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Impact of different land uses on soil properties

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Abstract

As we all know that population is increasing all over the world and with the increase in population agriculture land is used intensively and due to intensive use of land soil is degrading like deficiency of nutrient is increasing in numbers, erosion is increasing etc. all these shows that there is risk of sustainability. Changes in land use can significantly affect soil properties. Land use change can simultaneously cause both beneficial and harmful effects, because any change in land use has important consequences for many biological, chemical, and physical processes in soils and so indirectly the environment. Unsuitable land use due to human activities is a widespread problem that leads to land degradation. The conversion of pasture or forest land to cropland leads to a decrease in soil organic matter content, aggregate stability and hydraulic conductivity. The decrease in hydraulic conductivity, aggregate stability is due to decrease in soil organic matter and the decrease in organic matter is due to continues cultivation. Natural vegetative cover plays an important role for the quality of soil and with the change of land use like from forest to agriculture land or agriculture land to industrial land use decrease the soil health.

Keywords: land use, hydraulic conductivity, electric conductivity, heavy metals

Introduction

Land use is one of the main derives of many processes held responsible for environmental change, as it influences basic resources within the landscape, including the soil resources. Land use is defined as the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it. Consequences of land use changes on soil can occur so unmarked that land managers rarely contemplate initiating ameliorative measures. Poorly managed soil can rapidly deteriorate the land, which often, becomes a major threat to rural subsistence in many developing and developed countries. In most developing countries, the economy is primarily based on agricultural production. Thus, sustainable management of the agricultural resources such as soil provides the long-term benefits required for environmental health as well as for economic growth. The knowledge of land uses information can be used to develop solutions not only for natural resource management issues such as remediation or reclamation of disturbed or damaged soils but also for water quality. Many researchers reported that change of land use, implemented locally such as long term cultivation, deforestation, overgrazing and mineral fertilization may lead to erosion and leaching of soil nutrients which in turn adversely affect the physico-chemical properties of the soil (Conant *et al.*, 2003 [7]; Fraterrigo *et al.*, 2005 [10]; Hacisalihoglu, 2007 [13]; Saraswathy *et al.*, 2007). The effects of cropping systems and management practices on soil properties provide essential information for assessing sustainability and environmental impact (Ishaq *et al.*, 2002) [14]. Soils can also take centuries to form because of low organic matter turnover rates and the relatively slow acting effects of leaching. Because of this, it is widely believed that past land-use legacies can affect soil composition and vegetation for extended periods of time (Compton *et al.*, 1998 [6]; Goodale and Aber, 2001 [12]; Eberhardt *et al.*, 2003 [9]). Land use change can simultaneously cause both beneficial and harmful effects, because any change in land use has important consequences for many biological, chemical, and physical processes in soils and so indirectly the environment.

Impact of different land uses on soil pH

Chemeda *et al.* (2017) [5] reported that soil pH was significantly affected ($P \leq 0.05$) by land use. All land use types were clayey but clay loam for forest land. The highest pH = 6.47 and lowest pH = 5.29, were obtained in subsurface of grass land and surface layers of cultivated land, respectively.

Rajwinder Kaur and Bhat ZA (2017) [16] found that soil pH of the surface layer ranged from 7.83 to 8.20 and 7.69 to 7.95 under different land-use systems at Takarla and Mukerian, respectively. Rajput *et al.* (2017) [22] reported thatthe pH of soils irrigated with industrial effluents was not much influenced as compared to that under alternate use of industrial effluent use. Onwudike *et al.* (2016) [20] reported thatSoil pH was higher in forested land use with the sequence forested land > cassava dominated farm land > maize dominated farm land. Muche *et al.* (2015) [18] reported that soils in the natural forest had significantly ($p<0.05$) higher soil pH and lower exchangeable acidity ($p<0.01$) than the other land uses. Chauhan *et al.* (2014) [4] reported that Soil pH was not significantly affected by land use systems. Sahare *et al.* (2014) [24] reported that pH of soil receiving industrial effluents were found to be significantly higher than that of soil not receiving industrial effluents and soil at distance from industry. The pH being ranging from 8.4 to 8.2 mean was found to be 8.06 indicating its alkaline nature while in that of soil not receiving industrial effluents it was ranging from 6.8 to 6.6 and mean was 6.56 and for soil at distance from industry these values were ranging from 6.9 to 6.7, mean was 6.74. Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher pH which is attributed due to the addition of manure than any other land use. Duguma *et al.* (2010) [8] the results showed that pH had significant differences across land uses ($p < 0.05$). Abbasi *et al.* (2005) [2] reported that most of the properties of the 0-15 cm surface level of grass were similar to those observed in the15-/30 cm level in forest. Regression analysis showed a negative correlation of OM with dry bulk density and pH.

