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Research Article

EFFECT OF LAND-USE/COVER CHANGE ON PHYSICAL AND CHEMICAL SOIL PROPERTIES WITHIN AN AGRICULTURAL ECOSYSTEM OF AJLOUN AREA-JORDAN

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ABSTRACT

This study is aimed to determine the effect of land-use/cover changes on spatial variability of selected surface soil (0-25 cm) and subsurface soil (25-30 cm) properties in Ajloun, which has sub-humid climate and adjacent agro-ecosystem of Northern Jordan. Disturbed and undisturbed soil samples were collected from two major land-use/cover categories: natural forest, and cultivated land. The soil in natural forest was used as a reference to assess extent of changes in soil properties. A one way analysis of variance and Pearson's correlation co-efficient were used to test the mean differences of the soil chemical and physical properties and to determine their degree of association. The results showed that the land-use/cover changes significantly affected a number of soil physical and chemical properties. The sand, bulk density, electrical conductivity, cation exchange capacity, organic matter, nitrogen and exchangeable potassium contents showed significant variations between the natural forest and the other land-use/cover types ($p<0.05$). Whereas the soil pH, electrical conductivity, cation exchange capacity, organic matter, nitrogen, available phosphorus and exchangeable potassium contents showed significant variations between the different soil depth, surface soil (0-25 cm. and 25-50 cm) of soil depth ($p<0.05$).The distribution of particle size classes revealed an increase in clay of cultivated land decrease of sand and silt contents following the conversion of natural forest to cultivated land. It is agree that shifting cultivation natural forest land can produce unfavorable changes in the soil properties and accelerate process of land degradation.

Keywords: *Shifting Cultivation, Land-Use/Cover Change, Soil Properties, Ajloun Northern Jordan*

INTRODUCTION

The conversion of Forest Reserve to other land uses in recent times has caused many complex changes in the forest ecosystem whose impact raises diverse ecological problems (Henrik *et al.,* 2010; Awotoye *et al.,* 2013). The conversion of tropical forests into land for agriculture or plantation might have negative impacts on soil properties and the carbon budget to explore history of land management, and diversely affect soil Carbon (C) and Nitrogen (N) levels (Michel *et al.,* 2010). Conversion of forest to cultivated land causes an appreciable change in organic matter content resulted in nutrient imbalances, and reduction in water-holding capacity, iron, aluminum, nitrogen, calcium, magnesium, potassium, phosphorus, and cation exchange capacity (Jha *et al.,* 1976; Brown and Lugo, 1990).

The surface soil plays a significant role in ecosystem function both as source and as a sink of nutrients after slash and burn treatment by fire. Burning dried vegetation resulted in higher concentration of Ca, Mg, and potassium in topsoil layer as compared to mechanical treatment (Alegre *et al.,* 1988; Marafa and Chau, 1999; Seubert *et al.,* 1977). Litter-fall is a major contributor to soil organic matter in the forest ecosystem (Chen *et al.,* 2000).

Forest litters and soil microbes constitute an important resource that makes forests fertile for arable farming in the tropics (Akachukwu, 2006) and the fertility status of a soil is acknowledged to be a reflection of the chemical and physical soil properties (Michel *et al.,* 2010).

Soil physical and chemical properties have been proposed as suitable indicators for assessing the effect of land-use changes and management (Janzen *et al.,* 1992; Bremer *et al.,* 1994; Alvarez and Alvarez, 2000). This approach has been used extensively by several authors to monitor land-cover and land-use change patterns (Schroth *et al.,* 2002; Airiohuodion, 2003; Faboya, 2010; Michel *et al.,* 2010). Similarly, a lot of studies have been carried out on the soil physiochemical and biological changes (Schroth *et al*., 2002; Tchienkoua and Zech, 2004; Walker and Desanker, 2004) over the humid tropical regions of the world.

The soil in order to supply the main needs to trees has to be a mixture of air, water, decaying organic and inorganic material and billions of living organisms within the surrounding ecosystem (Barreto *et al.*, 2000). Land use changes such as forest clearing, cultivation and pasture introduction are known to result in changes in soil chemical, physical and biological properties (Houghton *et al.,* 1999), these changes vary with land cover and land management (Baskin and Binkley, 1998; Celik, 2005).

Land use change and subsequent tillage practices resulted in significant decreases in organic matter, total porosity, total nitrogen and soil aggregates stability. There was also a significant change in bulk density among cultivate, pasture and natural forest soils. Depending upon the increasing in bulk density and disruption of pores by cultivation, total porosity decreased accordingly. Long term continuous cultivation of the natural forest soils resulted in change in soils both in physical and chemical characteristics. In addition, it was found that changes of land use and land cover associated with organic matter content can alter the soil enzyme activities within the soil profile (Kizilkaya and Orhan, 2010).

Soil physical properties: High change of soil physical properties is related to practice clearing methods. Traditional slash and burn clearing method, commonly used in shifting cultivation, is often replaced by various mechanical land clearing methods such as tree pusher, bulldozing with a straight blade, bulldozing with a shear blade, and straight blade, followed by continuous cultivation (Alegre *et al.,* 1988; Alegre and Cassel, 1996; Hulugalle *et al.,* 1984). Forest clearing and cultivation may cause compaction. Mechanical land clearing methods have caused soil compaction because of the action of the machine tracks including back and forth movement in the process of stamp removal, the removal of root mat, a highly porous material, and the exposure of bare soil to the impact of high intensity rains (Hulugalle *et al.,* 1984; Seubert *et al.,* 1977; Vander, 1974; Veldkamp, 1994). The degree of compaction most important adverse feature depends on the pressure exerted at the soil surface, vibrations in the soil, and the resistance of the soil to compaction. The resistance of the soil to compaction mainly depends on soil type and moisture content, forest soil with higher content of organic matter are greater resistance to compaction as compare to other field crops or rangeland (Guerreo *et al.*, 1995; Vander, 1974).

