: *assessment, Egbeada, free survey, land use types, soil properties*

## INTRODUCTION

Sustainable land-use practice is a rapidly growing field aiming at producing food security, nutrition security, bio-safety and environmental health. Poor land-use practices result to decline in soil physical and chemical properties. The soil properties are important factors to be considered in order to find a sustainable use of soil resources.

Land use types affect the soil properties through addition and removal of the nutrient element in the soil. [6] also stated that changes in soil properties such as the contents of availability of macro and micro nutrients have been altered by land use types. Land sustainability requires a periodical evaluation of soil fertility status and quality as it offers quality knowledge of factors which impose serious constraints to increased crop production and soil productivity under different land use types and for the adoption of suitable environmental friendly land management practices.

According to [22] knowledge about an up-to-date status of soil physical and chemical properties of different land use types plays a vital role in enhancing production and productivity of the agricultural sectors on a sustainable basis. However, practically oriented basic information on the status and management of soil physico-chemical properties as well as their effect on soil quality to give recommendations for optimal and sustainable utilization of land resources has been poorly implemented.

Every effort should be directed to maintain the physical, biological and socio-economic environment for the production of food crops, livestock, wood and other products through sustainable land-use practices. The optimum productivity of any land-use types depends on soil properties to adequately supply nutrient elements in required quantity and rate. When the soil does not supply sufficient nutrients for normal plant development and optimum productivity, application of supplemental nutrients and good soil management practices are required. There is every need to determine the soil properties under different land-use types in other to identify the associated problems and make recommendations for soil management best practices. Hence, this study was to ascertain soil properties as affected by four agricultural land-use types in Egbeada, South-East Nigeria.

## MATERIALS AND METHODS

*Study area*

The study was conducted at Egbeada in Mbaitoli local government area of Imo State South-east, Nigeria. It lies on latitude 04$^o$ 45' N and 7$^o$ 15′ N and longitude 06$^o$ 50′ E and 07$^o$ 26' E. A greater proportion of the land surface of Imo State is of near flat topography [28]. Egbeada has a humid tropical climate with mean annual rainfall of about 2500 mm and mean monthly temperature which varies from 30 $^o$C to 32 $^o$C while, the relative humidity ranges from 50 % to 65 % [25].

*Site location*

The studied sites under the different land-use types are whistling pine plantation, cassava farm, plantain plantation and the fallow land. These land-use types were geographically associated. The whistling pine plantation is located at latitude 5$^o$ 3' 44.2" N and longitude 7$^o$ 0' 5.4" E with an elevation of 47 m above the mean sea level. The area of the WPF is 1 acre. The whistling pine was established 26 years ago by Imo State Agricultural Development Programme (ADP).

The cassava farm is located on latitude 5$^o$ 31' 45.5" N and longitude 7$^o$ 0' 51.1" E, with an elevation of 80 m above mean sea level. The area of the CF is 1 acre. The area had been continuously cropped with cassava for 4 years.

The plantain plantation is located at latitude 5$^o$ 31' 51.6" N and longitude 7$^o$ 0' 51.1" E, with an elevation of 71 m. The plantain farm was established 20 years ago and it is thickly populated. It occupies an area of about 1 acre.

The fallow land which will serve as a control is located at latitude 5$^o$ 31' 46.5" N and longitude 7$^o$ 0' 55.6" E with an elevation of 74 m. It covers an area of about 1 acre. The land had been fallowed for four years. The area is densely covered with mixed vegetation consisting of guinea grass (*Panicum maximum Jacq.*), goat weed *(Ageratum conyzoids Linn.)*, oil palm *(Elaeis guineensis Jacq.),* oil bean tree (*Penthclethra macrophylla Benth.*), cassava (*Manihot esculenta* Crantz), broom weed (*Sida acuta Burm.f.*), Siam weed (*Chromolaeana odorate L.) R.M.King and H.Rob.*),

*Field studies*

The land use types were divided into 25 strata. Five surface soil samples were collected from each stratum to form a composite. Five composite soil samples were collected from each land use making a total of 20 composite soil samples for the research. The samples were collected at a depth of 0 – 15 cm using an auger. The collected soil samples were prepared for routine and special laboratory analyses.