Impact of different land uses on soil EC

Rajput *et al.* (2017) [22] reported that the electrical conductivity in industrial effluent-irrigated soils was high. The electrical conductivity in industrial effluent-irrigated soils was high due to salt content of industrial effluent water of domestic origin. However, it was below the threshold limit to cause salinity hazard to the soil. Sahare *et al.* (2014) [24] reported that there was a marked increase in EC of the soil receiving industrial effluents which was ranging from 0.52 to 0.50, mean 0.50 while in soil not receiving industrial effluents and soil at distance from industry its mean was 0.28 and 0.21 which indicates higher amount of salts present in discharges. Abad *et al.* (2014)[1] reported that there was no significant change in EC among studied land use types. Land use systems including were natural forest, pastureland and agriculture. Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher electrical conductivity (EC) which is attributed due to the addition of manure.

Impact of different land uses on soil organic Carbon

Rajput *et al.* (2017) [22] reported that the mean organic carbon content in industrial effluent-irrigated soils was higher and it was 0.99 and 0.91%, alone use of industrial effluent water the organic carbon percent was high which was ascribed to the addition of organic matter through long-term application of industrial effluents. Onwudike *et al.* (2016) [20] reported that Organic carbon was higher in forested land with the sequence forested land > cassava dominated farm land > maize dominated farm land. Muche *et al.* (2015) [18] shows significantly higher ($p<0.01$) organic matter was registered from soil of the natural forest compared to the other land use types. Yeshaneh (2015) [28] reported that soil organic carbon declined exponentially following deforestation and subsequent conversion to cultivated land. The imbalance in soil organic carbon addition from the crops and loss of soil organic carbon have led to the continuous decline of soil organic carbon in the cultivated land soils by 41.6% and 86.5% as compared to the forest and grazing lands, respectively. Sahare *et al.* (2014) [24] reported that the value of organic carbon in soil receiving industrial effluents was found to be from 0.86 to 0.93 Kg ha^{-1} mean 0.9 Kg ha^{-1} while in soil not receiving industrial effluents it was 0.36 to 0.43, mean 0.56 Kg $ha^{-1}$and soil at distance from industry it was 0.30 to 0.38, mean 0.40 Kg ha^{-1}, this increase in the amount of organic carbon is found to be beneficial for soil health. It is being also reported that increase in organic carbon facilitates the accumulation of available nutrients and metals in the soil. Patil *et al.* (2014) [21] found that recently converted forestland to paddy (i.e. land under paddy for >10 years) has resulted in highest loss in soil organic carbon (SOC) followed by soils growing paddy for more than 50 and 100 years. Estimated soil carbon stock at 0-30 cm depth varied between 13.5 to 50.2 tonns ha^{-1} in Gondia forest, 8.2 to 9.5 tonns ha^{-1} in 10 years paddy cultivated area, 12.3 to 12.6 tonns ha^{-1} in 50 years paddy cultivated area and 11.6 to 13.3 tonns ha^{-1} in 100 years paddy cultivated area which is being lowest in 10 year paddy cultivated area and highest in forest.

Impact of different land uses on soil nitrogen content

Rajput *et al.* (2017) [22] reported that he industrial effluent-irrigated soils recorded higher total N indicating its significant addition through industrial effluent suggesting use of alternate industrial effluent with well water as a low grade cheap fertilizer in agriculture which can markedly reduce the cost due to substitution of chemical fertilizers. The alternate industrial effluent-irrigation with well water resulted in an increase of N availability of about 1.01 times more compared to alone use of industrial effluent water. Chemeda *et al.* (2017) [5] reported that soil total nitrogen, available was significantly affected ($P \leq 0.05$) by land use. All land use types were clayey but clay loam for forest land. Mohammed (2017) reported that cultivated land with application of farm yard manure (FYM) at the homestead area had higher organic matter (OM), total and mineral nitrogen than the native vegetation land. Rajwinder Kaur and Bhat ZA (2017) [16] found that available N at Takarla and Mukerian varied from 37.78 to 234.78 and 40.48 to 264.47 kg ha^{-1}. Available N was significantly higher in forestry compared with agro-forestry and grassland. Onwudike *et al.* (2016) [20] reported that total nitrogen was higher in forested land with the sequence forested land > cassava dominated farm land > maize dominated farm land. Muche *et al.* (2015) [18] shows significantly higher ($p<0.01$) total nitrogen was also registered from soil of the natural forest compared to the other land use types. Chauhan *et al.* (2014) [4] reported that total soil nitrogen was significantly affected by land use systems in western Chitwan condition. Total soil nitrogen was significantly higher from pasture land (0.23 %) and the lowest were from farmer's field (0.08 %). Duguma *et al.* (2010) [8] the results showed that total N had significant differences across land uses ($p < 0.05$) while total N and Mg^{2+} concentration also showed significant difference across depth ($p < 0.05$). The soil total N followed a trend of homesteads > small-scale woodlots > pasturelands > cereal farms.