The effect of compaction degrades soil physical properties which lead to decreased total porosity, saturated hydraulic conductivity, infiltration rate, cumulative infiltration proportion of macropores and available water capacity (Seubert *et al.,* 1977; Vander, 1974) by decreasing root penetration, water infiltration rate, gas exchange and an increase in bulk density, although bulk density is often related directly to root growth and crop yield (Sanchez, 1982; Seubert *et al.,* 1977; Vander, 1974).

Conversion of forestland to cultivated land seems to reduce clay and increase sand contents (Brown and Lugo, 1990). Lavkulich and Rowles (1971); Awotoye *et al.,* (2013) indicate that the clay content increased in cultivated in Ap and B horizons and attributed this change to the grinding effect of cultivation on the surface horizons. Beare *et al.,* (1994) found that no tillage practices can improve and increase the soil aggregation stability of macro-aggregates and change the distribution of soil organic matter level more than conventional tillage. The cropped soil and under grass soil had similar physical properties, while the forest soils were considerably different (Guerreo *et al.,* 1995; Gol and Dengiz, 2008). Alteration in soil physical properties attributed to mechanical methods of land clearing caused the reflection of soil bulk density, and total porosity (Hulugalle *et al.,* 1984; Seubert *et al.,* 1977; Vander 1974; Gol and Dengiz, 2008). Alegre *et al.,* (1986) found that compaction increased bulk density of the surface soil for all clearing methods (slash and burning, bulldozer with straight blade, bulldozer with shear blade). Which the subsoil bulk density increased only by bulldozer clearing methods. Bulk density of both burnt and bulldozed soil was greater than that of the virgin soil but in bulldozed soil bulk density was higher than that of burnt. It was noticed that bulk density in the surface soil was less than that of subsoil (Dias and Nortcliff, 1985). Moreover, Robert (1959) found that bulk density of lightly burned soils was less than that of the unburned one.

Land use plays an important role on the infiltration process, Vertisols of agricultural lands had lower infiltration rate than Vertisols forests (Navar and Synnott, 2000). Among soil physical properties negatives affects by mechanical methods of land clearing is infiltration rate, cumulative infiltration and saturated hydraulic conductivity (Alegre *et al.*, 1986; Alegre and Cassel, 1996; Hulugalle *et al.*, 1984; Seubert *et al.*, 1977; Vander, 1974). The infiltration rate was reduced for soil cleared by slash as compared to that cleared by straight blade and shear blade, but the highest infiltration rate was found for the soil cleared by chisel plowing and disking for newly cleared land. Infiltration rate was reduced due to soil compaction during forest harvesting generally through soil compaction by reduces macropore space, which reduces infiltration and increases the potential for surface erosion (Startsev and McNabb, 2000).

Pore space was reduction due to mechanical clearing methods and decreased total porosity (Seubert *et al.*, 1977; Vander, 1974; Simmons and Pope, 1987; Robert, 1959). Hulugalle *et al.*, (1984) found that mechanical clearing increased proportion of medium-size pores, and decreased total porosity and proportion of macropores.

Forest plays a major role in maintaining biodiversity and in providing environmental services such as improving water flow and reducing soil erosion. Shifting cultivation destroys ecological balance and results in substantial soil erosion (Lianzela, 1997). The effects of erosion on the soil surface clearly illustrate the soil degradation (Olson, 1981).

Chemical Properties of Soil: In soils covered with forest much of the soil nutrient is stored in the trees, whose canopy protects the soil against the impact of the heavy rainfall and other weather elements in a delicate ecological relationship. Therefore, exposure of the soils by deforestation and bush burning leads to impaired nutrient status of the soil (Owusu-Bennoah, 1997). Seubert *et al.*, (1977) found that the slash and burn treatment provided superior chemical properties and better pasture growth than mechanized land clearing treatments. Effects of forest harvesting on water and nutrient cycling and losses vary with local conditions such as type of vegetation, nature of cutting; site characteristics, degree of soil variation with tree species, time of cutting, local precipitation and temperature pattern; topography, soil characteristics, and the method of cutting and timber removal (Marks and Bormann, 1972; McColl, 1978).

Forested soils maintained high levels of organic matter comparable to soil from the continuously cultivated fields, which exhibited lower than those in soil kept under prolonged fallow (Fuller and Anderson, 1993; Funakawa *et al.*, 1997; Sanchez *et al.*, 1983). Litter-fall is a major contributor to soil organic matter in the forest ecosystem (Chen *et al.*, 2000). Conversion of forest to cultivated land causes an appreciable change in organic matter content resulted in nutrient imbalances, and reduction in water-holding capacity, iron, aluminum, nitrogen, calcium, magnesium, potassium, phosphorus, and cation exchange capacity (Jha *et al.*, 1976; Brown and Lugo, 1990).

The reduction in organic matter content and mean thickness of the A horizons were found to be caused by burning (Phillips *et al.*, 2000). The reduction in the soil pH and plant nutrients with continuous cultivation is caused by increased losses associated with lowering of the organic matter in the soils. Accelerated organic matter decomposition was expected immediately after harvest because of increase in soil temperature, aeration, and substrate availability associated with the imposed treatments (McLaughlin *et al.*, 1996).

Soil mineral analysis indicated that organic matter might be translocate into upper mineral horizon following the post-harvest initiation of surface decomposition. Initially calcium, magnesium and potassium are released from surface organic matter by mineralization following the opening of the stand and a reduction in plant uptake (Snyder and Harter, 1985).

Seubert *et al.*, (1977) concluded that soil pH values increased slight after clearing and remained stable afterwards in both burned and bulldozed plots at all depths. Topsoil pH was raised after burning and remained relatively constant for next 8 years. This was attributed to the root mat remaining in the burned plots which have released hydrogen ion and attenuated the pH increase. Whereas in the bulldozed plots, the root mat was scrapped off. Ashes from the burnt increased soil pH, by ignition of organic residues at the soil surface (Forgeard and Frenot, 1996; Sanchez *et al.*, 1983). Clearing and burning of forest cause several changes in soil properties, which generally occur within the first year. Among those changes, which exhibits rapid increase the pH of soil after burning (McGrath *et al.*, 2001; Sarma *et al.*, 1995; Slaats *et al.*, 1998; Shukla and Agrawal, 1984). It was clearly indicated that soil pH had increased, and remained elevated, for at least 5 years after pasture establishment (McGrath *et al.*, 2001; Moraes *et al.*, 1996; Jin *et al.*, 2000; Sarma *et al.*, 1995). The reduction in the soil pH with continuous cultivation is caused by increased losses associated with lowered organic matter in the soils. There is a possibility of an extension of the zone of depletion into lower soil horizons (Owusu-Bennoah, 1997).

