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Original Paper

Effect of Indigenous Tree Species Component in Homegarden Agroforestry System on Selected Soil Physicochemical Properties in Habro District, Oromia Regional State, Ethiopia

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Abstract

Homegardens are one of the most important niche in which farmers feel confident to plant and maintain tree and shrub species. Indigenous tree species that are used for soil fertility improvement in Homegardens in western Harerghe in general and Habro district have not been given much research attention. The study assessed the effect of indigenous tree species components of homegarden agroforestry system on selected soil physicochemical properties. The study was carried out in Habro district at three sites (Melka Belo, Haro Chercher and Lega Bera). Soil samples were collected from under Cordia africana and Faidherbia albida canopy and outside canopy at three distances (at half of the canopy radius under the tree, at canopy edge and at three times canopy radius away from the tree trunk outside the canopy) within the 0-20cm and 20 to 40cm soil depths. Mean total nitrogen, available phosphorus, available potassium and organic carbon were significantly higher under the tree canopy than outside the canopy area ($P<0.05$). Bulk density was significantly higher at subsurface than surface soil while organic carbon was significantly higher at surface soil than subsurface soil. The analysis of variance revealed that moisture content, soil texture and soil pH were not significantly affected by tree species, distance from the tree trunk and by soil depth. The present study demonstrates that Cordia africana and Faidherbia albida tree that were planted or maintained in homegarden *agroforestry system of Habro district improved soil properties and they can be used as an economically feasible, environmentally friendly and sustainable alternative to maintain soil fertility of the resource poor farmers in similar agro-ecological conditions. Hence, the research encourages indigenous tree species that are found to have positive effects on soil physical and chemical properties.*

Keywords

Cordia africana, Faidherbia albida, Physicochemical Properties

1. Introduction

Ethiopia has diverse macro and micro climatic conditions that have contributed to the formation of diverse ecosystems inhabited with a great diversity of life forms of both flora and fauna (Tesfaye *et al.*, 2013). Clearance of natural vegetation to meet the demands of an ever-increasing human population has been an ongoing process as a result of increasing demand for agricultural land use, fuel wood, and construction materials. Currently, agricultural production falls at risk due to a number of factors, such as climate change, soil erosion, soil fertility loss and severe soil moisture stress which is partly the result of loss of trees and organic matter (Feyera & Demel, 2003).

Homegarden is one of the most elaborate systems of indigenous agroforestry practice found most often in tropical and sub-tropical areas where subsistence land use systems predominate (FAO, 1986). It can provide a sound ecological basis for increased crop and animal productivity, more dependable economic returns and greater diversity in social benefits on sustained basis (Saka et al., 1990). Homegarden agroforestry system could be considered as potential technology for rural poverty alleviation because of its diversified functions (Haque, 2014). Kumar and Nair (2006) defined homegarden as land use system involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole tree-crop, and animal unit is being intensively managed by family labour.

According to Haque (2014), homegarden refers to home and adjoining land occupied by a family for the purpose like small scale agricultural production, home-up keeping, health, sanitation and nutrition. The main values derived from homegarden are foods, energy for domestics use, source of nutrients, fodder for domestic animal, medicinal products, timber for house construction, and a pleasant environment for dwellers.

The absence of formal or informal links between the homegardens on the one side and the national research and extension service on the other do not allow this important production system to benefit from the outcome of research or from the services of the extension system.

Contribution of some indigenous tree species for soil fertility improvement on farmlands has been investigated in different areas of Ethiopia by different authors such as (Tadesse *et al.*, 2000; Abebe, 2006; Zebene & Agren, 2007; Agena *et al.*, 2014; Belay *et al.*, 2014). But all of these were not done in western Harerghe homegarden agroforestry system in general and Habro district.

Therefore, investigation of soils under indigenous trees in Homegarden Agroforestry System (HAgFS) of the district is imperative to overcome the stated problems and up-scaling best practices through research to increase agricultural productivity in a sustainable way to enhance agricultural growth and achieve food security, disseminate technologies in faster pace, to appropriately utilize the plant and soil resource. To improve our understanding on how the agroforestry systems, work, there is a need to design scientific investigation, and study the contribution of indigenous trees on soil physicochemical properties in the existing traditional agroforestry. Hence, the present study is proposed to assess the effect of indigenous tree species components of homegarden agroforestry system on selected soil physicochemical properties.