Impact of different land uses on soil available phosphorus

Rajput *et al.* (2017) [22] reported that the industrial effluent-irrigated soils recorded higher total P indicating its significant addition through industrial effluent suggesting use of alternate industrial effluent with well water as a low grade cheap fertilizer in agriculture which can markedly reduce the cost due to substitution of chemical fertilizers. The alternate industrial effluent-irrigation with well water resulted in an increase of P availability of about 1.03 times more compared to alone use of industrial effluent water. Chemeda *et al.* (2017) [5] reported that available P, exchangeable Mg and Na were significantly affected ($P \leq 0.05$) by land use. The higher 16.00mg/kg available P, and CEC (32.80 cmol(+) kg^{-1}) were recorded in surface layer of cultivated land than in subsurface. Mohammed (2017) reported that cultivated land with application of farm yard manure (FYM) at the homestead area had higher available phosphorus (AvP), cation exchange capacity (CEC), exchangeable cations, and micronutrients than the native vegetation land. Rajwinder Kaur and Bhat ZA (2017) [16] found that available P at Takarla and Mukerian varied from 3.81 to 21.44 and 3.19 to 18.56 kg ha^{-1}. Available P was significantly higher in cropland compared with agro-forestry and grassland. Onwudike *et al.* (2016) [20] reported that available phosphorus was higher in forested land with the sequence forested land > cassava dominated farm land > maize dominated farm land. Muche *et al.* (2015) [18] reported that there was significant ($p<0.05$) difference in available phosphorus among the different land use types. Chauhan*et al.* (2014) [4] reported that available soil phosphorous content was significantly higher from cereal based upland (448.3 kg ha^{-1}) and it was the lowest from forest land (13.0 kg ha^{-1}). Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher available P which is attributed due to the addition of manure. Somasundaram *et al.* (2013) [26] reported that available potassium (Av-P) and cation exchange capacity (CEC) were higher in natural vegetation compared to other land cover. Therefore, trees along with grasses should be encouraged in ravenous land of Chambal region to maintain soil nutrient status for ecological sustainability in line with the changing landscape in the area Yihenew G. Selassie and Getachew Ayanna (2013) [25] found that the highest and lowest available P contents were recorded under natural forest and grassland, respectively. From the results of the study it was possible to conclude that conversion of forest lands to cultivated and grasslands had detrimental effects on the soil physico-chemical properties under subsistance farming systems of the study area.

Impact of different land uses on soil available potassium

Chemeda *et al.* (2017) [5] reported that exchangeable Mg, K and Na were significantly affected ($P \leq 0.05$) by land use. All land use types were clayey but clay loam for forest land. Rajwinder Kaur and Bhat ZA (2017) [16] found that available K at Takarla and Mukerian varied from 15.83 to 286.67 and 6.66 to 149.17 kg ha^{-1}. Available K was significantly higher in cropland compared with agro-forestry and grassland. Rajput *et al.* (2017) [22] reported that the industrial effluent-irrigated soils recorded higher total K indicating its significant addition through industrial effluent suggesting use of alternate industrial effluent with well water as a low grade cheap fertilizer in agriculture which can markedly reduce the cost due to substitution of chemical fertilizers. The alternate industrial effluent-irrigation with well water resulted in an increase of K availability of about 1.17 times more compared to alone use of industrial effluent water. Muche *et al.* (2015) [18] shows significantly higher ($p<0.01$) available potassium was registered from soil of the natural forest compared to the other land use types. Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher available P which is attributed due to the addition of manure. Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher exchangeable K which is attributed due to the addition of manure, whereas maize fields had lowest average K and Mg, cation exchange capacity (CEC), percentage of base saturation. Duguma *et al.* (2010)[8] the results showed exchangeable K^+ and exchangeable Na^+ had significant differences across land uses ($p < 0.05$) while only organic C, total N and Mg^{2+} concentration showed significant difference across depth ($p < 0.05$). The soil organic C, total N, exchangeable K^+ followed a trend of homesteads > small scale woodlots > pasturelands > cereal farms.