*Laboratory analyses*

Particle size distribution was determined by hydrometer method [16]. Soil pH was determined using 1:2.5 soil–water ratio using a pH meter [35]. Organic carbon was determined by wet digestion method [24]. Total nitrogen was determined by micro-Kjeldahl digestion technique [10]. Available phosphorus was determined using Bray II method [27]. Exchangeable acidity was gotten by the method described by [23]. Exchangeable bases were determined by neutral ammonium acetate procedure buffered at pH 7.0 [34]. The trace elements (Zn, Cu) content of the soils were extracted using the procedures of [30] and Atomic Absorption Spectrophotometer (AAS) (Buck Scientific model 210 VGP USA) was used to determine the amount of the individual trace element in the soil solution.

*Data analysis*

The data generated were analyzed statistically using the completely randomized design of analysis of variance (ANOVA) at 5 % level of probability.

## RESULTS AND DISCUSSIONS

The results of the particle size distribution of the soils under different land-use types were shown in Table 1. The result indicated that percent sand ranged from 82.4 – 86.4 % for soil under plantain plantation (PP), 78.4 – 90.4 % for soil under cassava farm (CF), 74.4 – 86.4 % for soil under whistling pine forest (WPF) and 76.4 – 80.4 % for soil under fallow land (FL). Generally, the land-uses have high sand particle compared to other fine earth fractions. This could be attributed to parent materials, climate, and land-use. These factors influence pedogenesis and properties of soils ([40]; [31]). It is also in agreement with the findings of [15] and [29] that sandy nature of the soils reflects the parent material from which they were formed, which is coastal plain sand. Sandiness of soils suggests low cation exchange capacity and high infiltration. Sand particle under PP and CF land-uses had differed significantly (p= 0.05) with that of FL while it differed non-significantly among PP, CF and WPF land-uses. The significant difference could be associated with soil management practices and runoff. The silt particle as arranged in an increasing order WPF< FL< CF< PP with mean values of 3.2 %, 3.6 %, 4 % and 4.8 %, respectively. The silt particle was low, which is an indication that most of the silt has been weathered into clay. The soil under PP land-use had the highest percentage silt when compared with soils of other land-uses. Comparing the soils under the various land-uses with the rating (< 1) of [21], it would be observed that the soils are highly weathered and pedologically mature due to low silt content. This is in conformity with the findings of [1] that high weatherability leads to the formation of coarse textured soils. Silt under PP land use differed significantly (p= 0.05) with silt under WPF land use and non-significantly with silt under CF and FL land use. The clay had a mean of 10 %, 10.40 %, 13.20 % and 17.60 % for soils under PP, CF, WPF and FL land uses, respectively. These values are similar to the findings of [38] on soils of southeastern Nigeria. The clay under FL land use differed significantly (p= 0.05) with that of PP and CF land use while it had no significant difference with that of WPF land use. This shows that vegetation cover may have reduced the rate of water movement into the soil, thus the reduction in the amount of clay translocation in the soil.