Soil cation exchange capacity (CEC) increased by following conversion of forest to pasture or field crops (McGrath *et al.*, 2001). Blake *et al.*, (1999) found that the CEC of the soil under woodland increased with the depth, because the clay content increased. Also, they found that the CEC of the surface soil decreased by 47% during the last 100 years after forest conversion. However CEC appears to rise and remain elevated in pasture soils following conversion from forest (McGrath *et al.*, 2001). In some pine forest, the CEC value decreases with the depth. The percentage of base saturation is also higher in the surface soils as compared to subsurface layers, possibly, because of plant recycling (Nair and Chamuah, 1988). In general, the results showed that the decrease in the CEC is reflected in the decrease of the pH and organic matter contents in the soils (Owusu-Bennoah, 1997). When forest was cleared for cultivation, there was a slight decrease in the exchange capacity at all soil depth (Watters, 1971).

Nitrogen is one of the key elements in ecosystems where shifting cultivation is practiced. The decline in soil fertility in the soil could be controlled through the application of suitable fertilizers and through growing crops such as legumes in suitable rotations (Owusu-Bennoah, 1997; Sanchez, 1982; Sanchez *et al.*, 1983; Yitbarek, 2013). Several factors contribute to the loss of N in shifting cultivation fields. When forest is cleared and burned, large losses of nitrogen occur upon burning by volatilization and reduction of organic matter (Gimeno-Garcia *et al.*, 2000; Gol and Dengiz, 2008).

Following clearing and crop harvests topsoil remains exposed for climatic conditions that allow for an increase in soil temperature and rates of microbial decomposition, and the lack of vegetation reduces plant uptake of mineralized N, which is then more vulnerable to losses by leaching (Alegre *et al.*, 1988). Continuous cropping of the soils causes a reduction in the total N attributed to decline of organic carbon (Owusu-Bennoah, 1997; Vazquez *et al.*, 1991). Nitrification may develop in surface horizons (Krause and Ramlal, 1987). Sanchez (1982) found that the rate of total-N decomposition in the arable layer is high during the first two years after burning, but reaches equilibrium with continues cultivation. Soil N declined following forest to pasture conversion (Juo and Manu, 1996). McColl (1978) indicated that concentration of NO3 in the soil solutions decreased following clear-cutting compared to those in the forest. Factors contributing to these results were the higher exchange capacity of the clay-loam soil, the short rainfall season, the removal of slash and some litter, and lack of ion inputs from fall in clear-cut. The proportion of NO3, decreased in soil solution in clear-cut. Also the researcher found that ion concentration decreased with soil depth in the uncut forest, but increased with depth in the clear-cut. Also, indicated total amount of ions in the solution in lower portion of the profile were greater in the clear-cut due to increased quality of soil water and subsequent increased leaching following clear cutting, rather than to increased ion concentrations of the soil solution. McGrath *et al.*, (2001) found that soil concentrations of total nitrogen were higher in topsoil than in lower depths. Also they indicated that soil N concentrations were strongly related to clay content across all land uses. Researchers also indicated that soil N maintenance and/or accumulation following forest conversion was greater in pastures than in other two land-uses of annual cropping and secondary forest fallow. In general, mineral soil had more N than forest floor, and soil N decreased after harvesting. Nitrogen losses occurred in the top one meter of soil. This was attributed to mixing of forest floor with the surface mineral soil by the full tree skidding and the subsequent leaching of mineralised N (Mroz *et al.*, 1985).

Phosphorus is considered a limiting nutrient for bilolgical activity in the forest area. The tradition slash and burning method produced more favorable change in supply of available soil phosphorus several folds more than bulldozing. This was attributed to higher composition of ash (Alegre *et al.*, 1988; Awotoye *et al.*, 2013; Sanchez *et al.*, 1983; Sarma *et al.*, 1995; Seubert *et al.*, 1977; Slaats *et al.*, 1998). Slash burning resulted in large transformations of un-available phosphorus in soil into mineral forms readily available to plants. At dry forest site, soil heating had a much higher influence on soil phosphorus availability than inputs of ash (Giardina *et al.*, 2000). Gimeno-Garcia *et al.*, (2000) found that available phosphorus concentration increased markedly as a result of the fire, especially under the most intense fire. Krause and Ramlal (1987) indicated that rasin-extractable phosphorus was about 2.5 times higher for clear-cut area compared to the forest area. This may also be attributed to increased organic matter decomposition and P release at increased temperature. Shortly after forest conversion to cultivated land, readily extractable inorganic phosphorus concentrations generally was raised in pasture and in soils cultivated with field crops (Awotoye *et al.*, 2013; Juo and Manu, 1996; McGrath *et al.*, 2001; Garcia-Montiel *et al.*, 2000). Available phosphorus in the top soil increased after few years of continuous cultivation. During cropping, the total amount of available phosphorus in the soil was reduced; this was attributed crop take and that phosphorus remains become insoluble (Shukla and Agrawal, 1984). The loss of total phosphorus is probably because it was not replaced naturally (Vazquez *et al.*, 1991). Sarma *et al.*, (1995) found that available phosphorus of the soil was depleted after successive 3 years of cropping. Cultivation largely decreased the phosphorus sorption capacity of soils, and those reduced phosphorus availability to plants. Cultivation with annual crops primarily decreased the inorganic phosphorus reserves in the topsoil and the organic phosphorus. Long-term cultivation reduced labile inorganic and organic phosphorus fraction, while the portion of more stable organic phosphorus was increased (Vazquez *et al.*, 1991). Holscher *et al.*, (1996) strongly recommended that slash burning be abandoned in order to keep the nutrients in the ecosystem. Jin *et al.*, (2000) indicated that there was a trend of increasing phosphorus retention capacity with shifting from forest to pasture cover. Moreover, soil inorganic phosphorus declined following forest-to-pasture conversion (Juo and Manu, 1996; Jin *et al.*, 2000).

