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Impacts of Land Use Types on Selected Soil Properties: The Case of Dire Enchini District, West Showa Zone, Oromia Regional Sate

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Abstract: The objective of this study was to assess and explore the effect of land use types on selected soil property of Dire Enchini District. Three composite of representative soil samples from depth of (0-25cm) were collected randomly from (Cultivated, grazing and forest) lands which were adjacent to each other and subjected to laboratory analysis. Physicochemical results was analyzed by One way ANOVA ($P<0.05$) was employed to compare the mean of soil parameter. The textural classes of present study area were clayey dominated. As the depth increase bulk density increase in all selected land uses due to soil organic matter decrease and compactness by field traffic. However, the total porosity of present study result by two depths indicated as the depth increase the mean value of total porosity decrease. Generally the values show that the overall soil condition in the present study area appropriate condition in forest and cultivated lands than grazing land. Because of grazing land has the least concentration of soil chemical properties except physical properties, clay textural particle which suggests an increasing degradation rate in soils of grazing land. Therefore, strategies to conserve soil properties versus the expanding population in the area have to seek a sustainable solution that better addresses society awareness creation on appropriate management practice of land resource and wisely uses.

Key words: Dire Enchini · Land Use Types · Soil Properties

INTRODUCTION

Fast population growth and long history of sedentary and traditional practicing method of agriculture has changed the land use/land covers system and has been a major cause of environmental degradation on most parts of the world including our country [1]. In Ethiopian, where agriculture is the main contributor of the national economy that contributing approximately 85%of job opportunity, 50% of growth domestic product and 90% of foreign exchange earnings and also sector on which the country's food security based and serve as a source of raw material for agro industries [2]. Agricultural production has dependent on natural resource for a long period of time and it was estimated that half of the Ethiopian highlands, Arable lands were moderately to severely degraded and nutritionally depleted due to over cultivation, over grazing, primitive production techniques, rain fed agriculture practice according to [3, 4].

Land use changes have remarkable effects on the dynamics of soil properties, increased rate of erosion and agricultural sustainability requires periodic evaluation of soil fertility status this was important in understanding factors that impose serious constraints to increased crop production under different land use types and for adoption of suitable land management practice [5, 6]. The survival and wellbeing of the surrounding communities of the present study area are mainly dependent on subsistence agriculture and oxen plough farming practices. Maintaining soil fertility status and nutrient supplying power of the soil to the plants and microbes is determined by the soil chemical properties and

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the up-to-date assessment of soil physico-chemical properties was used to identify the potential status of nutrients in the soil under different land use systems [7, 8]. Moreover, the chemical reactions that occurs in the soil affect process leading to fertility build up and soil minerals inherited from the parent materials over time release chemical elements that undergo various changes and transformations within the soil practically oriented un complicated information on the status and management practice of physico-chemical properties as well as their effect on soil quality to give recommendations for optimal and sustainable utilization of land resource of remains poorly understood [9].

Nutrient degradation of soil on different land uses type and management practice impact on soil degradation related soil process such as erosion, oxidation and leaching on both physical and chemical properties of soils and also influences the soil nutrients. However, information on the effect of land use types and management practices on soil properties in the country is very less. Understandings in land use and projecting future land use trajectories require understanding the interaction of the basic human forces that motivate production, communication, interaction and information on soil management such as use of the fertilizer, duration of fallow period, rotation system and yield are important parameters For arable land use description [10]. Although, land uses type was one of the major cause of soil erosion and subsequent loss of soil organic carbon in the ecosystem [11]. For instance, Nearly 10 million ha of crop land worldwide is abandoned every year because of problem associated with soil erosion alone [12]. In other words the loss of soil nutrients in Ethiopia land was related to traditional practicing method like tilling and land management practice. Changes in land use and soil management can have a marked effect on soil fertility. Mainly the conversion of natural ecosystem (Forest land) to human manage which resulted in decline of soil physical, chemical and biological properties [13]. The physical, chemical and biological properties alterations may be assessed by measuring and comparing present values against the values at the origination of the monitoring period, historical data when available, support decision and policy making processes at regional as well as national levels and soil properties under reference ecosystem or by using values measured at different time intervals [14]. A change in land use, poor soil management, to pography of the area and socio economic activities can negatively affect the potential use of an area and may ultimately lead to land degradation and loss of productivity lss of arable land due to soil degradation was a wide spread phenomenon in the high land of Ethiopia which accounts for 45% of Ethiopia total land area [15]. Therefore, this study was conducted with specific objectives to assess and explore the status of soil physic chemical properties and add value to the update scientific documentation of selected land use types of the Dire Enchini District and other similar agro-ecological environments in the country.

MATERIALS AND METHODS

Description of the Study Area: Dire Enchini district is located in Oromia regional state, West Shewa Zone at the distance 40 km from zonal capital city of Ambo at South West direction and 155km from Addis Ababa at west direction. It bounded by Toke Kutaye district in East and North, Jibat district in the West and South West Shewa Zone specifically Amaya district in south direction. At present Dire Enchni district have 20 *kebeles* and 1 urban village. The district comprises 20 peasant associations and each *kebele* hosts one farmer training center. In particular, in the study area primary schools were fairly distributed throughout the district; therefore, children from every household get access to education. There are one senior secondary school and health services are available in the district. Geographically, the study area is located (Situated) in mid highlands of Ethiopia and central Oromia region lying between 08°45'N and 08°77` N latitude and 37°38` and 37°62`E longitude and ranges between the lower Altitude 2050m to 3028 m the higher at an average of 2540m meters above sea level (Masl). In general the physiographic features of the study area have various land forms such as plateaus, hills, plains and valley. Tullu Roggee, Saqee, Daballee and Gafare Local named important mountains and Balesa, Urufa Donjo and Farisi were the local named plateaus of the district respectively according to Dire Enchini District Agricultural Office.