Table 1. Physical properties of soil under the studied land use types

| Land use | Rep | Sand % | Silt % | Clay % | SCR | TC |
|---|---|---|---|---|---|---|
| Plantain Plantation (PP) | 1 | 86.4 | 4 | 9.6 | 0.42 | LS |
| | 2 | 86.4 | 4 | 9.6 | 0.42 | LS |
| | 3 | 86.4 | 6 | 7.6 | 0.79 | LS |
| | 4 | 84.4 | 4 | 11.6 | 0.35 | SL |
| | 5 | 82.4 | 6 | 11.6 | 0.52 | SL |
| **Mean** | | **85.2[a]** | **4.8[a]** | **10.0[b]** | **0.50[a]** | |
| Cassava Farm (CF) | 1 | 88.4 | 4 | 7.6 | 0.53 | S |
| | 2 | 90.4 | 4 | 5.6 | 0.71 | S |
| | 3 | 88.4 | 4 | 7.6 | 0.53 | S |
| | 4 | 78.4 | 4 | 17.6 | 0.23 | SL |
| | 5 | 83.4 | 4 | 13.6 | 0.29 | SL |
| **Mean** | | **85.8[a]** | **4.0[ab]** | **10.4[b]** | **0.46[ab]** | |
| Whistling Pine Forest (WPF) | 1 | 86.4 | 4 | 9.6 | 0.42 | LS |
| | 2 | 84.4 | 2 | 13.6 | 0.15 | SL |
| | 3 | 74.4 | 4 | 21.6 | 0.19 | SCL |
| | 4 | 86.4 | 4 | 9.6 | 0.42 | LS |
| | 5 | 86.4 | 2 | 11.6 | 0.17 | SL |
| **Mean** | | **83.6[ab]** | **3.2[b]** | **13.2[ab]** | **0.27[bc]** | |
| Fallow Land (FL) | 1 | 80.4 | 2 | 17.6 | 0.11 | SL |
| | 2 | 78.4 | 2 | 19.6 | 0.10 | SL |
| | 3 | 80.4 | 4 | 15.6 | 0.26 | SL |
| | 4 | 78.4 | 4 | 17.6 | 0.23 | SL |
| | 5 | 76.4 | 6 | 17.6 | 0.34 | SL |
| **Mean** | | **78.8[b]** | **3.6[ab]** | **17.6[a]** | **0.21[c]** | |
| **$LSD_{0.05}$** | | **5.061** | **1.529** | **4.963** | **0.209** | |

Rep= replicate, LSD= least significant difference, SCR= silt clay ratio, LS= loamy sand, SL= sandy loam, S= Sand, SCL=sand clay loam
Source: Own results.

The silt-clay ratio had mean of 0.50, 0.46, 0.27 and 0.21 for soil under PP, CF, WPF, and FL land use types. However, the silt clay ratio is greater than 0.15, hence this indicates that the soils were formed from young parent material according to the findings of [7]. This shows that soil under FL land use has the oldest parent material among the studied land use types. Silt-clay ratio for soil under PP land-use differed significantly with that of soil under WPF and FL land uses. However, silt-clay ratio for soil under CF land use had no significant difference with that of WPF land use while it differed significantly with silt clay ratio for soil under FL land use.

Table 2 showed that the results of the soil pH($H_2O$) of the land-use types were generally acidic according to the rating of [33]. The mean values indicated that CF (6.42) and PP (6.35) were weakly acidic while WPF (5.36) and FL (5.81) were moderately acidic. The level of soil pH($H_2O$) in WPF and FL could be attributed to organic acids released by litter decomposition and deposit of chemical fertilizer earlier used on the land. This is in conformity with the findings of ([8]; [19]). Soil pH of FL land use type had no significant difference with soil pH of PP and CF land uses while soil pH of WPF land use differed significantly with soil pH of PP and CF land uses. The significant difference could be associated to the impact of climatic factors and acidic level of the litter deposit on each land use.

Organic matter (OM) was generally low when compared with the rating of [4] on soils of eastern Nigeria. The amount of OM in soil under FL and PP land uses could be attributed to the quantity of litter deposit. The OM of soils under CF land use differed significantly (p= 0.05) with that under PP, WPF and FL land-use types while OM of soils under PP, WPF and FL land-use types differs non-significantly. The significant difference is not unconnected with the level of organic material deposit and plant uptake. [2] stated that for most low activity clay of the tropical soils, the OM is the major exchange site for the basic nutrient cations in the soil. Organic matter has been reported to have a significant positive influence on soil pH, cation exchange capacity, base saturation and water holding capacity [3].

Total nitrogen (TN) content of the studied soils was low when compared with critical values (1.5 – 2.0) % for tropical soils according to [15] and [21]. [18] observed that the main cause of N deficiency in tropical soils is intense leaching and erosion due to the high tropical rainfall. The least total nitrogen value recorded in soil CF land use may be attributed to the intense cultivation of the soils which normally increase the rate of mineralization of the organic matter.