McGrath *et al.*, (2001) found that soil concentrations and contents of total inorganic phosphorus declined following forest-to-pasture conversion. Farther mores, they indicated that soil concentrations of total inorganic phosphorus increased in secondary forests with time since abandonment from agricultural activities. Concentrations of extractable soil inorganic phosphorus were equally low in both forest and pastures of all age classes, which demonstrated that post-burning pulses in soil inorganic phosphorus concentration following a slash-and-burn decreased rapidly after forest-to-pasture conversion, perhaps due to accumulation in organic phosphorus fractions. They also reported that soil concentrations of total extractable inorganic phosphorus were higher in samples taken from the top 5 cm than in those sampled to lower depths. The proportion of organic phosphorus increased by nearly a third, while the occluded pool declined. The authors hypothesized that a decline in the occluded pool in aging pastures was due to a larger competitive ability of pasture grasses to "access" this fraction and recycles phosphorus through the organic pool. Marks and Bormann (1972) The extent of nutrient loss from forest clear-cutting varied according to type of vegetation, nature of cutting, site characteristics (slope, drainage, and so forth), and soil characteristics. Farther mores, they indicate that following clear cutting, the growth and development of dense stands of successional species such as pin cherry caused extremely rapid growth. Such growth attributed to minimum nutrient losses from the ecosystem. McGrath *et al.*, (2001) reported that extractable soil inorganic phosphorus concentrations in soils from both secondary forest and shifting cultivation fields, although diagnostically low, were significantly higher than those found in both pasture and primary forest. The concentration and weight of soluble phosphorus in the soil and forest floor prior to harvest generally increased with site quality. The effect of harvesting on soluble soil phosphorus was highly variable (Mroz *et al.*, 1985). Moreover, the effect of vegetation type and management were more reflected by the available phosphorus.

Effects of forest harvesting on nutrient cycling vary with tree species, time of cutting, soil characteristics, method of cutting and timber removal (Huntington *et al.*, 1988; McColl, 1978; Pregitzer *et al.*, 1983). Mroz *et al.*, (1985) and Yitbarek (2013) reported that the soil nutrient capital was greater as site quality increased. Ca and Mg quantities in the forest floor before harvest were higher with increasing site quality (Likens *et al.*, 1969). The substantial increases in soil cation concentrations remain elevated for up to a decade or more following the slash and burn conversion of forest to pastures, field crops, and agroforests (Sanchez *et al.*, 1983; Alegre *et al.*, 1988; Moraes *et al.*, 1996; McGrath *et al.*, 2001). The surface soil plays a significant role in ecosystem function both as source and as a sink of nutrients after slash and burn treatment by fire. Burning dried vegetation resulted in higher concentration of Ca, Mg, and potassium in topsoil layer as compared to mechanical treatment (Alegre *et al.*, 1988; Marafa and Chau, 1999; Seubert *et al.*, 1977). The basic cations in the ash gave marked increases in exchangeable Ca, Mg, and potassium level after burning. Potassium is highly mobile, and has been leached, probably both by mechanical down wash and by ash derived particles (Stromgaard, 1991). Rates of exchangeable potassium, and Ca sorption were significantly increased on clear-cut area as compared to forested area. K enhanced ion mobility is considered the principal factor responsible for higher sorption rate in the clear-cut area (Krause and Ramlal, 1987). Exchangeable Ca concentrations increased and remained elevated following the slash-and-burn conversion of forests to pastures or crops (McGrath *et al.*, 2001). When forest was cleared for cultivation, mean values of exchangeable Ca, Mg, K, were significantly higher in cultivated plot than in the plot with natural vegetation (Paz-Gonzalez and Taboada, 2000; Watters, 1971). A large influx of Ca, Mg, and K into the mineral soil was associated with the decomposition. K concentration showed a rapid increase throughout the solum soon after harvesting. The harvest was the most important flux for the K (61%) output (Snyder and Harter, 1985).

Concentration of Ca, Mg, Na, K, and NO3 increased in stream water of cutover watershed than in undisturbed watershed about 9, 8, 3, 20, and 100%, during the same period. These changes may be accounted by an increase in microbial nitrification (Likens *et al.*, 1969). Ca and Mg quantities in the forest floor before harvest increased with increasing site quality. The principle impact is an accumulation of exchangeable Ca, Mg, and K throughout the solum. Snyder and Harter (1985) found that there is slight increasing trend in pH a conjunction with this. Furthermore, Mg concentration tends to increase continuously with time after harvest (clear-cut). Initially Ca, Mg and K are released from surface OM by mineralization following the opening of the stand and a reduction in plant uptake. Marks and Bormann (1972) reported that following clear-cutting, the growth and development of dense stands of successional species such as pin cherry was extremely rapid, and was attributed to minimum nutrient losses from the ecosystem. Concentration of K, Ca, and Mg decreased following clear-cut of forest. Factors contributing of these results were the higher exchange capacity of the clay loam soil, the short rain season, the removal of slash and some litter, and lack of ion inputs from through-fall in clear-cut. Ion concentration decreased with soil depth in the uncut forest, but increased with depth in the clear-cut. The proportion of K, Ca, reduction in soil solution in clear-cut, compared to those in the forest; proportion of Mg remains the same (McColl, 1978). Moreover, total amount of ions in the solution in lower portion of the profile were greater in the clear-cut due to increased quality of soil water and subsequent increased leaching following clear-cutting, rather than to increased ion concentrations of the soil solution (McColl, 1978). Significant reduction in soil K occurred in the forest floor and in every mineral horizon on each site following harvesting. These losses from the surface meter of mineral soil presumably were due to the displacement of K from exchange site by H released from increased nitrification following harvesting (Mroz *et al.*, 1985). Moreover, majority of the K Also, they indicated that the major pool of K was in mineral soil horizons, rather than in the forest floor. And nutrient content in the litter layer increased as site productivity increased due to greater litter production.