Population, Socio-Economic Condition and Climate: According to the Ethiopian agro-climatic zonation [16] and Dire Enchini district Agricultural office data the study area characterized in the high land (*Baddaa*) and recorded an average annual rainfall 1000 mm -1800 mm and characterized by Bimodal rainy season the first rainy season was known as summer locally called "*Ganna"* started from (June to September months) and the second rainy season was known as "*Arfaasa*" from March to May first week rainfall pattern and its mean annual temperature min. 11°C and max 24°C. Mixed farming is the

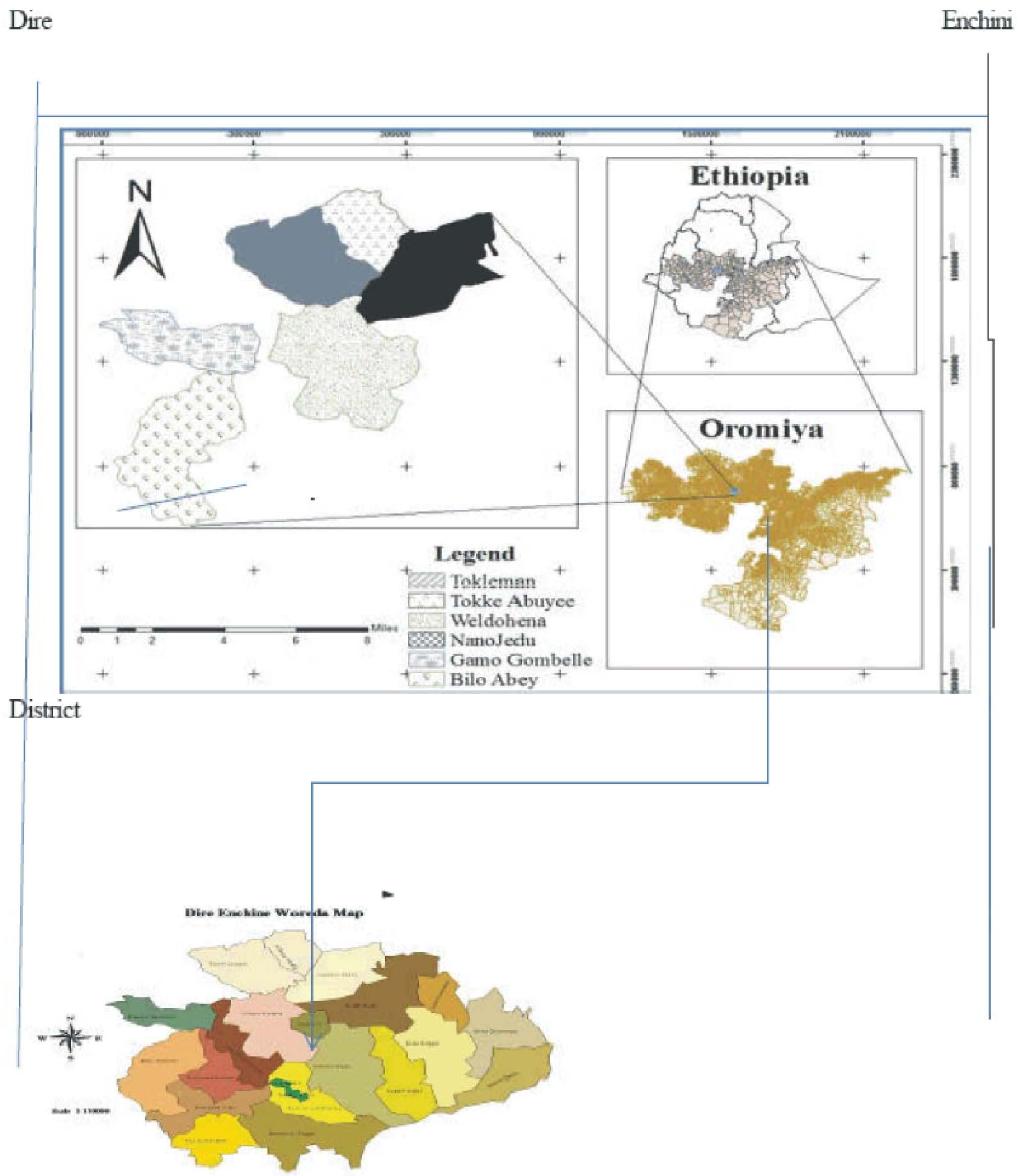

Fig. 1: Location map of the study area

major economic activity and it forms their lively by cropping at a subsistent level. Livestock cattle equine, sheep and goat and poultry are essential component of the farming system, oxen are the critical ploughing. The major crop cultivated in the study area are Eragrostisteff, (*Teff*), Hardiumvulgare (*Barley*), Tritcumaesticum, (*Wheat*), Phaseoulusvulgare (*Haricot Bean*), Zea mays (*Maize*), linseed, *Solanumtuberosum* (*Potato*) and Ensete Ventricosum (*Enset*) and mostly the rearing system characterized by indigenous /zebu type farming system through a person who have their own land and landless farmers leading their life by micro trading that was retailing in the market and have been selling. Off-farm activity is very limited within the study area. Women produce local alcohol and men serves as laborer to rich farmer to plough land and other activities. The villagers' main income sources are selling crops and livestock. Some of them also sell fire wood and charcoal especially the surrounding Kebele to Enchini town.

Land Uses, Soil Types and Vegetation: Previously vast expense of land of the district was covered by natural forest until the early 1983, which seemed very dense unlike the present status. This forest, however subjected to continuous clearing, selective cutting and ruined to small fragmented patches of forest, very sparse owing to farm land expansion and continuity. However, the indigenous vegetation that covers in the present study area were *pirunus Africana* (“*Hoomii,ficussur (Arbuu"), Hageniaabyssinica ("Heexoo")*, *Ekerbergiacapensis, ("Bakkanisa"), OleaAfricana ("Ejersa"), Arudina Alpina* ("*Leemana"), Juniperus procera* ("*Gattira*"*) Acaciaabyssinica ("Laaftoo"*), verniriaamygdalina (*Ebicha*). Additionally, to mention some of various man-made forests (Eucalyptus species (*Eucluptusglobullus ("Bargamoo")* and *eucluptuscamaldulensis* ("*Keyi*") types are of dominant vegetations of the study area. Although detailed soil description was lacking in the study area. however, according to Dire Enchini Agricultural office data showed that: those three soil description in the study area were Red soil locally known as Brown soil (“*Biyyoo Diima*”) covered about 17%, Black brown (“ *Biyyoo Guraacha*”) covered about 79% and clay loam “*supheemisoomawa*” 4% were the percentage coverage of soil in the study area respectively.

