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EVALUATION OF SOME SELECTED SOIL PROPERTIES FROM DIFFERENT LAND USE TYPES IN J3 AREA OF OMO FOREST RESERVE OF SOUTHWESTERN NIGERIA

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ABSTRACT
Human activities such as deforestation of natural cover for plantation, farming, industrialization and urbanization among others have been shown to negatively affect soil quality. Physical and chemical parameters in soils were determined to assess the effect of land use types on the soil quality for agricultural production and environmental sustainability. Four different land use types: natural forest, tree plantation, farmland, and residential were selected for this study. Forty samples each of disturbed and undisturbed soils were collected for physical and chemical analysis using standard instrumentation techniques. Undisturbed soil samples were analyzed for bulk density and porosity while disturbed soil samples were analyzed for other selected physical and chemical parameters. Results of study show that the soils are sandy to loamy. The pH of soils was acidic (4.87) to nearly neutral (6.90) in nature. The results of moisture content, organic matter content, total nitrogen, available phosphorus, exchangeable cations and micro-nutrients in soils were found higher while the values of bulk density were lower at natural forest land than at tree plantation, farmland, and residential lands at $P \leq 0.05$. This study has shown that uses of natural land for other land use types will reduce the soil fertility and quality. Deforestation should be discouraged and afforestation should be intensified for sustainability and management of the environment.

KEY WORDS
Human activities, degradation, reforestation, soil quality, sustainability.

Indiscriminate use of land has led to environmental degradation in most countries of the world. The productivity and sustainability of land for a particular use depend on the soil physical, chemical and biological properties. Soil, as one of the most dynamic, lively and complex natural systems on the earth's surface is crucial for the survival of living organisms, plants, animals and human. Geological and geomorphologic factors such as weathering of rocks, water, wind, temperature change, pressure, gravity, chemical interaction, and topography, vegetation, living organism can significantly affect the soils in their natural form (Akintola et al., 2020). Soil in its natural form contain numerous organic matter content and nutrients that can provide adequate support and helps needed for living organism, plants and human existence (Akintola et al., 2020). Vegetation provides covers and shields for soils and other living organism that take their abode in soils. Soil organisms as well as surface litters from plants play major roles in soil processes, decomposition of organic matter and improvement of soil structure among others (Voroney, 2007; Wassenaar, 2010). However, the increase in population coupled with urbanization and developmental growth has led to continuous removal of forest cover and their attendance effects on the soil can be disastrous. Caravaca et al. (2002) reported that human activities such as burning, deforestation, farming, building, construction of roads and highways expose the soils to various degradation processes and consequently reduce the fertility and quality of the soils. Studies have also

shown that continuous removal of natural vegetation cover has led to reduction in soil quality and productivity (Beaver et al, 2014; Akintola et al., 2020). The unremitting evaluation of soil quality is therefore important for environmental management, agricultural production and sustainability (Alemayehu and Sheleme, 2013). This study thus assessed the effect of different land uses (natural forest, tree plantation, farmland area and residential) on some selected physical and chemical properties of soil in the study area to ascertain their nutrient and fertility status.

MATERIALS AND METHODS OF RESEARCH

The study area, J3 is an area within Omo Forest Reserve. It is located within the latitudes 6º 35' to7º 05' N and longitiude 4º 19' to 4º40' E at about 136 km to the Northeast of Lagos and 80 km to the east of Ijebu- Ode in Ogun State, southwestern Nigeria (Figure 1). The Forest reserve is about 130,500 hectares (Okali and Ola-Adams, 1987). The mean annual rainfall ranges from about 1600-2000 mm. The topography of the area is mostly flat and wee drained with some low hills forming part of the Omo water shed (Ojo, 2014).

Forty Bulk soil samples (10 sample each from Natural forest, tree plantation, Farmland and residential land area) were randomly collected at the depth of 0-20cm with the aid of auger put in the sack bags and labeled accordingly. Ten undisturbed soil samples, each was also collected from the four location land are with the aid of core cutters and sealed straight away on both edges with candle wax to avoid loss of moisture. The disturbed soils samples were air dried ground and sieved through 2 mm mesh. Both the air-dried disturbed and undisturbed soil samples were taken to the laboratory for analysis.