The objectives of this study were to: 1- To investigate the effect of forest clearing on some soil physical properties. 2- To investigate the effect of forest clearing on some soil chemical properties.

MATERIALS AND METHODS

Description of Study Area

The study area was conducted at Samta and Bergish village, located in northern highlands of Jordan. Bergish is located at (32° 25′ and 32° 26′ northern latitudes, and 35° 44′ and 35° 45′ eastern longitudes), with 779-880 m Altitude and 5-13% slops. Second are Samta located at (32° 23′ northern latitudes, and 35° 51′ eastern longitudes), with 1063-1075 m Altitude and 2-7% slops. Topography for both locations is mountainous with steep slopes and valley. The dominant climate within the study area is sub-humid Mediterranean climate. The area receives approximately between 267-753 mm with average 559 mm of annual rainfall. Precipitation occurs during November to April. Maximum temperature occur in August (mean maximum is 34 C) and minimum temperature in January (mean minimum is -4.2 C). Mean annual relative humidity is 63%. A majority of the area is represented by soils of the Inceptisols and Vertisolsorder. Soil is highly variable within the area. About 80% of soil has depth. The area consists of indigenous planted forest (14225 ha) distributed as follows; natural forest (9100) ha, artificial forest (2100) ha, and private forest (3025) ha. The other land utilization includes; fruit trees (5406 ha), field crops (3700 ha), rangeland (458 ha), and (665 ha) consider as cultivated area and rangelands at the same time. Fruit tree includes; olive, grape, fig, apple and almond, while field crops includes; wheat, barley, and feed legumes. Both goats and cattle graze the rangeland. 65% of the land is privately owned, and 21.3 % of the forests are privacy. The study included four adjusted land parcels under different uses at both sites (Bergish and Samta) two natural forest parcel and two cultivated parcel covered with orchards tree for last 30 years.

Soil Sampling and Pretreatments

Surface soil samples from 0-25 cm depth and subsurface soil sample 25-50 cm depth were collected from 16 selected profiles in eight adjacent land parcels, by digging a profile. In total 32 samples were collected, air-dried and pass through a 2 mm sieved to remove stones, roots, and large organic residues before conducting analyses for chemical and physical characteristics.

Analyses of Soil Samples

Particle size distribution was determined by the hydrometer method, following dispersion with sodium hexametaphosphate 5 %, and shaking overnight (Gee and Bauder, 1986). Bulk density was determined by core method (Blake and Hartge, 1986); organic matter by the Walkley-Black method (Nelson and Sommers, 1982); soil pH was measured on 1:1 soil: water suspensions with glass electrode on a pH meter (McLean, 1982); soluble salts were determined by measuring the electrical conductivity in 1:2.5 soil to water extract (Rhoades, 1982); calcium carbonate ($CaCO_3$) equivalent values by acid neutralization method (Richards, 1954); cation exchange capacity (CEC) was determined by the sodium (Na) saturation method (Chapman, 1965). Extractable Ca, Mg, and K, were obtained by extracting soil with 1N NH4OAC pH 7. extractable potassium were measured by flamephotometer (Knudsen *et al.,* 1982); extractable calcium and magnesium were determined by an atomic absorption spectrophotometer (Lanyon and Heald, 1982); total nitrogen by using Kjeldahl method (Bremner and Mulvaney, 1982); available phosphorus by extraction with sodium bicarbonate (Olsen *et al.,* 1954).

Statistical Analysis

The experiment compared two land use types (shifting cultivation forest to cultivated land), and two soil depths (0-25 cm, and 25-50cm). A one way Analysis of variance (ANOVA) was used to test differences in soil physical and chemical properties across land use/cover types and a cross soil depth (0-25 and 25 to 50 cm). For statistically different parameters ($p<0.05$), means were separated using the Significant Difference comparison test. Pearson's correlation co-efficient was also estimated for all possible paired combinations of the variables to generate a correlation coefficient matrix. Key informant interviews (n=32). The statistical analysis of variance (ANOVA) using the *Statistical Package for Social Science* (SPSS 17) program for windows.

RESULTS AND DISCUSSION

Particle Size Distribution

Analysis of variance showed an overall significant effect of land-use/cover in the distribution of particle size classes. Significantly higher of sand and silt, and lower clay contents were recorded in forest lands (Table 1). The proportion of sand was significantly high in forest soil than cultivated, however, there was no significant difference between cultivated and forest soil for silt and clay particle.

The distribution of particle size, in the present study, reveals a decrease in larger particle size and an increase in smaller particle size contents following the conversion of natural forest to other land-use/cover. Table 1 clearly shows that sand fractions differed significantly across the land use types (p=0.036 for sand).

Within the different land use types, clay content in the surface layer (0-25 cm depth) varied from 51.5 to 82.1 % and subsurface layer (25-50 cm depth) varied from 40.9 to 83.3%, while sand fractions ranged from 3.5 to 21.7 and 3 to 25% respectively and there are no significant difference in soil particle size according to soil depth. Our result indicate that the particle size redistributed in soil profile, by eluviations of clay from the surface to sub surface soil, mixing the A horizons with B horizons by cultivation practice at cultivated land; therefore there are more thickness of A horizon at cultivated area. The forest soils were more stable than cultivated soil. Beare *et al.,* (1994) found that no tillage practices can improve and increase the soil aggregation stability of macro-aggregates and change the distribution of soil organic matter level more than conventional tillage. The cropped soil and under grass soil had similar physical properties, while the forest soils were considerably different (Guerreo *et al.,* 1995). Lavkulic and Rowles (1971) indicate that the clay content increased in cultivated in Ap and B horizons and attributed this change to the grinding effect of cultivation on the surface horizons. The absence of protective vegetation cover in the cultivated land and grass lands also indirectly contributes to the removal of finer particles as it reduces the organic matter that disturbs soil aggregates and accelerates soil loss via erosion (Abbasi *et al.,* 2007).