Sampling Site Selection, Soil Sampling and Preparation: Reconnaissance survey was conducted to select the representative land uses before collecting the soil samples, a physical observation was made to identify the major land use type within the representative of soil of the study district. Purposive sampling was carried out to select the Kebele and land used types because of the land use type’s identification according to the title selected. Then the major land forms land uses, topography and vegetation cover of the study sites observation was carried out. Accordingly, three major representative selected land use types (Forest, grazing and cultivated lands) of the study area were identified. The criteria used to select the land use were land uses that are identified first by district agricultural office in the land use types. After the selection of the representative land uses the next step was to select the land used types. To take purposive sampling the land use types were systematically on the basis of similarity in, soil color, vegetation cover by visual observation, with closest altitude and slopes as well as soil type different impacts on soil nutrient status that were adjacent to each there with in the respective land use types were selected for soil sampling lands. Thus, undisturbed land use types composite from depth of (0-25 cm) soil samples were collected randomly from each land uses and replicated three times and subjected to laboratory analysis.

The representative sampling sites were selected for each of the major land use types. For each land use types, three composite samples per major land use types. About 1 kg of the composite soil samples were put in a plastic bag with proper label according to major sample land use types on it and transported to Ambo University of the laboratory of chemistry department for chemical analysis and department of plant science for physical properties analysis. For determination of bulk density, undisturbed soil samples were also collected from each land use types using core samplers of known dimension. The core samples collected was uncapped and transferred into pre dried and weigh moisture tin ;the moisture tin was put in oven dry at 105°C and dried for 24 hour. Then the moisture was removed and cooled in desiccators. The net dry weight of the soil was obtained by subtracting pre measured from moisture and dried soil weight;

$$BD = \frac{\text{Ovendry weight}}{\text{Coresampler volume}} \tag{4}$$

The composite samples were air-dried and crashed to pass through a 2 mm diameter sieve for analysis of most of the soil properties except total nitrogen and organic carbon. For these two parameters, the soil samples were ground further to pass through a 0.5 mm diameter sieve. The laboratory analysis was carried out in Ambo University Laboratory and Holeta Agricultural Research Center for atomic absorption spectrophotometer (AAS) reading.

Laboratory Analysis of Soil Samples and its Determinations: Determination of soil physical and chemical properties: Soil particle size distribution was determined by the Bouyoucos hydrometer method using sodium hexameta phosphate as dispersing agent [17]. Soil bulk density was determined on undisturbed soil samples collected using the core sampler (Which is weighted at field moisture) after drying pre- weighted soil core samples in an oven at 105□ as described in [18]. Percentage total porosity was calculated from the bulk density (BD) and particle density (PD) values as:

$$\text{Total porosity (TP)} = (1\frac{Db}{pD}) \times 100 \tag{5}$$

An average particle density value for mineral soils ($2.65gcm^{-3}$) was used for estimating the total porosity.

The pH of the soil suspension was measured using pH meter that was calibrated using buffer pH at 4. 0, 7.0 and 9.22or10 that bracketed the pH of the soil suspension.

The manufacturer instruction manual was used for calibration of pH meter between each pH reading value; electrode was rinsed with distilled water and gently dried with a tissue paper. The pH meter was checked to ensure correct pH reading using buffer soil pH. Soil pH) was measured using digital ph meter in the supernatant suspension of 1:2.5 soil-water ratio. The quantity of organic carbon of soil was estimated by method of [19] to determine soil organic carbon through oxidation with excess dichromate solution in a strong acid.

$$(H_2SO_4)\ OC\ (\%) = \frac{N(V1 - V2),\ 0.36}{w} xmcf \quad (6)$$

where: N is the normality of ferrous sulfate required for the blank (mL), V_1 is the volume of the ferrous sulfate required for the blank mL, V_2 is ml ferrous sulfate solution used for sample and W is the weight of the soil in gram taken for analysis, 0.39=3 x 10^{-3} x 100% x 1.3 (3=equivalent weight of carbon), mcf= moisture correction factors. It is assumed that only 77%of OM is oxidized and fraction of 100/77=1.31. Then the OM content of the soil was estimated by multiplying the percent OC by 1.724; that is, Organic matter=1.724 x carbon%; The 1.724 Is average content of carbon in soil organic carbon equal to 58%. The acid digest ate was transferred quantitatively to 500mL capacity kjedhal flask and tube was rinsed with distilled water small portion at a time and 20mL of 2% boric acid solution was measured from dispenser in to receiver Erlnmeyer flask corresponding to the number of sample. Two drops of mixed indicator were added to Erlnmeyer flask and placed under the condenser in which the tip of the condenser was dipped into boric acid solution. Slowly 75mL of 40%sodium hydroxide was added by letting it to down the neck of distilled flask. The content of the flask was shaken by swirling and heat turn on. When about 80m L distillate was collected, the receiver was removed and stirrer bar added and the distillate was titrated from green to pink end point with 0.1N H_2S0_4. The result was calculated by using equation.

$$N = \frac{(b-a),\ N.0.014.100,\ mcf}{S} \quad (7)$$

where: a=mL of H_2S0_4(0.1N), S= air dry sample weight in grams 0.014=meq weight of nitrogen in g and mcf = moisture correction factor. Therefore, the total nitrogen content was determined as above procedure using the Kjeldahl method by oxidizing the organic matter with sulfuric acid and converting the nitrogen into NH_4^+ as ammonium sulfate [20].