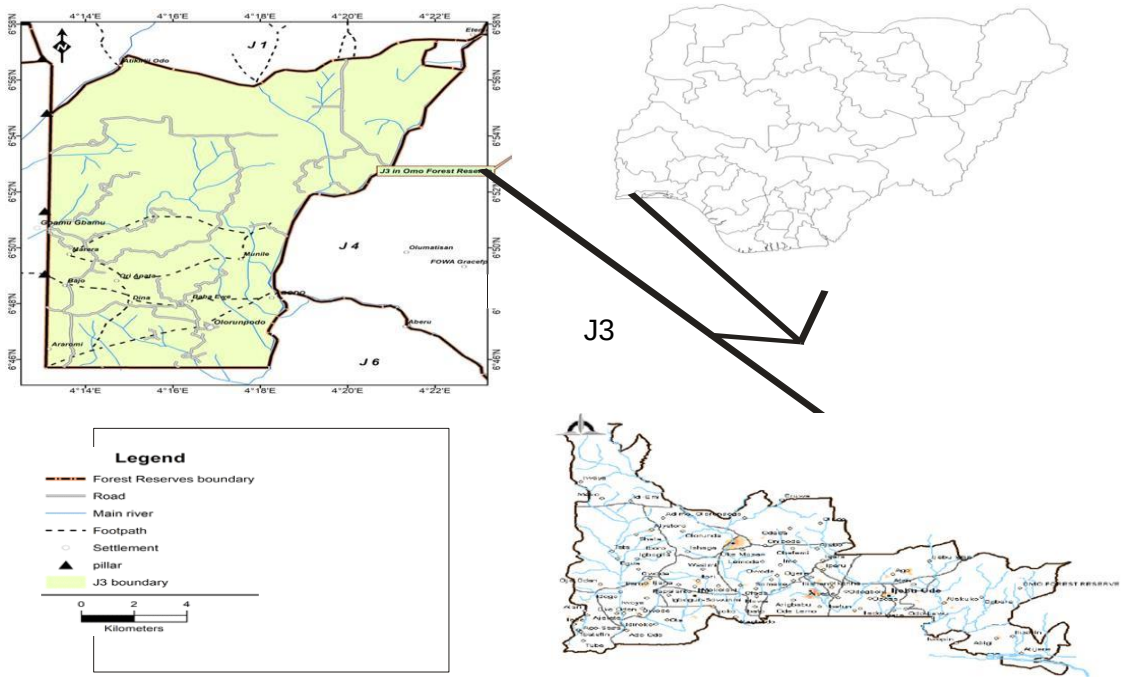

Figure 1 – Map of the study location Analysis of soil samples

Determination of particle sizes of the soil, pH, bulk density, porosity and moisture content Particle size distribution test was carried out on the disturbed soil samples using a sedimentation method of analysis described by (ASTMD7928). The pH of the soil samples was determined using Hanna electrical pH meter. Determination of bulk density of the soils was done by first drying the undisturbed core soil samples to a constant weight at 105°C. The volume of the core samples was also measured. The weight of the dried soil sample was then divided by the volume of the core samples. The calculated bulk density was expressed

in g/m^3. The soil porosity was measured by weighing the dried core soil samples, saturates the sample in fluid and weighed it. The difference between the weighed saturated core samples and weighed dried core soil samples was divided by the density of water (1g/m^3) to get the porosity values. The moisture content of the soils was measured by subtracting the weight of the dried soil samples from the weight of the wet soil, divided it by the weight of the dried soil and multiplied by 100. The calculated moisture content is in percentage.

Determination of organic carbon and organic matter content. Total soil organic carbon contents were determined by measuring 0.5g of 0.5mm sieves soil samples into 250ml conical flask, 10ml of 1M potassium dichromate (K2Cr2O7) and 20ml of concentrated tetraoxosulphate (VI) acid were added to soil samples to make mixture.. The mixture was allowed to settle for about 1hr for oxidation to occur. After that, the solutions was mixed with distilled water up to 100ml and allow to cool for another 1hr. then, 3 drops of ferroine indicator (1-10 phenanthroline monohydrate) was added and titrate with 2.5 M ferrous sulphate (Fe2SO4) solution until a maroon brown colour solution is obtainable and the values gotten was recorded. A blank analysis was repeated and the organic carbon was calculated. Total organic matter content was then calculated by multiplying the value obtained from total organic carbon by 1.724.