2. Materials and Methods

2.1 Description of the Study Area

This study was conducted in Habro district in Melka Belo, Haro Chercher and Lega Bera *kebele* administrations (Figure 1). The district is found in West Harerghe Zone of Oromia National Regional State, eastern part of Ethiopia. The district is located at 8.57°N—8.91°N and 40.34°E—40.69°E. Gelamso town is the administrative seat of the district.

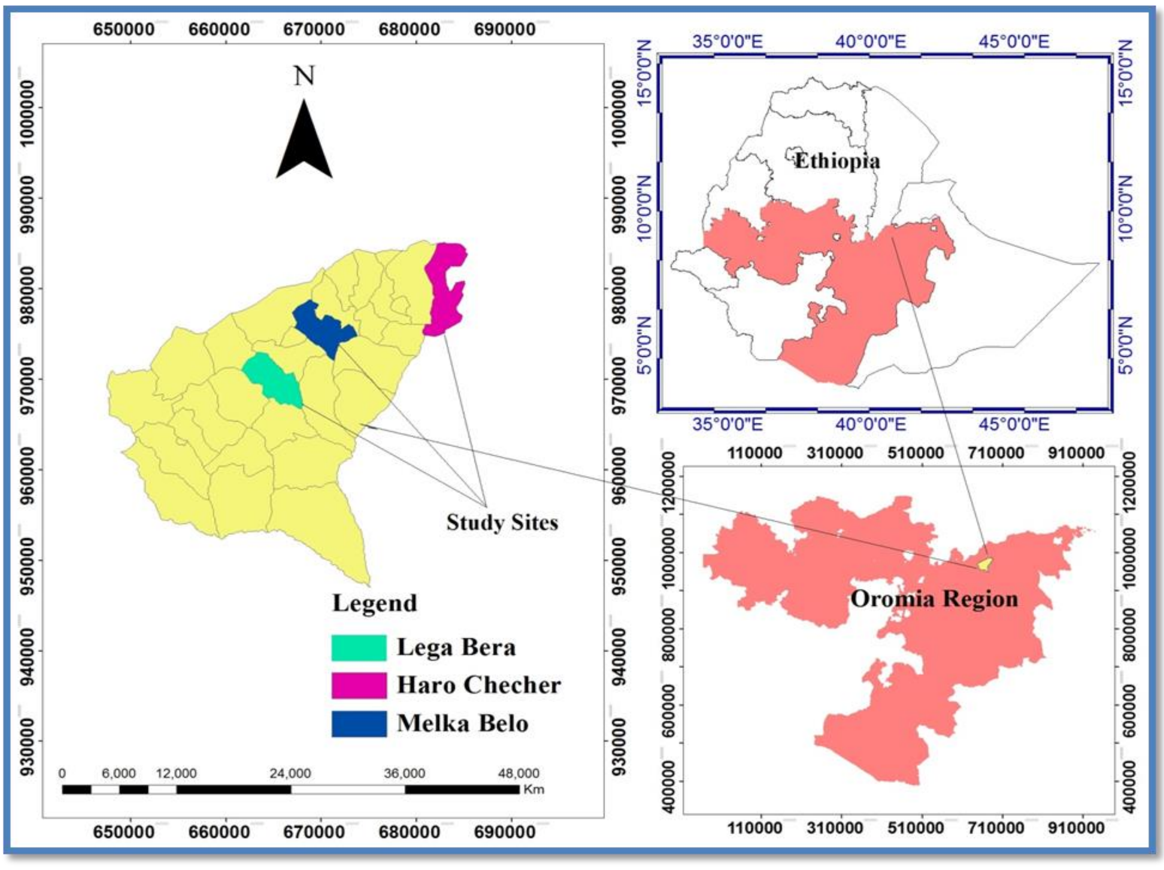

Figure 1. Map of the Study Area

The elevation of the district ranges from 1600 to 2400 m.a.s.l. The district is characterized by plateaus, mountains, hills, plains and valleys. The district is generally classified into three agro ecologies, the lowland, the midland and the high land constituting 5%, 80% and 15% of the total area of the district respectively (HDoANRO, 2014).