Available phosphorus (Av P) of the studied soils ranged from 2.18 – 8.83 mg/kg. According to the ratings of [21] available P was medium for soil under PP and FL land use, low for soils under WPF land use and very low for soils under CF land use. The available P for soils under cassava farm differed significantly (p= 0.05) with that of soils under PP and FL land use while available P of soils under PP, WPF and FL land uses differed non-significantly.

Table 2.The results of soil pH, organic matter (OM), total nitrogen (TN) and available phosphorus (Av P) under the studied land use types

| Land-use | Rep | pH $H_2O$ | OM (%) | TN (%) | Av.P (mg/kg) |
|---|---|---|---|---|---|
| Plantain Plantation (PP) | 1 | 6.35 | 1.17 | 0.05 | 10.20 |
| | 2 | 6.32 | 3.55 | 0.17 | 9.00 |
| | 3 | 6.33 | 4.00 | 0.20 | 6.93 |
| | 4 | 6.58 | 3.00 | 0.15 | 7.52 |
| | 5 | 6.19 | 3.00 | 0.15 | 10.5 |
| **Mean** | | **6.35$^{a}$** | **2.94$^{a}$** | **0.14$^{a}$** | **8.83$^{a}$** |
| | | | | | |
| Cassava Farm (CF) | 1 | 6.71 | 1.17 | 0.05 | 0.82 |
| | 2 | 6.13 | 1.13 | 0.05 | 2.45 |
| | 3 | 6.14 | 1.34 | 0.06 | 2.54 |
| | 4 | 6.21 | 1.41 | 0.07 | 1.50 |
| | 5 | 6.90 | 2.31 | 0.11 | 3.60 |
| **Mean** | | **6.42$^{a}$** | **1.47$^{b}$** | **0.07$^{b}$** | **2.18$^{b}$** |
| | | | | | |
| Whistling Pine Forest (WPF) | 1 | 4.80 | 2.89 | 0.14 | 1.45 |
| | 2 | 5.83 | 2.58 | 0.12 | 4.93 |
| | 3 | 4.95 | 2.75 | 0.13 | 3.85 |
| | 4 | 4.94 | 2.72 | 0.13 | 10.40 |
| | 5 | 6.28 | 3.03 | 0.15 | 7.65 |
| **Mean** | | **5.36$^{b}$** | **2.79$^{a}$** | **0.13$^{a}$** | **5.66$^{ab}$** |
| | | | | | |
| Fallow Land (FL) | 1 | 5.88 | 3.48 | 0.17 | 11.10 |
| | 2 | 6.10 | 3.34 | 0.16 | 5.10 |
| | 3 | 6.43 | 3.20 | 0.16 | 11.80 |
| | 4 | 5.46 | 2.86 | 0.14 | 6.25 |
| | 5 | 5.17 | 1.82 | 0.09 | 3.10 |
| **Mean** | | **5.81$^{ab}$** | **2.94$^{a}$** | **0.14$^{a}$** | **7.47$^{a}$** |
| | | | | | |
| **LSD $_{0.05}$** | | **0.612** | **0.916** | **0.047** | **3.682** |

Rep= replication, BS= base saturation, OM= organic matter, TN= total nitrogen, Av.P= available phosphorus, LSD= least significant difference
Source: Own results.

The significant difference among available phosphorus in soils under the different land-uses could be attributed to organic material deposit, the rate of mineralization and leaching. Several researchers ([6]; [12]) have reported high P deficiency for tropical soils. According to [11], the causes of P deficiencies have been attributed to high weatherability of the soils, clay type, leaching by intense rainfall and adsorption reaction by soil constituents.

Table 3 showed the mean of Ca, Mg, K and Na, respectively (2.44, 1.36, 0.256 and 0.16) cmol/kg for soils under PP land use, (1.92, 1.04, 0.182 and 0.18) cmol/kg for soils under CF land use, (1.56, 0.80, 0.162 and 0.19) cmol/kg for soils under WPF land use and (2.48, 1.52, 0.140 and 0.12) cmol/kg for soil under FL land use. Critical values of basic cations as reported by [21] and [17] showed that soils under study have very low to medium basic cations at various land-uses. Thus, Ca was very low in soils under CF and WPF land uses but low in PP and FL land uses. Mg was medium in soils under PP, CF, and FL land uses but low in WPF land use. K was low in soils under PP land use but very low in CF, WPF and FL land uses. Na was low in soils under PP, CF, WPF and FL land uses. Low values of basic cations, have however been reported for most Nigerian soils [4] and could be attributed to leaching and erosion losses by the high tropical rainfall as well as low content in the parent materials.