Determination of total Nitrogen in the soil samples. Total nitrogen in the soils was determined by measuring 0.5g of 0.5mm sieved soil samples into a digestion tube, 5ml of concentrated H2SO4 and 1 tablet of Selenium was added to the soil samples in the tube. The tubes was then placed in the digestion block and allow to digest at 360°c for about 3hrs until a light yellowish solution is obtained. The digestion is allowed to cooling for some time, transferred into a 100ml volume beaker and digested with distilled water to 50mls. Five (5) ml of the digested solution was measured into the distillation chambers where 5ml of 40% NaOH and distilled water was added up to 100ml in a conical flask containing 5ml of Boric acid indicator, until 50ml of a greenish colour solution is obtained. The green colour solution was titrated with 0.01M HCl until faint pink color is obtained and the value is recorded. The blank analysis was done and total nitrogen (TN) value was calculated in percentage.

Determination of available phosphorus in the soil samples. Two (2) gram of 2mm sieve mesh of soil samples were weighed and put in an extraction cup, 20 ml of Bray P solution was added and shakes on the shaker for 15mins. It was later filtered through the 90mm Whatmann filter paper. Five (5) ml of the filtrates was measured and put, into a clean 50 ml volume beaker, 5mls of Murphy and Riley solution (colour reagent) was then added into it, and make up to 25ml with distilled water. The mixture was allowed to stand for about 10mins for colour formation. A bluish colour solution is obtained whose deepness indicated the presence of phosphorus. A Spectrophotometer at 882nm wavelength was used determine the absorbance of each solution for standardization. It was use to derive a slope on which the value of P is calculated in mg/kg for each sample.

Determination of exchangeable cations (Ca, Na, K and Mg). These were done by weighing 2.0g of 2mm sieved soil into an extraction cup and add 20ml of 0.1M Ammonia to the mixture. The mixture was shaking for 10 mins, allows settling for some time and filtered through 90mm Whatman filter paper. The concentration of Ca and Mg were determined from the filtrate using Atomic Absorption Spectrophotometer model 210/211 VGP while Na and K were determined using flame photometer.

Determination of micronutrients (Zn, Cu, Fe and Mn). This was done by weighing 0.5g of the 0.5 mm sieve into a 50ml beaker and 10ml of an acid mixture and nitric acid in ratio of 1:2 was added under a fume cupboard. The beaker content was placed on a digester or a heating mantle to undergo digestion at 105°C for about 20 minutes until the colour changes from brownish red to colourless. The digest was allowed to cool and made up to 25ml distilled water. The content was read on Buck scientific Atomic Absorption Spectrophotometer model 210/211 VGP. The process was repeated to obtain the concentrations of Fe, Mn, Cu and Zn.

Descriptive statistics and One-way Analysis of Variance (ANOVA) was used to analyze the data. Means were separated using Duncan Multiple Range Tests. Statistical package used in this study was SPSS 20.0.

RESULTS AND DISCUSSION

Figure 2 presented the results of the grain size distribution analysis of the soils from the four land areas Results of study shows that the mean particle sizes in soils from the natural forest is sand (72.01%), silt (16.89%) and clay (11.10%); at tree plantation land is sand (69.99%), silt (16.21%) and clay (13.80%); at farmland is sand (70.28%), silt (16.56%) and clay (13.16%) and at residential land is sand (85.02%), silt (9.87%) and clay (4.11%). The soil samples are sandy to loamy in texture. The result of the particle sizes of the soils agreed with similar works carried out by Li and Shao (2006) and Akintola et al (2020).