Habro district has a mean minimum and mean maximum temperature of 13.4oC and 26.8oC, respectively and receive mean monthly rainfall of (80mm) and mean annual rainfall of 959.7 mm (Figure 2). Rainfall type is bimodal, erratic and uneven in nature with high amount of rainfall occurring during the main rainy season between June to September and the short rainy season stretching from March to June. The highest rainfall is received in August. The higher mean maximum airs temperature is from February to June while the higher mean minimum airs temperature is from April to September.

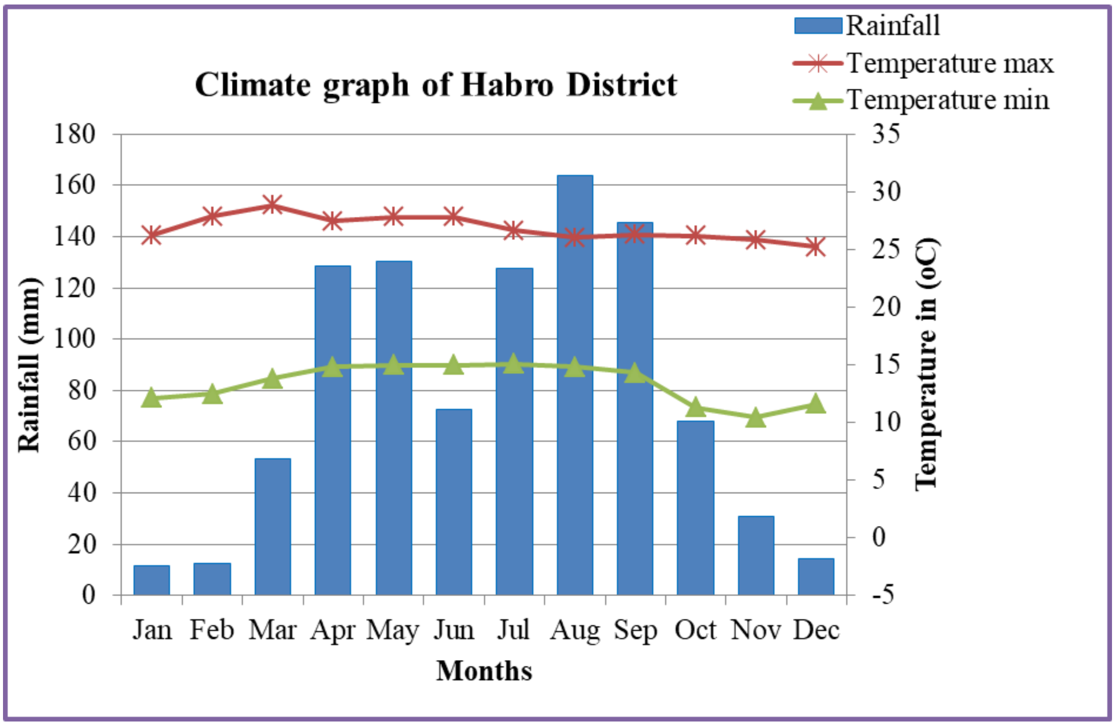

Figure 2. Mean Monthly Rainfall and Mean Minimum and Mean Maximum Monthly Temperatures of Habro District (2001-2016)

Source: Habro District Metrology station.

As per the geological map obtained from Geological Survey of Ethiopia, Habro district consists of (1) Alage Formation which consists of transitional and subalkaline basalts with minor rhyolite and trachyte eruptives, (2) Mormora Group that contains biotite schist, gneiss, marble and graphitic schist, (3) Alghe Group dominated by biotite and hornblende gneisses, granulite and migmatite with minor metasedimentary gneisses, (4) Hamanlei Formation that contains Oxfordian limestone and shale, (5) Adigrat Formation characterized by Triassic-Middle Jurassic sandstone and (6) Urandab Formation (Ju) which consists of Oxfordian-Kmmerdgian marl and shale limestone (Mengesha *et al.*, 1990).

Soil map obtained from the Ministry of Water Resources (MoWR) indicates the presence of five major soil types in Habro District including Vertic Luvisols, Rendzic Leptosols, Haplic Luvisols, Eutric Vertisols and Eutric Leptosols. Of these soil types, Vertic Luvisols occupy a major portion of the area followed by Rendzic Leptosols, Eutric Leptosols, Haplic Luvisols and Eutric Vertisols (Mengesha *et al.*, 1990).