Table 3. The results of soil Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), Aluminium (Al), Hydrogen (H), Cation exchange capacity (CEC), Zinc (Zn), Copper (Cu) under the studied land use types

| Land-use | Rep | Ca cmol/kg | Mg cmol/kg | K cmol/kg | Na cmol/kg | Al cmol/kg | H cmol/kg | CEC cmol/kg | Zn mg/kg | Cu mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Plantain | 1 | 3.4 | 1.8 | 0.19 | 0.10 | 0.3 | 0.1 | 5.89 | 5.507 | 0.018 |
| Plantation | 2 | 2.8 | 1.4 | 0.20 | 0.20 | 0.7 | 0.1 | 5.40 | - | 0.037 |
| (PP) | 3 | 0.8 | 0.8 | 0.22 | 0.10 | 0.3 | 0.2 | 2.42 | 8.615 | 0.017 |
| **Mean** | 4 | 2.8 | 1.2 | 0.40 | 0.20 | 0.2 | 0.2 | 4.70 | 8.072 | 0.006 |
| | 5 | 2.4 | 1.6 | 0.27 | 0.20 | 0.3 | 0.1 | 4.87 | 4.146 | 0.049 |
| | | **$2.44^{ab}$** | **$1.36^{ab}$** | **$0.26^{a}$** | **0.16** | **0.36** | **0.14** | **4.66** | **5.268** | **0.025** |
| | | | | | | | | | | |
| Cassava | 1 | 1.6 | 0.8 | 0.13 | 0.07 | 0.3 | 0.2 | 3.10 | 2.986 | 0.051 |
| Farm | 2 | 1.6 | 0.8 | 0.24 | 0.30 | 0.4 | 0.1 | 3.44 | 10.610 | 0.006 |
| (CF) | 3 | 2.0 | 1.2 | 0.20 | 0.30 | 0.3 | 0.2 | 4.20 | 0.009 | 0.009 |
| **Mean** | 4 | 1.8 | 1.2 | 0.16 | 0.15 | 0.3 | 0.3 | 3.91 | 3.105 | - |
| | 5 | 2.6 | 1.2 | 0.18 | 0.10 | 0.2 | 0.1 | 4.38 | 7.878 | - |
| | | **$1.92^{ab}$** | **$1.04^{bc}$** | **$0.18^{ab}$** | **0.18** | **0.3** | **0.18** | **3.81** | **4.918** | **0.013** |
| | | | | | | | | | | |
| Whistling | 1 | 2.2 | 1.4 | 0.20 | 0.10 | 0.6 | 0.2 | 4.70 | 3.911 | 0.026 |
| Pine | 2 | 1.0 | 0.4 | 0.12 | 0.09 | 0.4 | 0.2 | 2.21 | 14.770 | 0.020 |
| Forest | 3 | 1.4 | 0.8 | 0.15 | 0.30 | 0.8 | 0.3 | 3.75 | 0.936 | 0.043 |
| (WPF) | 4 | 1.6 | 1.0 | 0.14 | 0.20 | 0.4 | - | 3.34 | 2.825 | 0.021 |
| **Mean** | 5 | 1.6 | 0.4 | 0.20 | 0.25 | 0.1 | 0.3 | 3.85 | 11.360 | - |
| | | **$1.56^{b}$** | **$0.80^{c}$** | **$0.16^{b}$** | **0.19** | **0.46** | **0.25** | **3.57** | **6.760** | **0.022** |
| | | | | | | | | | | |
| Fallow | 1 | 2.6 | 1.6 | 0.18 | 0.17 | 0.3 | 0.2 | 5.05 | 11.090 | - |
| Land | 2 | 2.0 | 1.2 | 0.21 | 0.14 | 0.4 | 0.2 | 4.15 | 4.710 | - |
| (FL) | 3 | 2.8 | 1.6 | 0.09 | 0.12 | 0.4 | - | 5.01 | 1.864 | 0.027 |
| | 4 | 1.6 | 1.2 | 0.10 | 0.08 | 0.3 | 0.4 | 3.68 | 11.640 | 0.027 |
| **Mean** | 5 | 3.4 | 2.0 | 0.12 | 0.10 | 0.3 | 0.5 | 6.42 | 14.240 | 0.016 |
| | | **$2.48^{a}$** | **$1.52^{a}$** | **$0.14^{b}$** | **0.12** | **0.34** | **0.26** | **4.86** | **8.709** | **0.014** |
| | | | | | | | | | | |
| **$LSD_{0.05}$** | | **0.904** | **0.468** | **0.077** | **$0.105^{NS}$** | **$0.226^{NS}$** | **$0.156^{NS}$** | **$1.338^{NS}$** | **$6.460^{NS}$** | **$0.023^{NS}$** |