Bulk Density

Analysis of variance (ANOVA) showed significant variations in the bulk density values amongst different land-use/cover categories, it indicted that the cultivated land higher than forest land use (Table 1). The low bulk density in the natural forest is due to a relatively high amount of organic matter. Pearson's product-moment correlation coefficient showed that the bulk density is inversely correlated to the organic matter ($r=-497$; $p=0.004$) table 3. This confirms that change in the content of organic matter results in the change of soil bulk density value. The practice of ploughing in cultivated soil also tends to lower the quantity of organic matter of that soil.

The high total porosity of the natural forest soil is attributed to higher organic matter content, as total porosity is affected by the levels of organic matter and bulk density (Liu *et al.,* 2007; Gebrelibanos and Mohammed, 2013). Thus, a decline in porosity and the corresponding rise in bulk density are manifestations of removal of organic matter. A significant higher bulk density of the cultivated land soil suggests of conducive situation that increases runoff which then enhances erosion, because soil in filtration and water holding capacity reduce as BD increases (Ahmed *et al.,* 1987).

Bulk density increased with soil depth for all studied areas, the minimum bulk density observed at surface of forest soil, then increased in all different subsoil profile, table 2, shows the different level of bulk density in different soil depth. The increase of bulk density in cultivated land as compared to the forest soil, referring to the effect of reduction of organic matter, and effect of compaction of machinery through the forest clearing, and agricultural practices as plowing, and crops harvesting. The bulk density in cultivated higher than the forest area, because there is reduction in the roots, and organic matter resulted in greater compaction of mineral soil.

Organic Matter and Total Nitrogen

Different land-use/cover systems cause variation in the levels of soil organic matter contents. The results of this study revealed that a mean soil organic matter value of 2.27% in forest, and 1.16% in cultivated land soil (Table 1). The ANOVA also indicated the existence of significant difference amongst land-use/cover types ($p<0.001$). Forest soil had significant higher quantity of organic matter followed by cultivated land soil. This is obviously attributed to the addition of plant residues on the surface of these soils and their reduced rate of disturbance. The lower organic matter content in cultivated land soil is attributed to anthropogenic factors (e.g. reduced biomass return as a result of removal of plant and animal organic sources, and livestock grazing) that enhances organic matter loss by hastening oxidation. The relatively better organic matter content in the forest soil is attributable to higher biomass input. This indicates vegetation restoration has implication for improvement of soil nutrients. Our result agree with Fuller and Anderson (1993); Funakawa *et al.,* (1997); Sanchez *et al.,* (1983); Gebrelibanos and Mohammed (2013). That the amount of organic matter is normally highest in the forest soil comparable to continuously cultivated soil. Letter fall is the major contribution of soil organic matter in the forest ecosystem. The ANOVA table 2, also indicated the existence of significant difference amongst soil depth ($p=0.001$). The surface soil had significant higher quantity of organic matter than subsoil Organic matter also highest in the surface soil, reflecting highest root densities and increased biological activity (Nair and Chamuah, 1988). Conversion of the natural forest into continuous cultivation had resulted in significant reductions of both the concentration and stock of organic matter. Lobe *et al.,* (2001) reported that the organic matter content in soils decreased rapidly in the first few years they were cultivated.

The total N content of the soil has revealed variations among the land-use/cover types with similar pattern of distribution as that of soil organic matter (Table 1). Pearson's coefficient of correlation also has indicated an overall significant positive correlation between organic matter and total N content of soil in different land-use types (r= +0.84). In addition, the findings indicated that the soil in the native forest, and cultivated land had 0.25%, and 0.16% of nitrogen (N) content of respectively. The removal of the biomass above ground by harvesting crop residue and grazing by livestock is responsible for the observed decline. ANOVA also indicated that there is significant difference in total N among the considered land-use/cover types (Table 1).It is apparent that conversion of natural forest into other land-use/cover results in a decline of total N in the soil as found in the present study. An addition of a relatively higher plant residue and minimal rate of decomposition might be responsible for higher amount of total N in natural forest soil as described by Kreast *et al.,* (2008). Also, Seubert *et al.,* (1977) found that the topsoil N status remained higher when the soil was cleared by slash and burning than when it was cleared by bulldozing. They attributed that to contamination by plant material that was partially burned or was in an advanced stage of decay. When the forest is cleared with bulldozers instead of the traditional system of felling and burning, nitrogen losses increased considerably. That happens because the blades of the machines and the action of dragging stems leads to remove part of the topsoil and accumulated it far away from the area to be sown. The high nitrogen content referring to high content of organic matter at forest soil, or due to fertilizer application.The low level of organic matter and total N in cultivated land soil suggests degrading effects due to long history of crop cultivation.

The climatic factors that favour fast rate of nitrogen loss from the soil after clearing (Brown and Lugo, 1990). Following clearing and crop harvests, the topsoil remains exposed, allowing for an increase in soil temperature and rates of microbial decomposition, and this lack of vegetation reduces plant uptake of mineralized nitrogen, which is then more vulnerable to leaching losses (Alegre *et al.,* 1988). Cropping had indicated reduction of total N contents. The reduction in the total N is entirely accounted for by the decline of the organic matter through the continuous cropping of the soils. (Owusu-Bennoah, 1997; Vazquez *et al.,* 1991).

Soil pH

A one way analysis of variance showed an overall significant effect of land-use/cover on soil pH values. The mean comparison of soil pH among land-use/cover has also showed that the forest soil differ from the soil of other cultivated (p=0.018). As Table 1 shows, the conversion of natural forest into other land-use/cover has resulted in a decreased soil pH value. This decreasing trend of soil pH suggests a systematic removal of bases by annual crops.