The existing land use system of the Habro district consists of 33.7% cultivated area of which 10.3% is under perennial crops, 22.9% pasture, and 1.7% forest and shrub and bush lands, while the rest is accounted for barren, settlement area and others. Agricultural production and productivity in the district are generally found to be poor mainly because of many natural and anthropogenic adversities, such as higher population density, shortages of farm land, deforestation, soil erosion, and loss of soil fertility Kibebew (2014). Mixed crop-livestock agriculture is a common farming system in the study area. The main crops grown in the area are cereals such as *teff (Eragrostis tef),* maize *(Zea mays),* wheat *(Triticum aestivum*), barley *(Hordeum vulgare*), haricot bean (*Phaseolus vulgaris*) and sorghum (*Sorghum bicolor*) and cash crops such as coffee (*Coffea arabica*), *chat* (*Catha edulis*), pepper (*Capsicum species*) and onion (*Alluim cepa*). The major animals kept in the area are cattle, goats, donkeys, chickens and bees (HDoANRO, 2014). Agricultural land is very limited and as a result, intercropping is a common practice in these areas. Common bean and maize are often intercropped to increase yields and maximize land use. Growing maize and sorghum in chat alleys is also another common practice.

There are no protected forests and wildlife conservation areas in the district. Only a few *Junipperus procera*, *Podocarpus falcatus*, *Olea europaea* subsp. *cuspidata* and plantation forests of *Eucalyptus globulus* are the most important tree species that are found scattered here and there in the district, but many areas are being protected and different indigenous trees species are being planted to regenerate the native vegetation cover of degraded hill slope of the areas (Dereje, 2013).

The district has population of about 214,591, of which 103,472 are females. Young, economically active and old age populations accounted for 45.3%, 52.4% and 2.3%, respectively. An average family size for rural area is 5 persons (HDoANRO, 2014).

2.2 Sampling Method

Purposive sampling was used based on extensive presence of homegarden agroforestry systems in the area. Three sites (here after *Kebele* Administration, KA) were selected. Six villages (two from each KA) were identified based on the extensive presence of the system through preliminary field observation and discussion with natural resource management experts of the district. Thirty-six homegardens (six from each village) were randomly selected from the six selected villages.

2.3 Data Collection

Two indigenous tree species (*Cordia africana* and *Faidherbia albida*) that are grown in the same homegarden were selected for the soil study. *Cordia africana* and *Faidherbia albida* that are nearly identical with diameter at breast height (DBH about 30 - 35 cm), crown diameter (3 - 4 m) and heights

(7 – 10 m) and isolated (that have no other trees/shrubs under/over its canopy) and free from addition of farm weeded material; manure or house wastes and inorganic fertilizers were selected from three homegardens. Homegardens were considered as replications for the soil study. Soil samples were collected from under *Cordia africana* and *Faidherbia albida* tree species at three distances (at half of the canopy radius under the tree, at canopy edge and at three times canopy radius away from the trunk outside the canopy as control. For each selected tree species, one composite sample was collected from each sampling distance in North, South, East and West directions at the depth of 0-20 cm and 20-40 cm. Totally, there were 2*3*3*2 (2 trees *3 distance *2 depth *3 replication = 36) sample units for soil analysis.

2.4 Soil Sample Preparation and Laboratory Analysis

2.4.1 Soil Sample Preparation

Soil samples were air-dried, ground to pass through 2 mm sieve and prepared for the determination of soil physical and chemical properties. The laboratory analyses were done at Haramaya University Soil Laboratory center.

2.4.2 Analysis of Soil Physicochemical Properties

Soil texture: Soil texture was determined by standard hydrometer method as described by Gee and Bauder (1986).

Bulk density: The soil cores for bulk density were oven dried at 105^0C for 24 hours, weighed and bulk density was calculated as: BD (g cm^{-3}) = WOS (g)/ VC (cm^3)

Where: BD = Bulk density, WOS= weight of oven dry soil, VC= volume of core = 98.125 cm^3

Moisture content (MC): A 10-g of soil was dried at 105 ℃ for 24 hours to determine relative moisture content. $MC = \frac{\text{Wet soil (g)} - \text{Dry soil (g)}}{\text{Dry soil (g)}}$

Soil reaction (pH): Soil water suspension was prepared using a soil to water ratio of 1:2.5. The contents allowed equilibrating for 30 minutes and then the pH was recorded by using pH meter with combined glass electrode.