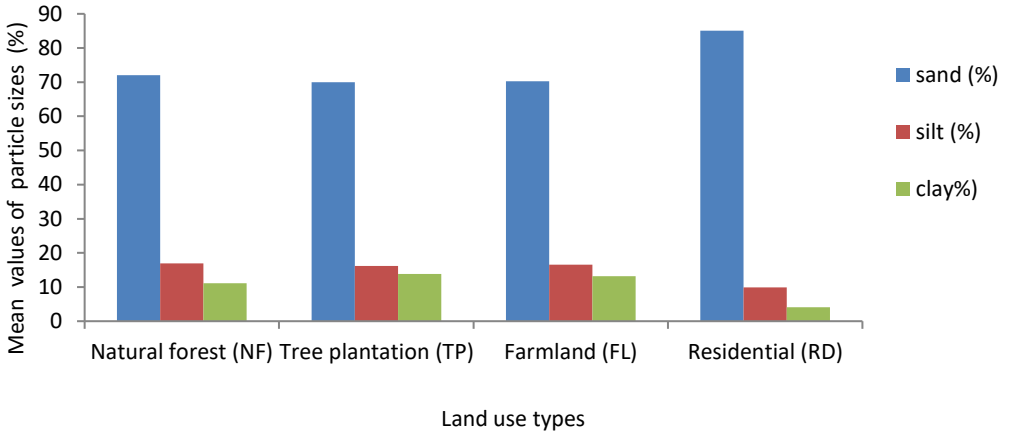

Figure 2 – Percentages of Particle sizes of soils from studied land use areas

Table 1 – Physiochemical parameters of soils from the studied land use areas

Parameters	Land use types			
	Natural forest	Tree plantation	Farmland	Residential
pH	6.90±0.11[a]	6.18±0.05[b]	5.27±0.12[c]	4.87±0.07[d]
Bulk density(g/cm^3)	1.01±0.01[c]	1.08±0.02[c]	1.18±0.05[b]	1.30±0.02[a]
Organic carbon (%)	2.98±0.07[a]	1.71±0.01[b]	0.88±0.12[c]	0.21±0.005[d]
Organic carbon content (%)	10.11±1.08[a]	4.56±0.42[b]	1.22±0.01[c]	0.91±0.001[d]
Total nitrogen (%)	2.01±0.01[a]	0.99±0.11[b]	0.38±0.02[c]	0.11±0.001[d]
Available phosphorus (mg/kg)	35.28±1.56[a]	18.61±0.12[b]	9.22±0.81[c]	2.05±0.01[c]

Note: Mean Values with the different letter within the same rows are significantly differ from each other at P≤0.05.

Table 1 shows the result of physiochemical parameters of soils from four land use areas. The results of pH in soils from the four land use areas have different mean values. The mean pH values of soils at natural forest land is 6.90, at tree plantation is 6.18, at farmland is 5.27 and at the residential land area is 4.29. The pH values according to Akintola et al (2020b) ranged from acidic to nearly neutral.

Different results were also obtained for organic carbon and organic matter content (Table 1). Mean organic carbon content for soils from natural forest land is 2.89%, at tree plantation is 1.71%, at farmland area is 0.88% and at residential land area is 0.21% while the mean values of organic matter content in soils at natural forest land is 10.11 %, at tree plantation land is 4.56%, at farmland is 1.22 % and at residential land is 0.91%. Elevated values of organic carbon and organic matter contents were pragmatic in soils from natural forest and tree plantations than soils from farm land and residential land area at P≤0.05. According to Eash et al. (2008), the elevated high organic matter content in soils from natural forest and tree plantation area could be ascribed to decomposition of dead organisms, leaf and stems litters in soils. The presence of organic matter in the soil will assist in holding the soil aggregates together and prevent the soils from leaching, surface runoff, erosion, flooding, and degradation among others.

The mean concentration values of total nitrogen in soils from natural forest land is 2.10%, at tree plantation land is 0.99%, at farmland is 0.38% and residential land is 0.11 %

area were 2.01%, The mean concentration of available phosphorus in soil at natural forest land is 35.28mg/kg, at tree plantation land is 18.61mg/kg, at farmland is 9.22mg/kg and at residential land is 2.05 mg/kg. Lower values of total nitrogen and available phosphorus were found in soils at farmland and residential land at P≤0.05 (Table 1).