Impact of different land uses on soil micronutrients

Onwudike *et al.* (2017) [19] showed that in soil organic matter, total nitrogen and exchangeable bases among the land use types. The highest concentration of Cu (0.21 mg kg^{-1}) was recorded in PMPF while the highest concentration of Zn (17.95 mg kg^{-1}) was recorded in PPM. Fe concentration was highest (77.68 mg kg^{-1}) in PMPF while the highest Mn concentration (6.14 mg kg^{-1}) was recorded in PPM. Mohammed (2017) reported that cultivated land with application of farm yard manure (FYM) at the homestead area had higher micronutrients than the native vegetation land. On the other hand, most of these soil physical and chemical properties found to be declined in the research farm, fertilized and unfertilized cultivated lands. Rajput *et al.* (2017) [22] reported that the industrial effluent-irrigated soils recorded higher total Fe, Mn, Zn Cu, and Ni indicating their significant addition through industrial effluent suggesting use of alternate industrial effluent with well water as a low grade cheap fertilizer in agriculture which can markedly reduce the cost due to substitution of chemical fertilizers. Onwudike *et al.* (2016) [20] reported that forested land recorded the highest concentrations of Mn (3.13 mg kg^{-1}), Zn (1.58 mg kg^{-1}) and Bo (0.78 mg kg^{-1}) in this sequence forested land > cassava dominated farm land> maize dominated farm land. Yeshaneh (2015) [28] study indicated that the direction and magnitude of changes in soil attributes under land uses reflect the long-term impact of human being on the landscape as the consequences of increasing human as well as livestock populations. All the above values were higher than the critical values of 4.2, 0.2, 0.5 and 1.0 mg kg^{-1} for Fe, Cu, Zn and Mn, respectively. Also the test analysis showed that the content of Fe, Cu, Zn and Mn were significantly higher ($P < 0.05$) in grazing soils than in forest and cultivated soils. Kiflu *et al.* (2013) [17] reported that Enset (*Ensete Ventricosum*) fields had higher pH Zn which is attributed due to the addition of manure, whereas maize fields had lowest average Zn and Mg. Abbasi *et al.* (2005) [2] reported that Arable exhibited lowest nutrient status and poorest physical conditions, indicating a degrading effect of arable cultivation practices on soil.

Impact of different land uses on soil heavy metal content

Ghorbani *et al.* (2016) [11] found that heavy metals accumulations in soil samples of the industrial land uses were higher than agricultural and natural land uses. There was significant correlation among the soils heavy metals (more than 30% for most samples) and also between soil heavy metals and organic carbon content in different types of land uses (average of 40%). Chaudhary *et al.* (2016) [3] reported that the average concentrations of Zn (25 ± 6 mg kg^{-1}) and Pb (33 ± 6 mg kg^{-1}) leached in EDTA were higher than that of in acetic acid (Zn: 22 ± 6 mg kg^{-1}; Pb: 24 ± 5 mg kg^{-1}) whereas

Ni (24 ± 6 mg kg^{-1}) leached more in acetic acid compared to EDTA (Ni: 21 ±4 mg kg^{-1}). Zheng Rong *et al.* (2016) [23] showed that soil properties (salinity, total organic carbon and grain-size distribution) and the concentrations of heavy metals and As in the soils differed under the different land use types. The conversion of wetland to forest had caused obvious losses of all the measured heavy metals. In paddy field and dryland with frequent cultivation, the concentrations of Cr, Zn, Cu, Ni and As were higher when compared to forest land which was disturbed rarely by human activities. Speciation analysis showed that Cr, Zn, Cu, Ni and As were predominated by the immobile residual fraction, while Pb and Cd showed relatively higher mobility. Karim *et al.* (2014) [15] for temporal investigations, the samples were collected in both pre-monsoon (PRM) and post-monsoon (POM) conditions. The results revealed that the mean concentrations were in the order Fe-Zn > Pb > Cu > Cr, in both the seasons. Increase in concentration of Pb and Fe, after rain, seems to be the result of sinking of aerial metal and relocation by flood runoffs. Memet Varol and Bulent Şen (2011) [27] reported that metal concentrations in sediment samples from the first three sites situated downstream of Ergani Copper Mine Plant were much higher than those at other sites. There was a significant decrease in the concentrations of heavy metals in sediment from the last site downstream of the Dicle Dam. The sediments of sites downstream of the copper mine plant showed significant enrichment with Cd, Co, Cu, Pb and Zn, indicating metallic discharges from the Ergani Copper Mine Plant.The sediments of sites downstream of the copper mine plant showed significant enrichment with Cd, Co, Cu, Pb and Zn, indicating metallic discharges from the Ergani Copper Mine Plant.

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