Organic carbon (OC): The organic carbon content of all samples was determined by Walkley and Black method in which the organic matter was oxidized by potassium dichromate in the presence of concentrated H_2SO4. The excess potassium dichromate was back titrated with ferrous ammonium sulphate using diphenylamine indicator (Walkley & Black, 1934).

Total nitrogen: The total nitrogen available in soils was estimated following the Kjeldahl Method (Bremner & Mulvaney, 1982).

Available phosphorous: Available phosphorus was determined by using Olsen extraction (0.5 M $NaHCO_3$) (Olsen & Sommers, 1982).

Available potassium: Available potassium was measured by the Neutral Ammonium Acetate extraction method (Merwin & Peech, 1951). The extracted sample was estimated by flame-photometer.

2.5 Statistical Analysis

The results of the soil samples laboratory analysis were subjected to ANOVA using the General Linear Model (GLM) procedures of SAS (SAS, 2002). Comparison of treatment means was performed using Fisher's Least Significant Difference test (LSD) at $P < 0.05$ probability level.

3. Results and Discussion

3.1 Effects of Trees on Soil Physical Properties

Soil moisture content (MC)

The analysis of variance (ANOVA) for soil MC revealed that soil MC was not significantly affected by tree species, distance from the tree trunk and by soil depth (Table 1). Additionally, the interaction effects of tree species, soil depth and distance from the tree trunk was not statistically significant ($P>0.05$). Similar to this finding, Belay *et al.* (2014) found non-significant difference in soil moisture content (MC) at different distance from the bole of the tree in Southern Ethiopia. Contrary to this Abebe (2006) reported a significant variation in MC that varies with tree species and with geographical location of tree species from the Highland of Harerghe in Ethiopia.

Bulk density (BD)

Comparisons of soil bulk density showed that BD under tree canopy was significantly lower ($P<0.05$) than soil outside the tree canopy while BD in the top soil (0-20cm) was significantly lower than subsoil (20-40 cm). However, the interaction effect of distance from tree trunk and soil depth was not significant ($P>0.05$). The lowest mean value of bulk density was under *Cordia africana* and *Faidherbia albida* shade tree species than out of shade effect. In general, the bulk density of the soil increased significantly with the distance away from the shade tree trunks. The soil BD increased from 1.4 to 1.49 within distance of the tree from under the canopy and to the open area (Table 1). The interaction effect of tree species, distance from tree trunk and soil depth was not significant ($P>0.05$). Alemayehu *et al.* (2017) reported similar result for *Cordia africana* and *Erythrina abyssinica* trees in Arsi Golelcha District, Ethiopia. Similarly, Abebe (2006) reported similar result for *Croton macrostachyus*, *F. albida* and *Cordia africana* trees in the Harerghe highlands of Ethiopia. Enideg (2008) also reported though not significantly higher bulk density outside the canopy of *F. thonningii* as compared to the canopy zone in Ethiopia. Belay *et al.* (2014) also reported lower bulk densities under scattered *Faidherbia albida* and *Croton macrostachyus* in the Umbulo Wacho watershed (Hawassa *Zurya* district), southern Ethiopia. On the contrary to the current study, lower bulk densities were observed under isolated *Croton macrostachyus* (Yeshanew *et al.,* 1999) and *Milletia ferruginea* (Tadesse *et al.,* 2000) trees. Gonfa *et al.* (2015) also reported significant difference in BD along the soil depth with the lower BD at the surface than subsurface under *Hypericum revolutum* tree at Goba District, Oromia, Ethiopia. This decline in bulk density at the surface soil might be due to frequent cultivation and organic matter coverage than at the sub-soil. It is known that incorporation of organic matter in soil improves BD of soils.