Soil pH value increased slight at cultivated after forest clearing and continuous cultivation in all study area, pH value increased in cultivation due to reduction of organic matter and ploughing process of cultivated fields. The pH value increased significantly with soil depth for all studied areas (p=0.018). Minimum values of pH observed at surface horizons then increased with depth of subsoil horizons. Paz-Gonzalez and Taboada (2000); Sanchez *et al.,* (1983); and Sarma *et al.,* (1995); reported that the pH increased by improved cultivation methods and with continues cultivation, also increased tillage led to higher pH in the surface soil than no tillage.Increased tillage led to higher pH in the soil surface than no tillage. Thompson and Whitney (2000); Juo and Lal (1979) no-tillage lead to stratification of soil pH throughout 0-50 cm profile, and continuous cultivation for several years resulting in the decrease in soil pH as compared with initial time of clearing. Yimer *et al.,* (2007) also reported high pH value for cultivated land as compared to forest and grazing land.

Cation Exchange Capacity and Electrical Conductivity

The cation exchange capacity did not show any significant difference among the land-use/cover systems. The highest CEC (51.03Cmol/kgsoil) was registered in natural forest soil while the lowest (50Cmol/kg soil) was recorded in cultivated land soil (Table 1). Analysis of variance also showed significant difference in CEC resulted in different soil depth, it was (56.4 Cmol/kg soil) at surface soil decreased to

(44.5 Cmol/kg soil) at subsoil (p=0.013). The low CEC in cultivated land was in line with the low clay and organic matter contents of the soils. The soil CEC values in agricultural land uses decreased mainly due to the reduction in organic matter content Nega and Heluf (2009).The computed correlation coefficient has indicated strong and positive association between soil CEC and organic matter contents (r=+0.58) table 3. Thus, the degradation of organic matter had left the soil of cultivated land with low CEC. Soil CEC is important for maintaining soil fertility as it influences the total quantity of nutrients available to plants at the exchange site (Yitbarek *et al.*, 2013). CEC increased with high clay content. Topsoil chemical properties have improved with continuous cultivation because of fertilizer additions. Soil CEC increased by following conversion of forest to crop fields (McGrath *et al.*, 2001). The CEC was significant more in the forest than cultivated land, both surface and subsurface soil; CEC decreased with soil depth, the decrease in the CEC is reflected in the decrease of the pH, organic matter contents in the soils and the clay content as well as the dominant clay mineral.

Electrical conductivity values depend on rainfall. It was relatively low in all studied area table 1 and 2. Electrical conductivity for forest soil were highly significant than cultivated (p=0.001) and decreased gradually with increasing soil depths (p=0.018). It is suggested that the electrical conductivity values were very much effected by the amount of rainfall where high rainfall mean more leaching of salts and more translocation out of solum.

Calcium Carbonate

Study area soil, generally had some free CaCO3, in general the CaCO3 value are low due to high rainfall and no carbonate accumulations. Calcium carbonate generally higher at forest soil as compare to cultivated soil (table 1). Calcium carbonate varied with soil depth, in both land-used/covers the calcium carbonate decreased with soil depth. Calcium carbonate although depend upon the parent material.

Available Phosphorus

Higher concentration of available phosphorus (13.9 ppm) was recorded in the soil of forest land and (10.78 ppm) was found in cultivated soil (table 1). The ANOVA results show no significant difference for different land-use/cover. Mean comparison test of available phosphorus amongst the soil depth, available phosphorus (16.76 ppm) on the surface soil and (8.04 ppm) on subsurface soil. The ANOVA results show there are significant difference for different soil depth ($p<0.001$) table 2 and 3. The relatively high content of available phosphorus in the forest soil could be due to high content of soil organic matter resulting in the release of organic phosphorus, Gebrelibanos and Mohammed (2013). Probably for this reason, available P is strongly associated with soil organic matter (r=0.84). During cropping, the total amount of available phosphorus in the soil is reduced; some is taken up by the growing crop, and what remains gradually become less soluble (Seubert *et al.*, 1977; Shukla and Agrawal, 1984). Available phosphorus of the soil was depleted after few years of cropping.In cultivated soil, tillage almost eliminates the mulch, which cause reduction of phosphorus (Buschiazzo *et al.*, 2000). Although the loss of total phosphorus is probably because phosphorus is not replaced naturally. Our result agree with Yitbarek *et al.*, (2013), The available P contents of the soils under all land uses were generally high, although cultivated land showed variation in available P content from the forestland which obviously could be due to crop mining, cropresidue removal and erosion.

Exchangeable Bases (K+, Ca2+, and Mg2)

The distributions of exchangeable bases showed clear differences among land-use/cover patterns and among the soil depth (Table 1 and 2). Analysis of variance has shown a significant effect of land-use/cover on the distribution of exchangeable K+ (p=0.005), and significant difference of exchangeable K+ within the soil dept (p=0.004). The distribution pattern of exchangeable bases has been characterized in the order of Ca2+> Mg2+ and > K+ (Table 1). The conversion of natural forest into other land-use/cover category resulted in decreased amount of exchangeable bases. The concentration of exchangeable Ca2+ in the soil under all land-use/cover systems was rated as high (Table 1). The relatively low exchangeable K+ and Mg2+ in cultivated land soil is attributed to their continuous removal with crop harvest. As the level of soil organic matter is low to withhold release of nutrients, soil erosion is also responsible for the low content of exchangeable k+ and Mg2+ in cultivated soil. The level of exchangeable potassium (K+) differs significantly as a consequence of differences in land-use/cover systems (ANOVA; Table 3). The highest exchangeable K+ was recorded in the forest soil (1.53) followed by cultivated land soil (0.76 meq/100 g).