For determination of Available phosphorus, the sample was extracted by sodium bicarbonate solution at pH 8.5. Phosphate in the extract was determined calorimetrically after treated it with ammonium molybdate sulfuric acid reagent with ascorbic acid reducing agent.

$$P(ppm\ or/mg/Kg\ soil = (a-b)\ x\ \frac{100}{S}\ x\ mcf \quad (8)$$

where: a=mg/l pin sample extract, b=mg/l P in blank, S =sample weight in gram (5g), mcf=moisture correction factor 100=ml of extracting solution. Determination of available P was done using [21].

The exchangeable bases (Ca, Mg, K and Na) in the soils of the different land use were determined from the leachate of 1 molar ammonium acetate solution at pH 7.0. Then the flame photo meter was calibrated with standard solution. And injected into the instruments and the K and Na were read by using method of [22] whereas Exchangeable Ca and Mg were read by atomic absorption spectrophotometer.

The soil percent base saturation (PBS) was calculated from sum of the basic exchangeable cations (Ca, Mg, K and Na) as the percentage of CEC.

$$PBS = \frac{(Ca + Mg + K + Na)}{(CEC)} \times 100 \quad (9)$$

To determine the cation exchange capacity (CEC), the soil samples were firstleachedwith1M ammonium acetate (NH4OAc), washed with ethanol and the adsorbed ammonium was replaced by Na [23]. Then, the CEC was measured titrimetrically by distillation of ammonia that was displaced by Na. For measurement of Available Soil Micronutrients, A 0.5g fine grounded samples, accurately weighed in kjedahl flask capacity of 500mL and 0.5mL of HNO_3,4mL $HClO_4$ and 2Ml H_2O_2 were added for digestion. Then the digested sample were added for to vial and distilled water added up to mark and placed in the refrigerator until analysis by AAS.

$$Mn, Fe, Cu\ and\ Zn\ (ppm) = \frac{ppm\ inextract - blank\ x\ A}{wt} \quad (11)$$

where: A is the total volume of extract in mL and wt is weight of dry soil sample taken.

Data Analysis: The obtained data were treated with one way analysis of variance (ANOVA) using IBM SPSS version 20 software to detect the presence value to assess the variation of the selected sample among cultivated, grazing and forest land. Mean comparison was employed by mean value of physic chemical properties.

RESULTS AND DISCUSSION

Status of Selected Physicochemical Properties: The soil texture analysis of the soil of the present study area was shown in Table 1 and indicated that in most of the soil of the selected study area the proportion of the textural particle the clay fraction was high in the top (0-25cm) soils depth of the present study area taken from three selected land use types, were indicating the nearest similarity in parent material (Table 2). The composition percent of sand, Silt and clay content of the cultivated, forest and grazing lands were: (32.5±3.95 % 20.2±5.75, 47.3±4.71) %, (26.374±3.96, 21.51±4.09, 52.12±2.12) % and (26.4±4.91, 22.85±4.77and 50.75±2.43) %, respectively. The result of the present study area showed that the composition of the textural particle dominated by clay particles (Fraction) followed by sand particle sand (Fraction). Thus the textural class of all land use was clayey dominated. However, the difference in particle size distribution which can be attributed to the effect of deforestation, traditional cultivation practice such as tilling 1^{-3} until seedling or seeds sow and extensive grazing, through over stocking could be observed. The finding is correspond with 5 who described on soils of different land use type, but of the same area with same soil type and textural class differed in some other physical condition mainly due to the fact of soil physico-chemical properties changes with change in land use system and its management practice. The textural classes of soils taken from different land uses types were significantly affected (P<0.05) in all land use types. For soil of cultivated, grazing and forest lands the percent of clay content was significantly higher than that of sand and silt contents. Percent of clay content was significantly higher in soil collected from grazing land than cultivated land followed by forest land as shown in (Table 1).

Soil Bulk Density, Particle Density and Total Porosity: The mean value of bulk density obtained from three land use types were (0.795±0.10, 0.76±0.10,0.74±0.11) in depth of 0-12cm for grazing, forest and cultivated lands respectively as shown in (Table3) and also (0.91±0.18, 0.822±0.07 and 0.8±0.09) obtained from depth of 12-25cm in grazing, cultivated and forest lands respectively as shown in (Table 2). The lowest and highest bulk density in the depth 0-12cm of soil under cultivated and grazing lands in present study area attributed to the high SOM and less disturbance that means compaction of soil surface resulting from extensively field traffic and over grazing with high herd composition may increase the bulk density of grazing land whereas less compaction due to traditional cultivation by oxen and communal grazing (That reduce free grazing in cultivated land), crop rotation, fallow land and management practice may decrease the bulk density of cultivated land. The bulk density of the second depth increase in grazing land may be due to over grazing, overstocking might have resulted in the soil compaction and erosion problem that reduces the organic matter content in surface layer and the lowest bulk density observed in forest land might be due to the nutrient accumulation sub-layer through infiltration. This finding revealed consistence with [15] who investigated the variation of bulk density due to soil depth. The bulk density of present study area increase as the depth increase this finding is in line with [24] who determined on bulk density under both cultivated and grazing land increased with increasing soil depth. The present study result of total porosity

Table 1: Mean value of selected soil physical (soil texture) properties.

		Textural particle in (%)			
Land use type	Depth in(cm)	Sand	Silt	Clay	Textural classes
CL	0-25	32.5±3.95	20.2±5.75	47.3±4.71	Clayey
GL	0-25	26.374±3.96	21.51±4.09	52.12±2.12	Clayey
FL	0-25	26.4±4.91	22.85±4.77	50.75±2.43	Clayey

Source: Laboratory results, 2019 (Mean± SD) CL=cultivated land, GL= grazing land and FL= forest land

Table 2: Selected soil physical properties (Bulk density) of the study area

LUT	Depth in (cm)	Dry soil in (g)	Bulk density (g/cm^3)	Total porosity (%)
CL	0-12	72.7±11.44	0.735±0.11	71.32±4.74
	12-25	81.07±7.12	0.822±0.07	68.73±2.66
FL	0-12	79.08±9.31	0.760±0.10	71.9±3.28
	12-25	78.59±10.93	0.8±0.09	69.5±3.78
GL	0-12	71.6±10.83	0.795±0.10	73.8±9.12
	12-25	89.71±7.12	0.91±0.18	67.5± 6.73

Source: Laboratory results, 2019 (Mean± SD) CL= cultivated land, GL=grazing land, FL= Forest land. LUT, Land use types.