Lower soil BD under the tree species' canopies is presumably because of litter addition to the soil. This has resulted from organic matter build up in the soil under the canopies relative to levels in soil outside the canopies. Also, the higher concentration of tree roots near the base of the trees may have had the effect of loosening the soil, thereby reducing soil BD. It is well known that incorporation of organic matter in soil improves physical (aggregate stability, bulk density, water retention) and biological properties (nutrients availability, cation exchange capacity, reduction of toxic elements) of soils. Furthermore, the soil outside the tree canopies dries out more, being exposed to direct solar radiation. This not only accelerates thermally induced soil organic matter decomposition, but results in the shrinking of organic matter and clay colloids, thereby making the soil more compact.

Soil texture

Soil particle size composition was first examined in order to ascertain whether the soils under the canopies of the two tree species are similar to the soils outside their canopies. The results showed that the soil texture was not significantly (P>0.05 Table 1) influenced by tree species, soil depth and horizontal distance from the tree trunk as well as their interaction suggesting that the influence of C*ordia africana* and *Faidherbia albida* on soil texture was minimal. As the size of mineral particles in a soil is not readily subjected to change by management practices, the soil textural class is important and permanent characteristics of a soil and gives a general picture of the soil physical property. Like this Zebene (2003) reported non-significant difference between *C. africana*, *Millettia ferruginea* and *Eucalyptus camaldulensis* tree species in Sidama, Southern Ethiopia. The present study is inconsistent with the results reported in other related study that indicated the clay fraction was higher under the *Faidherbia albida* canopy than open area (Belay *et al.*, 2014). Other studies on *Faidherbia albida* and C*ordia africana* (Kamara & Haque, 1992; Tadesse *et al.*, 2000) were also indicated higher clay fraction under the canopy of these species than under open farmland conditions.

Table 1. Soil Physical Properties as Influenced by Tree Species, Radial Distance and Depth

Tree species	**Soil Physical properties**					
	MC	**BD (g cm^{-3})**	**Soil texture**			
			Sand (%)	**Clay%**	**Silt (%)**	**Textural class**
Faidherbia albida	25.08	1.45	69.63	17.79	12.58	**Sandy loam**
Cordia africana	27.12	1.44	65.38	21.58	13.04	**Sandyclay loam**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	
Distance from the tree trunk						

Ander canopy	28.47	1.4 [b]	66.6	20.21	13.21	**Sandyclay loam**
Outside canopy	23.73	1.49[a]	68.4	19.17	12.42	**Sandy loam**
LSD (0.05)	**NS**	0.081	**NS**	**NS**	**NS**	
Soil depth (cm)						
0-20	25.35	1.39 [b]	67.8	19.33	12.83	**Sandy loam**
20-40	26.85	1.5 [a]	67.2	20.04	12.79	**Sandyclay loam**
LSD (0.05)	**NS**	**0.081**	**NS**	**NS**	**NS**	

*Main factor means within a column followed by the same letter (s) are not significantly different at P< 0.05; MC = Moisture content; BD = Bulk density. LSD= Least significant difference, NS= no significant difference.

3.2 Effects of Trees on Soil Chemical Properties

Soil pH

There was no significant difference (P>0.05) in soil pH across distance from the tree trunk, between tree species and between the two soils depths (Table 2). Similar to this finding Jiregna *et al*. (2005) from their study on trees on farms and their contribution to soil fertility parameters in Badessa, Eastern Ethiopia reported that the presence of isolated *C. africana* and *C. macrostachyus* trees on farms in Badessa area had no significant influence on pH. Similarly Belay *et al.* (2014) also reported no significant pH under the canopy of *F. albida* and *C. macrostachyus* tree species and the open cultivated land in the Umbulo Wacho watershed (Hawassa *Zurya* district), Southern Ethiopia. Tadesse *et al.*, (2000) also carried a research on the impact of *Millettia ferruginea* on soil fertility in southern Ethiopia and found that soil pH values did not show significant horizontal or vertical variations.

Contrary to this finding Kahi *et al.* (2009) reported significant difference (P<0.05) in pH between the soils under and outside the canopies of *Faidherbia albida* and *Croton macrostachyus*, with a lower pH under the canopy areas than in the open cultivated. Hailemariam *et al.* (2010) found that there was lower pH value under canopy (7.96) than outside canopy (8.22) showing a decrease of 3.10% under *Balanites aegyptiaca* at Goblel and Korbebite sites from Northern Ethiopia. According to FAI (1977), soils having pH value in the range 6.50 to 8.70 are considered normal, that do not require treatment, and are optimum for most crops. The soil pH under canopy and outside canopy of *F. albida and C. africana* were (7.04 to 7.14), it can support most agricultural crops as it was within the normal recommended range.