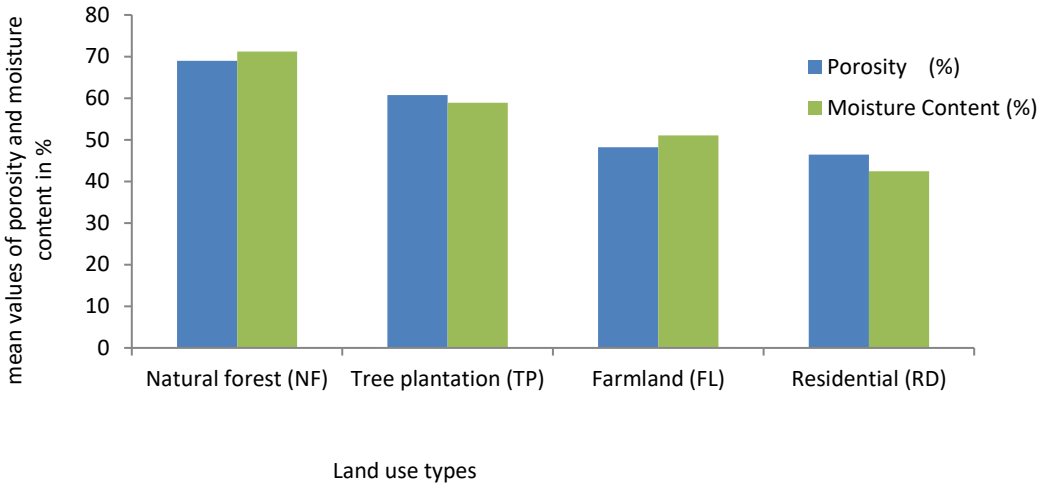

Figure 3 – Mean values of Porosity and Moisture content in soils from the studied land use areas

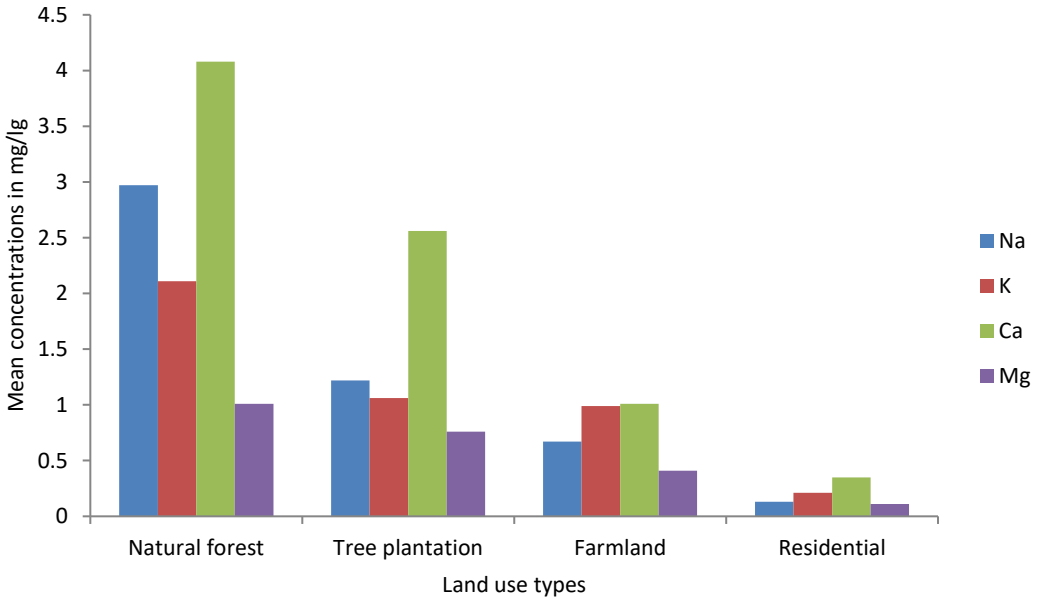

Figure 4 – Mean concentrations of Exchangeable cations in soils from the studied land use area

The bulk density values in the soils at natural forest land is 1.01g/cm^3, at tree plantation land is 1.05 g/cm^3, at farmland is 1.18 g/cm^3 and at residential land is 1.31 g/cm^3. There was no significant difference between the bulk density values of soils from natural forest and tree plantation lands (Table 2). The mean values of porosity and moisture contents in percentage are presented in Figure 3. The mean values of porosity in soils at natural forest land is 68.99.

%, at tree plantation land is 60.75 %, at farmland is 51.01% and at residential land is 46.44% while the mean values of moisture contents in soils from at natural forest land is 71.22 %, at tree plantation land is 58.89 %, at farmland is 48.22% and at residential land is 42.48% Soils from natural forest was found to have the highest average percentage values in porosity and moisture contents than those from farmland and residential land areas. This agreed with the similar work conducted by Akintola et al. (2020). The lesser values of organic

matter content, organic carbon, moisture content, porosity, moisture contents, total nitrogen, and available phosphorus coupled with increased bulk density and acidic nature of pH value explained the effects of land use types on the soil properties.