Rep= replication, CEC= cation exchange capacity, LSD= least significant difference.
Source: Own results.

Cation exchange capacity (CEC) had mean of 4.66 cmol/kg, 3.81 cmol/kg, 3.57 cmol/kg and 4.86 cmol/kg for soil under PP, CF, WPF and FL land use types. CEC of the studied soils under the different land uses were generally low when compared with the ranking (<8 cmol/kg) of [21]. He also stated that low CEC indicates the inability of the soils to retain nutrient and water. However, CEC had no significant difference among soils under the studied land-use types. The CEC level of the studied soils was similar to the findings of [37] in soils of south-east Nigeria.

The low CEC of the studied soils can be an index of low chemical weathering activity of the soil [26] and level of soil pH. However, the quantity of cations that a soil can retain against leaching is determined by the magnitude of the cation exchange capacity of the soil. According to [8] nutrient leaching results not only in declining soil fertility but also in environmental problems caused by the accumulation of nutrients in the groundwater and the eutrophication of River. Low level of cation exchange capacity in soils could be associated with tidal imports, runoff, and seepage [39].

The available Zinc (Table 3) had means of 8.709 mg $kg^{-1}$, 6.760 mg $kg^{-1}$, 5.268 mg $kg^{-1}$, 4.918 mg $kg^{-1}$ been a decreasing order of FL> WPF> PP> CF. Available zinc had no significant difference (p= 0.05) among the soils of the land-use types. Using critical available Zn level of 0.8 mg $kg^{-1}$ [20] or critical range of 0.2 – 2.0 mg $kg^{-1}$, Zinc deficiency was not a problem in the soil as having been reported for most Nigeria soils [20]. Zinc had been reported to be generally of low mobility in soils [13] and has a tendency of being adsorbed on clay size particles ([32]; [5]). The results obtained referred that the soils under the land use types possess adequate available Zn.

However, Cu content differed non-significantly among the soils under the land-uses. Cu was below the critical level (1-2 mg $kg^{-1}$) reported by [32] and (1.0 – 3.0 mg $kg^{-1}$) [14]; [36].

This also reflects deficiencies of Cu in the study sites are common in sandy soils. This is in conformity with the findings of [15] on tropical soils.

However, parent material, soil texture, and organic matter are factors that defer the availability of copper [9] and also the disparity observed among the studied soil under the different land-uses.

## CONCLUSIONS

After due examination of the soil, it was observed that the different land-use types have influenced the soil physical and chemical properties at a different level. However, soils under FL and PP recorded high level of OC, total nitrogen, available P and CEC over soils under WPF and CF. WPF soils were the most acidic among the land-uses. The FL had higher clay content and available Zn while CF is the most sandy. FL has more soil quality attributes than other land-uses which resulted from a high content of organic materials, a dense vegetative cover which mitigates erosion effects.

However, use of improved management practices on soil resources for sustainable agricultural use would be one of the most useful strategies that could help to protect biological diversity from agricultural land expansion. Practices such as improved composting, biomass transfer and also use of chemical and organic fertilizer and techniques complemented with strong land-use policy should be integrated into a strategy for sustainable agricultural development in the area.

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