Total nitrogen

Soil N concentration also showed significant variation between among the different distances from tree trunk which was higher under the tree canopy than outside tree canopy (Table). These horizontal variations in total nitrogen might be mainly due to high accumulation of organic matter under the tree canopy and fixation of atmospheric nitrogen by the tree species. Similarly, Alemayehu *et al.* (2017) and Enideg (2008) reported that total average soil nitrogen was higher beneath the canopy of trees than the open area. Enideg (2008) reported an increase of in average total nitrogen under *F. thonningii* canopy by 85% in the surface soil and by 63% in the subsurface soil depths as compared to soils in the open pasture. Yet, Jiregna *et al.* (2005) reported total soil N of surface and subsurface soils was higher under tree canopies by 22 to 26% for *C. africana* and 12 to 17% for *C. macrostachyus* than the corresponding soils away from the tree canopies.

But there was no significant variation between soil depths and between tree species. Also soil N was not affected by the interaction of soil depth, tree species and distance from tree trunk. Similarly Belay *et al.* (2014) reported no significance difference in total N between the depths of 0-20cm and 20-40cm under the canopy of *F. albida* and *C. macrostachyus* tree species and the open cultivated land in the Umbulo Wacho watershed (Hawassa *Zurya* district), Southern Ethiopia.

Soil organic carbon

Organic matter has an important influence on soil physical and chemical characteristics, soil fertility status, plant nutrition and biological activity in the soil (Brady & Weil, 2002). Organic carbon was significantly ($P<0.05$) higher under the canopies of the *F. albida* and *C. africana* tree species than outside tree canopy (Table 2). This variation in organic carbon with distance away from the tree canopy was quite logical as the higher contents of organic carbon under the tree canopies were due to the leaf litter fall and decomposition of dead roots from the tree. Similar with this finding, Abebe (2006) reported that there was gradual and significant decrease in soil organic carbon with increasing distance away from the tree trunk in Harerghe highlands, Ethiopia. Kindu *et al* (2009) also reported that the content of OC showed a decreasing pattern with soil depths and with increasing radius from the closest to the midst and distant positions under *Hagenia abyssinica, Senecio gigas, C. palmensis* and *Dombeya torrid* tree canopies. Belay *et al.* (2014) and Tadesse *et al.* (2000) have also reported a significant decrease in OC away from the tree trunk to the open cultivated land. Organic carbon on the surface soil (0-20cm depth) under the canopy of *F. albida* and *C. africana* was significantly higher than subsurface soil (20-40) (Table 2). This may be due to higher organic matter accumulation on the top soil than subsoil. Similarly, Jiregna (2005), has reported that the surface soil organic C under both *C. macrostachyus* and *C. africana* tree species was significantly higher ($P<0.05$) than that of the subsurface.

Available phosphorus (P)

As compared to the open field available phosphorus was significantly higher ($P<0.05$) under the canopy of *F. albida* and *C. africana* tree species than the open cultivated land (Table 2). It also showed a decreasing trend with increasing distance from the tree base towards outside tree canopy. Horizontal variations in available phosphorus under the tree canopies were also reported by different researchers in Ethiopia and elsewhere. For example, Kamara and Haque (1992) also found higher levels of available phosphorus under *Faidherbia albida* than outside the tree canopy. Furthermore, Kho *et al*. (2001)

reported that the phosphorus availability in the soil was estimated to be almost 30% higher under *Faidherbia albida* tree canopies than the open field. Like the present study, Belay *et al.* (2014) reported available phosphorus was significantly affected ($P<0.05$) by distance from the tree. Similarly, Tadesse *et al.* (2000) observed available soil P concentration in the surface soils that were significantly higher under the trees than in the open fields; and the surface soil values were higher than the subsurface.