Table 3: Selected soil chemical properties lab-result (Mean± SD)

LUT	OM (%)	TN (%)	C: N	Soil pH (H_2O)
CL	10.48±0.56	0.52±0.03	20.15±0.16	5.59±0.01
FL	13.09±0.17	0.65±0.01	20.13±0.12	5.62±0.01
GL	7.53±0.17	0.38±0.01	19.81± 0.20	5.4±0.02

Source: Laboratory results, 2019, CL= cultivated land, GL=grazing land, FL= Forest land LUT-land use types, OM –organic matter, TN- total nitrogen, C:N- carbon to nitrogen ratio pH-Power of Concentration of Hydrogen ion in soil

of the study area by two depth of (Cultivated, forest and grazing) lands were (71.32±4.74, 71.89±3.28 and73.8± 9.12) % respectively in depth of 0-12cm and (69.5±3.78, 68.73±2.66and 67.49± 6.73) % in forest, cultivated and grazing lands in depth of 12-25cm were obtained in present study area respectively in depth of 12-25cm as shown in (Table 2). In this present study showed that as the depth increase the percentage of Total porosity decrease in all land use type as shown (Table 2). This highly compacted by overstock, overgrazing plant biomass reduction soil organic matter decline in sub layer.

A decrease in total porosity in cultivated land as compared to grazing land and forest land in upper layer is the reduction of organic matter because of plant biomass uptake and 1-3 plough for seedling preparation and break large size into fine/small/ size which reduce air space the pore size. This finding revealed was in line with the finding revealed of [25] who described on long term cultivation tends to lower total porosity because of decrease in SOM and large peds. This might also consistence with finding of [5] who revealed on a decline of total porosity in the soil attributed to reduction in pore size and distribution and closely related to magnitude of SOM and management practices.

Soil Organic Matter, Total nitrogen and C: N ratio: The mean value of forest, cultivated and grazing lands were (13.09 ±0.17, 10.48±0.56 and 7.52±0.17)% respectively as Shown in (Table 3). The highest mean value of organic matter content (13.09 ±0.17 and 10.48±0.56)% obtained in forest land and cultivated land whereas the lowest value observed in(7.52±0.17) grazing land. The highest mean value of organic matter obtained in forest land as compared to the adjacent selected land use types in the present study area is due to long time accumulation of plant foliage and dead body of plant, less erosion that removes the top soil, high plant biomass that cover aeration. This finding was consistence with [5] who revealed on the highest soil organic matter in forest attributed plant litter fall enhance the content of soil organic matter in forest. The mean result of organic matter was highest in cultivated land as compared grazing land in the present study area due to management practice, adding manure to farm field, crop rotation, adding compost, fenced cattle into farm field locally known as "*Ciibsaa*", fallow land (For minimum one year crop calendar), drain mixture of manure in back yard during rainy time, contour plough, residue management. This finding in line with [26] who revealed traditional biological and physical land management Practices play great role in improving cropland productivity by adding and maintaining organic matter in the soil. whereas the lowest mean value of the organic matter content recorded under grazing land was the over grazing, declining humus no decomposed litter, less management practices, Biomass composition in the grazing land and due to the fact that over grazing increase basic cation leaching and increase bulk density.

This finding consistence with [27] who revealed the relation between bulk density and organic matter that is, as organic matter increase bulk density decrease and as bulk density increase due to different factors organic matter decrease and also in line with [28] who revealed on the accumulation of soil organic matter within soil was a balance between the returns or addition of plant residues and their subsequent losses due to the decay of the residue by microorganisms. According to [29] rating range of organic matter content the value >5.2 rating as high range and 2.6-5.2 ranges rating as medium organic matter content. The results of TN content of the study area (0.65±0.01, 0.52±0.03 and 0.38±0.01) % in forest, cultivated and grazing lands respectively as Shown in (Table 3).

The highest mean value of TN content obtained in forest land vegetation cover which improved the soil organic matter contents, forest land may have nitrogen fixing trees, plant dead body and foliage fall in forest ecosystem have the ability to increase organic matter content which enhance to soil nitrogen content. The next highest mean value of TN in cultivated land as compared to adjacent grazing land the present study area was due to the addition of organic manure, residue management, fallow period, crop rotation, leguminous plant cultivation which enhance nitrogen fixation, fenced cattle in farm field which provide large amounts of soluble nitrogen that was readily available to plants, drain mixture of manure in

Table 4: Selected soil chemical properties lab. result (Mean± SD)

LUT	Na	K	Ca	Mg	CEC
	---Cmol (+) kg^{-1}				---
CL	0.81 ±0.01	1.03±0.03	14.93 ±0.12	5.73± 0.64	22.51 ±0.6
FL	0.7±0.010	0.97±0.02	20.00 ±0.2	5.14 ±0.12	26.75±0.23
GL	0.64 ±0.01	0.93±0.01	9.27 ±0.12	3.13 ± 0.31	14.03±19