The mean concentration values of exchangeable cations (Ca, Mg, Na and K) in soils from the studied land use areas are presented in Figure 4. Calcium concentrations were found to be higher than the concentrations of Mg, Na and K. Mean concentration of Ca in soils at natural forest land is 4.08 mg/kg, at tree plantation land is 2.56 mg/kg, at farmland is 1.01mg/kg and at residential land is 0.35 mg/kg while Mg mean concentration in soils at natural forest land is 1.01mg/kg, at tree plantation land is 0.76 mg/kg, at farmland is 0.41mg/kg and at residential land is 0.11mg/kg. Also, the mean concentrations of Na in in soils at natural forest land is 2.97 mg/kg, at tree plantation land is 1.22 mg/kg, at farmland is 0.67mg/kg and at residential land is 0.13 mg/kg while K mean concentration in soils at natural forest land is 2.11mg/kg, at tree plantation land is 1.06 mg/kg, at farmland is 0.99mg/kg and at residential land is 0.21mg/kg. The lower values recorded in other land use areas when compared to the natural forest land could be attributed to the influence of human activities.

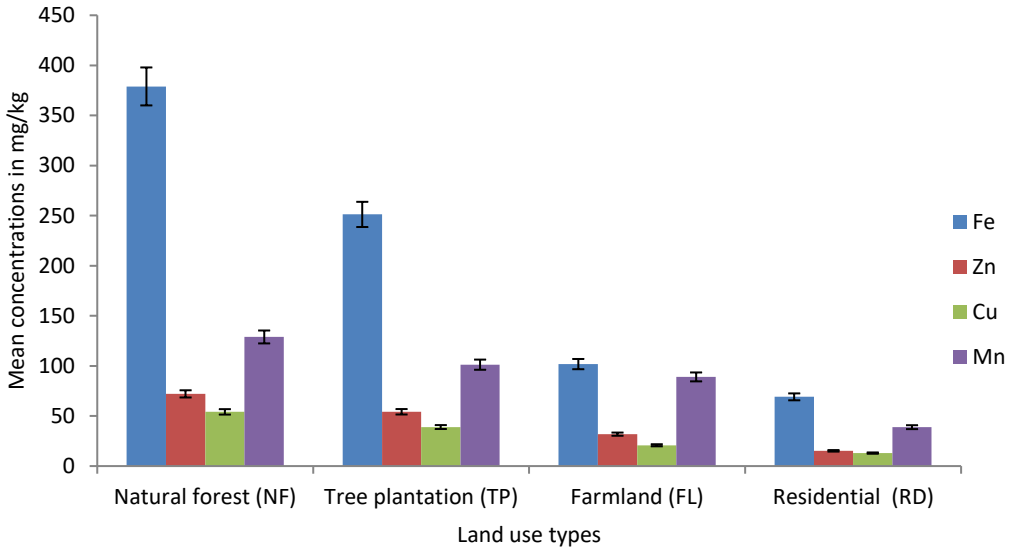

Figure 5 – Mean Concentrations of micro nutrients in the soils from the studied locations

The concentrations of the determined micronutrients in the soils from the four land use areas are presented in Figure 5. It was observed that Fe had the highest values in soils than Zn, Cu and Mn from the all the studied land use areas. This could be attributed to the abundance of Fe in the earth crust. Mean concentration values of Fe in the soil at natural forest is 378.99mg/kg, at tree plantation land is 251.22 mg/kg, at farmland is 101.81 mg/kg and at residential is 69.11 mg/kg while mean concentration value of Mn in soil at natural forest is 128.91 mg/kg, at tree plantation land is 101.22 mg/kg, at farmland is 89.22 mg/kg and at residential is 38.86 mg/kg. The mean concentration value of soils in Zn at natural forest land is 72.08 mg/kg, at tree plantation land is 54.22 mg/kg, at farmland is 31.86 and at residential land is 15.21mg/kg while mean concentration values of Cu in soils at natural forest land is 54.11mg/kg, at tree plantation land is 38.97mg/kg, at farmland is 20.78mg/k and at residential area is 12.97mg/kg. The values were significantly different among the four land use areas at $P \leq 0.05$.

CONCLUSION

This study has shown the impact of different land use type on the studied soils. The reduction in the values of studied physiochemical parameters, exchangeable cations

and micronutrients with the exception of bulk density showed the influence of land use types on soil properties. The removals of forest covers thus have great and significantly in soil fertility and quality. Deforestation should be discouraged and afforestation should be intensified for sustainability and management of the environment.

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