But soil P concentration was not affected by the, soil depth and tree species and their interaction effect (Table 2). Like this finding Gonfa *et al.* (2015) also reported not significant of available phosphorus along the soil depth under and outside *Hypericum revolutum* tree at Goba District, Oromia, Ethiopia. Whereas Enideg (2008) reported even though the average P content under canopy was 12 and 5% higher than the open pasture in the surface and subsurface soil depths respectively for the same species; there was no significant difference in P content between the soils under canopy and open pasture, supporting the present investigation. This horizontal variation could be attributed to high organic matter accumulation under the tree canopies than the control. Decomposition of organic matter results in release of phosphorus containing materials which increases the availability of phosphorus (Brady and Weil, 2002).

Available potassium (K)

Mean soil K concentration showed a significant variation with increasing distance from the base of the tree trunk (Table 2). But it did not show significant variation with regarding, soil depth, tree species and their interaction. In support of this study Tadesse *et al.* (2000) reported surface soils that were all significantly higher in soil K concentration under the Millettia trees than in the open fields. Besides, Alemayehu *et al.* (2017), reported that soil K that were significantly ($P<0.05$) affected by distance from the tree effects from Harerghe of Ethiopia for *Cordia africana* and *Erythrina abyssinica* while Enideg (2008) reported similar results under canopy of *F. thonningii* from Gondar, Ethiopia. Contrary to the present study, Gonfa *et al.* (2015) reported no significant difference of available potassium along the horizontal distance from tree trunk to the open field. The higher soil K accumulation under canopy zone as compared to outside canopy zone of the present study could be due to higher accumulation of OM under tree canopies.

Table 2. Soil Chemical Properties as Influenced by Tree Species, Radial Distance and Depth

	pH	%TN	Av.P	Av.K	%OC
Tree species					
Faidherbia albida	7.14	0.06	27.6	0.19	1.33
Cordia africana	7.04	0.07	27.25	0.26	1.22
LSD (0.05)	NS	NS	NS	NS	NS
Distance from the tree					
Ander canopy	7.12	0.08 a	31.68a	0.274 a	1.42 a

Outside canopy	7.06	0.05 b	23.17b	0.175 b	1.13 b
LSD (0.05)	NS	0.016	8.24	0.092	0.28
Soil depth (cm)					
0-20	7.11	0.06	28.32	0.26	1.44 a
20-40	7.07	0.07	26.53	0.19	1.11 b
LSD (0.05)	NS	NS	NS	NS	0.284

* Main factor means within a columns followed by the same letter (s) are not significantly different at $P< 0.05$; %OC= Organic Carbon percent; %TN= Total Nitrogen percent; Av.P= Available phosphorus and Av.K= Available potassium.

4. Summary and Recommendations

Homegarden is one of the most elaborate systems of indigenous agroforestry practice found most often in tropical and sub-tropical areas where subsistence land use systems predominate. It can provide a sound ecological basis for increase crop and animal productivity, more dependable economic returns and greater diversity in social benefits on sustained basis. However, fertility of the soil under this system has not been exhaustively evaluated and properly documented. The present study, was therefore, initiated to assess the influence of two widely grown indigenous tree species (*Cordia africana* and *Faidherbia albida*) components of the system on soil physicochemical properties. The study was carried out on farmers' homegardens at Melka Belo, Haro Chercher and Lega Bera kebeles in Habro district, west Hareghe Zone.

Thirty-six villages (12 from each KA) were identified based on the extensive presence of HAgFS. Two of the widely grown indigenous tree species in the homegarden agroforestry system namely, *Cordia africana* and *Faidherbia albida*, were used to assess their influence on the soil physicochemical properties.

Mean TN, Av. P, Av. K and OC were significantly higher under the tree canopy than outside the canopy area. Bulk density was significantly higher at subsurface (20-40 cm) than surface soil (0-20 cm) while OC was significantly higher at surface soil than subsurface soil. The analysis of revealed that moisture content, soil texture and soil pH were not significantly affected by tree species, distance from the tree trunk and by soil depth. Additionally, the interaction effects of tree species, soil depth and distance from the tree trunk was not statistically significant.

In general the present study demonstrates that *Cordia africana* and *Faidherbia albida* trees that were planted or maintained in HAgFS of Habro district improved soil properties. Hence, retention of *Cordia africana* and *Faidherbia albida* in the farmland and grazing fields as well as its planting in degraded areas within its agro-ecological zone should be widely considered.

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