Source: Exchangeable bases and CEC of the present study area Laboratory results, 2019, CL=cultivated land GL=grazing land, FL= Forest, Ca-Calcium, K-potassium, Mg-magnesium, Na $^{-1}$ sodium, CEC cation exchangeable capacity, LUT, Land use types

backyard to farm field during rainy time adding of inorganic fertilizer due to the fact that management practice and added organic manure enhance total nitrogen content. This finding revealed was consistence with [26] who revealed on traditional land management practices have a significant role in adding and maintain the total nitrogen contents of soil. The lowest mean value of total nitrogen obtained in grazing land may be due to over grazing; erosion that enhances organic matter reduction, overstocking of livestock, which might have caused degrading nitrogen fixing plant. This finding was consistence with [30] who revealed on the nitrogen content in controlled and free grazing lands. The mean value of grazing land is significantly lower than cultivated land and forest land because of overgrazing, overstocking, decomposed plant biomass decreased, soil erosion (Sheet and rill erosion) and may be due to the relative reduction of organic matter content in grazing land. Similarly the present study was in agreement with the [31] who revealed on grazing management effects on the magnitude, distribution and cycling of C and N in different grazing land ecosystems. According to [29] rating range of TN content value >0.25 rating as high range 0.12-0.25 ranges rating as medium and 0.01-0.12 range rating as low TN content. The TN content of all land use types were high according to rating range of [29] reported about TN content rating range. Such result may expect to since most soil nitrogen bounded in organic carbon. The C: N ratio of the soil should be considered as the informative indicators of soil organic matter quality than the carbon and nitrogen contents alone. The (C: N) ratio of a soil is obtained by dividing the organic carbon to TN [9]. The C: N ratio of the study area ranges from 19.81-20.15 as shown in (Table 3). The mean value of grazing land is lowest as compared to cultivated land and forest land. C: N ratio ranges from 20 to 30 considered as normal soil. This indicates the existence of enough N to meet microbial needs. As [32] reported that soil with C: N ratios in the range of 10to 12 provides in excess of microbial needs whereas soil with C: N ratios above 35 not likely to contain enough N to meet microbial needs. Therefore OM and TN content has direct relation to soil acidity. This implies that intensive cultivation removal of crop residue significantly depleted OM and TN that leads to soil acidity problem. And the value recorded in all land use type of C: N ratio was narrow /almost nearest value. The study area indicated normal in cultivated land and forest land whereas below normal in the grazing land because of it attributed to lower mean value of organic matter content in grazing land as compared to forest land and cultivated land. This finding revealed in line with the study of [5] and [33] who concluded higher microbial activity and more CO_2 evolution and its loss to the atmosphere.

Soil pH: A study of Bradyand Weil [25] described that Soil pH was a major variable that regulates almost all biological and chemical reactions in soil and indicated the degree of availability of plant nutrients and lime requirement of a soil. However, the results of pH revealed in the study area (5.59±0.01, 5.62±0.01and 5.4±0.01) obtained for cultivated, forest and grazing lands respectively as Shown in (Table 4). From this analysis of variance the pH of the present study was significant ($P<0.05$). As per rating range of the [32] the rating range of the present study revealed was moderately and strongly acidic affected and indicated figuratively 5.1-5.5f or strongly acidic affected and 5.6-6.0 was indicated moderately acidic affected. Thus the grazing land of the selected present study area was strongly acidic affected whereas cultivated land and Forest land were moderately acidic affected land use in the study. The strongly acidic affected land due to over grazing, erosion, land degradation, over stocking that was responsible for leaching of basic cation and left over acidic cation that can lead acidity of the area whereas the moderately affected selected land use types due to less erosion, extent plant litter decomposition adding farm yard manure fallow land which reduce basic cation leaching [5, 34].

Exchangeable Bases and Cation Exchange Capacity: The result of exchangeable Ca obtained in study area (14.93±0.1, 20±0.2 and 9.27±0.11) cmol (+)kg^{-1} in cultivated, forest and grazing lands respectively a shown in (Table 5). The exchangeable calcium content in all

Table 5: Selected chemical properties result of (Mean± SD)

LUT	TEB Cmol (+)Kg^{-1}	PBS %	Av.P Mg/Kg^{-1}
CL	22.5±0.60	99.95±0.00	8.71±0.12
FL	26.75±0.23	100.1±0.67	5.56±0.04
GL	13.97±0.20	99.6±0.05	5.48±0.35

Source: Laboratory results, 2019, mean ± standard deviation

CEC-Cation exchange capacity, TEB-Total exchangeable bases, PBS-percent of bases saturation, Av.P- available phosphorus, CL-cultivated land, FL- Forest land and GL- Grazing land.

selected land use types was significantly affected in ($P<0.05$) present study. The highest mean value of exchangeable Ca obtained in forest land followed by cultivated land and lowest in grazing land. The exchangeable Ca in cultivated and forest lands were qualified as highest in forest land and high in cultivated land respectively this indicate that there was no deficiency of Ca exchangeability in both selected land use types due to SOM accumulation through plant dead body in forest plant leaf and litter fall accumulation and organic manure application, fallow land in cultivated land and residue management ;whereas medium rate of Ca exchangeable may be due to over grazing and erosion reduce the surface soil which contain organic matter and leaching of basic cation and grazing land of the present study required to reduce those factors affecting the organic matter reduction and basic cation decline. This finding revealed consistent with [5] who revealed deforestation and continuous cropping mainly contributed to depletion of basic cations and CEC on the cultivated land as compared to the adjacent forest land. As per rating range Exchangeable Ca value recorded in present study was qualified as very high in forest; high in cultivated land and medium in grazing land according to the rating range of the exchangeable bases described by [35].

The Present mean value of exchangeable Mg (5.73±0.64,5.14±0.11 and 3.13±0.3) cmol (+)kg^{-1} in cultivated, forest and grazing lands respectively a shown in (Table 4). The exchangeable Mg content was significantly affected in all selected land use type in ($P<0.05$) due to the content of exchangeable Mg in selected land uses was different in content.