Table 1: Soil properties according land-use/cover change (LULC)

Soil properties	Cultivated LULC	Forest LULC	Over all	p-Value
Sand (%)	7.60*	12.63*	10.11	0.035
Silt (%)	19.56	22.37	20.96	0.186
Clay (%)	72.84	65.00	68.92	0.064
Bulk Density (Mg/m^3)	1.24*	1.12*	1.18	0.018
CaCo3 (%)	3.51	3.96	3.73	0.29
pH	8.13	8.12	8.12	0.94
EC (ds/m)	0.13**	0.21**	0.17	0.001
CEC (Cmol/kg)	50.00	51.03	50.47	0.80
OM (%)	1.16**	2.27**	1.71	0.000
N (%)	0.16**	0.25**	0.20	0.002
P (ppm)	10.78	13.93	12.40	0.134
K (meq/100 g)	0.76	1.53	1.14	0.005
Ca (meq/100 g)	21.80	21.50	21.65	0.800
Mg (meq/100 g)	1.25	1.33	1.29	0.65

*Mean value within the same rows follow by * are significantly different at p<0.05, and ** are significantly different at p<0.01*

Table 2: Soil properties according soil depth (0-25 and 15-50 cm)

Soil properties	0-25 cm soil depth	25-50 cm soil depth	Over all	p-Value
Sand (%)	9.86	10.37	10.11	0.84
Silt (%)	21.18	20.75	20.96	0.94
Clay (%)	68.96	68.88	68.92	0.102
Bulk Density (Mg/m^3)	1.14	1.21	1.18	0.47
CaCo3 (%)	3.89	3.58	3.74	0.63
pH	8.09*	8.15*	8.12	0.018
EC (ds/m)	0.20*	0.14*	0.17	0.018
CEC (Cmol/kg)	56.41**	44.53**	50.47	0.013
OM (%)	2.15**	1.28**	1.71	0.001
N (%)	0.24**	0.17**	0.20	0.004
P (ppm)	16.76**	8.04**	12.40	0.000
K (meq/100 g)	1.54**	0.75**	1.14	0.004
Ca (meq/100 g)	22.62	20.66	21.65	0.112
Mg (meq/100 g)	1.41	1.18	1.30	0.209

*Mean value within the same rows follow by * are significantly different at p<0.05, and ** are significantly different at p<0.01*

Table 3: Correlation matrix for linear relationship between selected physical and chemical soil properties

	Sand	Silt	Clay	B.D	CaCO3	pH	EC	CEC	O.M	N	P	K	Ca
Silt	.769**												
Clay	-.948**	-.932**											
B.D	-.562**	-.338	.486**										
CaCO3	.777**	.764**	-.820**	-.647**									
pH	.345	.523**	-.455**	-.137	.502**								
EC	.509**	.327	-.450**	-.531**	.459**	.198							
CEC	-.180	-.287	.245	-.239	-.006	.082	.489**						
O.M	.392*	.088	-.266	-.497**	.263	-.118	.875**	.478**					
N	.517**	.282	-.433*	-.604**	.483**	.103	.871**	.590**	.841**				
P	.323	.371*	-.367*	-.520**	.492**	.227	.580**	.500**	.453**	.694**			
K	-.241	-.106	.189	.039	-.185	-.137	.456**	.472**	.416*	.444*	.551**		
Ca	-.267	-.529**	.414*	.076	-.265	-.185	.487**	.622**	.580**	.381*	.060	.340	
Mg	-.161	.088	.047	.117	-.128	.263	.342	.530**	.198	.398*	.557**	.697**	.182

*Notes: * significant at 5%, ** significant at 1%*

Nutrient is higher in the forest soil because initially calcium, magnesium, and potassium are released from surface organic matter by mineralization following the opening of the stand and a reduction in plant uptake. The result agree with Likens *et al.*, (1969); Mroz *et al.*, (1985) and Snyder and Harter. (1985). Nutrient content in the litter layer increased as site productivity increased due to greater litter production). Bailey *et al.*, (1964) exchangeable calcium was great amount in the forest soil. In the surface soils, exchangeable bases such as calcium were generally dominant, decreased to low point in the subsoil (Bailey *et al.*, 1964; Funakawa *et al.*, 1997; Johnson *et al.*, 1991). The result was in agreement with Baker *et al.*, (1997) and Gebrelibanos and Mohammed (2013) who reported application of acid forming inorganic fertilizers enhanced depletion of K+ in soil.

Conclusion

Shifting cultivation is the practice of clearing away forests to plant crops, and then abandoned it when the soil nutrients depleted. But extensive clearing of forest vegetation in northern Jordan to establish orchards and farm based agricultural production systems has resulted in a general decline in the condition of our natural resources which includes the development of dry land, soil erosion, soil fertility degradation, soil degradation and a loss of biodiversity. In general, shifting cultivation in Jordan can described as a long terms, land use change, that increases productivity and provides multiple products with the objective of conserving a resource base. The shifting cultivation effects on soil physical properties as particle size distribution, the bulk density increased from 1.12 in forest area to 1.24 Mg/m^3.

Soil organic matter has the following major influences on soil chemical properties: Acts as a source of nitrogen, phosphorus, and cations. Has a direct influence in increasing the cation exchange capacity of a soil, and electrical conductivity.

Irrespective of a soils inherent organic matter content, the implementation of agricultural production systems results in a decline in organic matter due to (1) the inputs of plant carbon being generally low and (2) tillage and other agricultural practices increasing the rate of decomposition of soil organic matter by incorporation into the soil and thereby increasing the number and intensity of wetting and drying cycles.

Roots can have a significant influence on nutrient acquisition through chemical changes in the rhizosphere (ie. pH), the production of specific rooting structures (ie. proteoid roots), and the manipulation of microbial populations in close proximity to the root and the extraction of nutrients from depth within the profile.

Research has shown that many agroforestry systems with a cropping component resulted in a decline in soil fertility; this was most evident on soils with a low inherent fertility. Nutrients added in organic mulches are often inadequate to completely meet the total nutrient demands of a moderate crop. For the long-term sustainability of agroforestry systems the addition of inorganic or organic fertilizers is required to cropping systems particularly on acid, infertile soils. In addition, the maintenance of soil organic matter is essential although extremely difficult where soil disturbance takes place. Topsoil chemical properties can be improved with continuous cultivation by additions of proper fertilizer. No harm to replace forest by agriculture, on condition if the topography had low slope, soil deep enough for orchard or field crops, and had good agriculture management. But unfortunately most of Jordan forests are protection forest.

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