The mean value of exchangeable Mg in grazing land was significantly lower than that of the adjacent selected land use types this was due to the organic matter content and cation exchangeable capacity were decline because of no excess plant foliage decomposition and erosion (Sheet and rill erosion) problem that remove the surface layer which has accumulation of organic matter due to overstocking and leach of basic cation. Among the rating range of exchangeable bases value ranges >8 recommend as very high, 3-8 range as high and 1-3 range as medium based on this rating range the present study area qualified as high rating range. As per rating range of the exchangeable bases [10, 35]. In over all this indicates that there was no deficiency of Mg exchangeability due to the plant foliage decomposition reduces basic cation leaching and contain medium cation exchange capacity, addition of organic manure, cow dung cycling, fallow land. This finding is in line with [36] who revealed on deforestation, leaching, limited cycling of dung and biomass in the soil and soil erosion have contributed to depletion of basic cation from other land uses compared to forest land soil. The result of exchangeable Na obtained in the present study area (0.81±0.01, 0.7±0.00 and 0.64±0.01) cmol(+)kg^{-1} in (cultivated, forest and grazing) lands, respectively a shown in (Table 4). In the rating range of Na the value of range >2 very high, 0.7-2 high and 0.3-0.7 medium as well as 0.1-0.3 values determined as low as per rating range of Na [10, 35]. As per rating range of Exchangeable Na of [10, 35] value observed in Forest land and cultivated land were rating as high this indicated that there was no deficiency of Na in cultivated land and forest land because of the cation exchangeable capacity and organic matter content under those selected land use types was in optimum range because of organic manure application, fallow period crop residue management in cultivated land and litter decomposition basic cation infiltration due to no sever erosion in forest land whereas value of grazing land 0.64 ±0.01in the present study area was medium range according to the rating of the exchangeable bases. The medium mean value observed in grazing land leaching of basic cation because of erosion (Sheet and rill erosion), overgrazing less content of organic matter in grazing land due to no decomposed plant biomass in grazing land and erosion removes the surface organic matter. The mean value result of exchangeable K obtained in the study area (1.03±0.03, 0.97±0.01 and 0.93±0.01) cmol (+) kg^{-1} in cultivated, forest and grazing lands respectively as shown in (Table 4).

In this present study area exchangeable potassium mean value was highest in cultivated land as compared to the adjacent selected land use types due to crop rotation, residue management, fallow land, added feaces and urine through fenced cattle, farmyard manure application, contour cultivation which increase infiltration and reduce erosion and in organic fertilizer added into cultivated land during cropping time Where as lower value of the potassium in grazing land was due to a few plant biomass, over grazing, soil erosion, least biological recycling such as plant leaf decomposition and plant dead body which associated with soil organic matter was in grazing land due to harvested by cattle. As per rating range of [10] and [35] the value of K which is >1.2 rated as very high and 0.6-1.2 as high from this rating range the present study area rated as high in all selected land use types. Moreover, the present study consistence with [37] and [38] who revealed on variations in the distribution of exchangeable bases depends on deforestation leaching, Limited cycling of dung, soil erosion, overgrazing conversion of forest land into farmland, soil management practice. The CEC was the total capacity of a soil to hold exchangeable cations and also soil ability to react with positively charged molecules. The mean value of CEC in the present study (22.51± 0.60, 26.75± 0.23 and 14.03±0.19) cmol (+)kg^{-1} in cultivated, Forest and Grazing lands respectively (Table 4).

The highest mean value of forest land was due to the plant litter and foliage decomposition accumulation, accumulation of organic matter, less erosion that removing top soil which contains organic matter and basic cations, whereas the lowest mean value recorded in grazing land due to low accumulation of organic matter. Because of overgrazing and no plant biomass that use for decomposition and enhance organic matter content due to uprooting by cattle. This finding results in line with [25, 36] who revealed higher organic matter and clay content significantly contributed to directly related to the high content of clay and organic matter and the CEC. In rating range the value of the CEC value from 25-40 range was rating as high and 15- 25 rating range as medium and 5-15 was low rating range. As a result of this the present study area rating ranges the CEC value of forest land was high whereas the cultivated and grazing lands were classified as medium and low respectively in status of CEC value.

Total Exchangeable Bases and Percent of Base Saturation (PBS): The result revealed of total exchangeable bases in the present study area 22.51± 0.60, 26.74±0.22and 14.03±0.19 in cultivated, forest and grazing lands as shown in (Table 5). The highest mean value of total exchangeable bases observed in forest land whereas the lowest mean value under grazing land. This high mean value in forest land indicates there were no deficiency basic cation and leaching in forest land as compared to the adjacent land use type in the present study it may be due to plant litter accumulation with biological activities and accumulation from plant dead body, organic matter accumulation that related with basic cation. Thus total exchangeable availability associated with exchangeable bases availability. These indicated that highest mean value total exchangeable bases observed in forest land and the forestland has highest content calcium and magnesium which related with plant dead body accumulation. Generally, as the mean value of exchangeable bases decrease due to leaching by erosion or organic matter reduction the mean value of total exchangeable bases should be decrease. This study revealed consistence with [25, 38] who revealed on variations in the distribution of exchangeable bases depends on deforestation leaching, Limited cycling of dung, soil erosion, overgrazing conversion of forest land into farmland, soil management practice. The PBS was the percentage of the soil exchangeable site occupied by basic cations, such as (K, Na, Mg and Ca) the PBS were calculated for each cation then added up to determine base saturation. Its effect depends on other physico- chemical degradation considering the main effect of land use the mean value of the result observed (99.97±0.04, 100.1±0.00 and 99.61±0.66)% in cultivated, forest and grazing lands respectively as shown in (Table 5). The highest mean value of PBS of forest land may be due to Infiltration increase and the temperature that enhance decaying decrease due to plant canopy protect direct sunlight decomposition of plant litter and foliage less, erosion problem that remove organic matter and reduce decomposition basic cation in the top soil of forest land the accumulation of plant dead body and foliage whereas the lowest mean value of the grazing may be due to the over grazing and top soil that contained SOM and basic cation due to erosion removes the OM value on regulating soil basic cation with basic cation whereas the lower mean value of PBS in soil of grazing land might be due to over grazing leaching of basic cation, OM reduced due to no plant foliage and litter on grazing land due to over stocking. this finding revealed concurred with [5, 41, 43] who revealed on distribution of Percent of base saturation showed similarity with the distribution of CEC in the soil.

Table 6: Soil Micro nutrient availability laboratory results (Mean±SD)

LUT	Zn	Fe	Cu	Mn
	--	------------in (ppm)------------	--	----------------------------
GL	0.76±0.53	13.21±2.23	0.069±0.01	5.66± 1.11
CL	1.13±0.22	18.29±1.26	0.088±0.01	9.02±1.26
FL	0.86±0.07	19.37±1.07	0.100±0.02	8.02± 0.18

Source: Soil micro nutrient the present study Laboratory results, 2019

Available Phosphorus (P) and Extractable Soil Micro Nutrients: The finding revealed of Available phosphorus in the present study in related to selected land use types observed as (8.71±0.12, 5.56±0.04 and 5.48± 0.35) mg/kg^{-1} in cultivated, forest and grazing lands respectively as shown in (Table 5). However, the mean value of available P was highest in cultivated land as compared to the adjacent land use types in the present study. This might be due to fertilizer application, crop rotation, Residue management and fallowing and farmyard manure application, fenced cattle in farm field. The lower available P in grazing land is may be due to overgrazing and plant biomass decrease which resulted in erosion and leaching basic cation decline of residual decomposition, low decomposed material accumulation in grazing land because of SOM status in the soil organic matter also dependent on decomposed litter and foliage and management practice. Result of the present study is consistent with [5, 39, 41, 43] who revealed on SOM as the main source of available P in most soils of Ethiopia and declined by the impacts of P fixation, abundant crop harvest and erosion. As per rating range of chemical properties of soil the available phosphorus rates as medium ranges in the present study and it requires appropriate management system.

The soil micro nutrient is a chemical substance required in trace amounts for the normal growth and development of living things. The mean result of Zn in the three land use type of study area (1.13±0.22, 0.86±0.07 and 0.76±0.53) ppm observed for cultivated, forest and grazing lands respectively as shown (Table 6). The highest mean value of zinc in cultivated land was high as compared to the adjacent selected land use type by the application of in organic fertilizer which contained Zn^{2+} in the district and farm yard manure application for increasing organic matter, adding compost, fallowing that increase organic matter content. This finding revealed similar [9] who revealed on the availability of Zn increased due to the formation of organic complexes between organic matter and Zn that protect it from leaching. The deficiency level of Zn 0.5-1 mg/kg^{-1} the value of Zn in cultivated land is above deficiency level as compared to the adjacent land use type in the present study area above the critical levels indicating that there is no deficiency of these micro nutrients in cultivate land whereas the forest and grazing lands are in the range of deficiency and it required to appropriate management practice to enhance organic matter content. The mean result of Fe obtained in the present study area were (19.37±1.07, 18.29±1.26 and 13.21±2.23) ppm in forest, cultivated and Grazing lands respectively as shown in (Table 6). The level of the Fe was lowest in grazing land it may be due to decomposed plant accumulation in soil removed by soil erosion because of overgrazing problem leaching of basic cation in the grazing land. The value of the Fe obtained in present study area was above critical that means the critical level of Fe 2.5-4.5. This indicates that there is no deficiency of Fe in the study area. The mean value of Cu content varies from (0.088±0.01, 0.100±0.02and 0.069±0.01) ppm for cultivated, forest and Grazing lands respectively as shown (Table 6). Forest land contained high mean value of Cu contents while grazing land contained the lowest mean value of Cu. This was attributed to Cu mean value increase in both selected land use was due to manure application in farm field residue management in cultivated and plant litter and dead body accumulation in forest land where as the lowest mean value obtained in grazing land might be due to removal of plant biomass on grazing land by animal harvested and after it removed the erosion removes the top soil that rich in soil macro and micro nutrient. The present study was in line with [40] who reported decrease of Cu across soil depths from top to bottom layer. The value of Cu was at the critical level of that means critical level of (Cu =0.1-2.5) in this study the content of Cu indicates nearest to critical level and that the present study needs appropriate management practice that enhance Organic matter content to optimize and maintain the soil quality in the case of grazing land. In general, Special emphasis should be given for the management of soil OM as many physicochemical properties are associated with it. This finding concur with several studies [9, 41-45] who have studied on the impact of land use type on soil physico-chemical properties. The Mean value of Mn recorded in the present study area (9.02±1.26, 8.02± 0.18

and 5.66±1.11) ppm in cultivated, forest and grazing lands respectively. The highest mean value of Mn obtained in cultivated land and forest land in the present study due to the cultivated land managed by application of farmyard manure, inorganic fertilizer and organic manure applied, fallow land, crop rotation, residue management on farm field and plant litter accumulation in forest land and enhance soil OM which attributed Mn mean increase. However, the lowest mean value of Mn was recorded in grazing land as compared to adjacent selected land use types and associated with the soil organic matter content which declined by over grazing and sheet and rill erosion. The result of this study is similar to [46] who reported soil organic matter is as main source of available Mn. This indicated that there is no deficiency of Mn in present study.

CONCLUSIONS

Based on the result obtained from the present study the result indicates that the land use types were affecting the soil properties of the same ecological zone. For instance grazing land has the lowest value of soil chemical properties as compared to the selected land use types and highest in physical properties especially in bulk density results in all selected land uses in the study area and highest in clay particle fraction in grazing land attributed to the over grazing and herd composition and contribute to increase degradation prevalence whereas the chemical properties of forestland was highest in the selected land use types of the study area in soil organic matter accumulation by plant foliage decomposition and also cultivated land has the highest chemical properties next to forest land because of management practice through farmyard manure application, fallow period, crop rotation, in organic fertilizer application, residue management. Moreover, it is important to reinstate intensively grazing and cultivated degraded land through appropriate management practice by using intensive grazing system, crop rotation, cultivating no more than necessary and adding organic material and controlling exceptional deforestation are very crucial and should be considered as important source to upgrading the soil basic nutrients and increase pH of acidic soil to the required level. Moreover, result obtained in the present study area indicated that physicochemical status was at risk of deterioration in selected land use types based on management practice. Therefore, governmental, non-governmental, rural development and strategies should be flexible in responding to the various agro-ecological zones, local resource endowment and farmers capacity to invest in affordable integrated soil fertility management techniques.

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