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THE EFFECT OF LAND USE TYPE / LAND COVER AND ASPECT ON SOIL PROPERTIES AT THE GÖKDERE CATCHMENT IN NORTHWESTERN TURKEY

UTJECAJ NAČINA KORIŠTENJA ZEMLJIŠTA / VEGETACIJSKOG POKROVA I EKSPOZICIJE NA SVOJSTVA TLA U SLIVNOM PODRUČJU GÖKDERE U SJEVEROZAPADNOJ TURSKOJ

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Summary

Different studies have shown that the effects of land use conversion on soil properties are variable, so that more researches that focus on different ecological regions and land use types are required. The objectives of this study were (1) to evaluate the effects of land use types in two aspects (north and south) on soil properties and (2) to examine the impact of tillage and grazing on hydrological soil properties. Primarily, three different main land use type /land cover (LUTLC) were selected in north and south facing slope to investigate the soil properties, namely, forest, grassland, and agricultural land. Soil samples were taken from a soil depth of 30 cm. For these soil samples, various soil properties such as texture, dry bulk density (BD), soil organic matter (SOM), soil pH, water stable aggregates (WSA) field capacity, wilting point, infiltration rate, and saturated hydraulic capacity (Ks) were analyzed. According to the results BD, WSA, SOM, Ks, and infiltration rate significantly change with LUTLC and aspect. Soil characteristics negatively affected by tillage practices and grazing are SOM, WSA, infiltration rate, Ks, and BD. Finally, the findings indicated that tillage and over grazing, in semi – arid region, effected adversely on soil properties, and that over grazing damaged the hydrological properties of surface soil.

KEY WORDS: catchment, infiltration, land use, organic matter, Turkey

INTRODUCTION
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In a catchment, there are strong and mutual relationships between the land use types and hydrological phenomena such as the water flow efficiency, increases in stream flows, overflowing, flooding, erosion, and sedimentation (Gao et al., 2014; Zhao et al., 2015). The distribution of forests, agricultural activities, grasslands, and other land use types, in particular, various characteristics of forests, forestry practices, and all types of activities on these lands have a great impact on the intensity, duration, and continuity of all of these phenomena. Forestry activities changed the top soil surface structure (Enez et al., 2015; Watson et al., 2000). Changes in land–cover have a drastic effect on physical, chemical, and biological properties of soil and hence change

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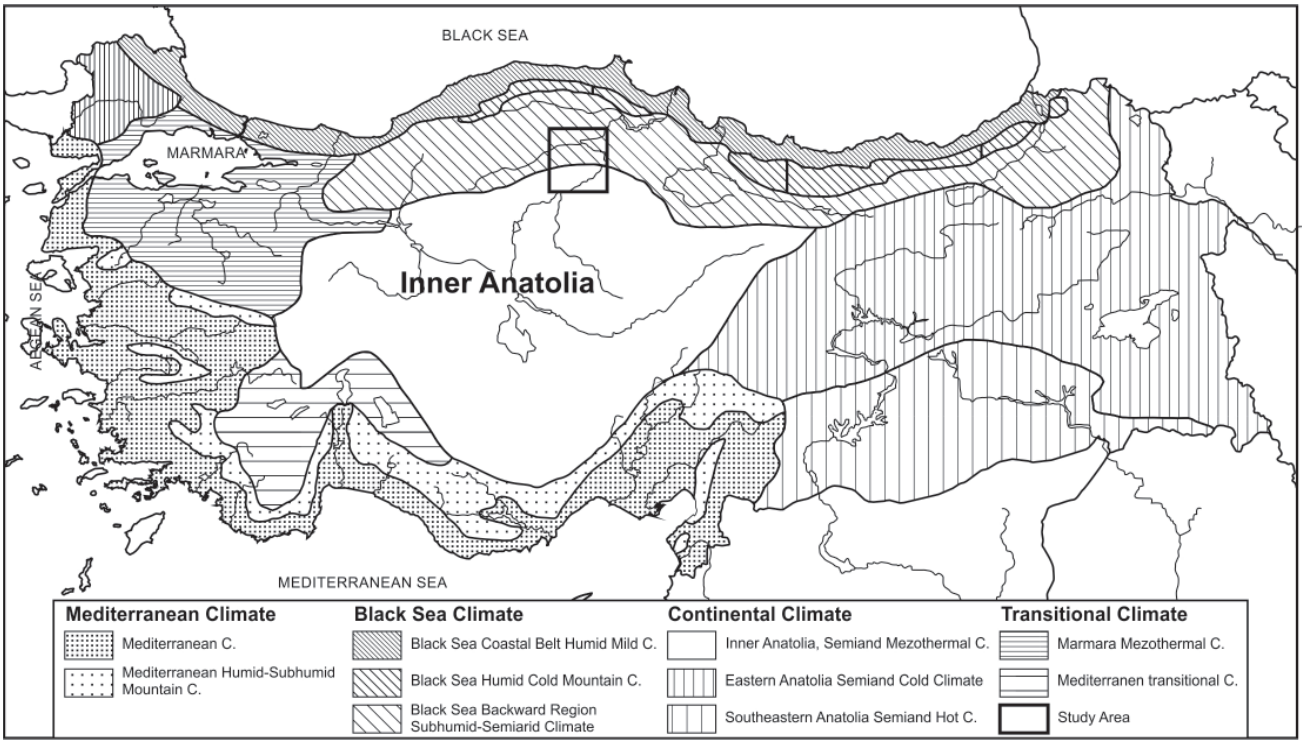

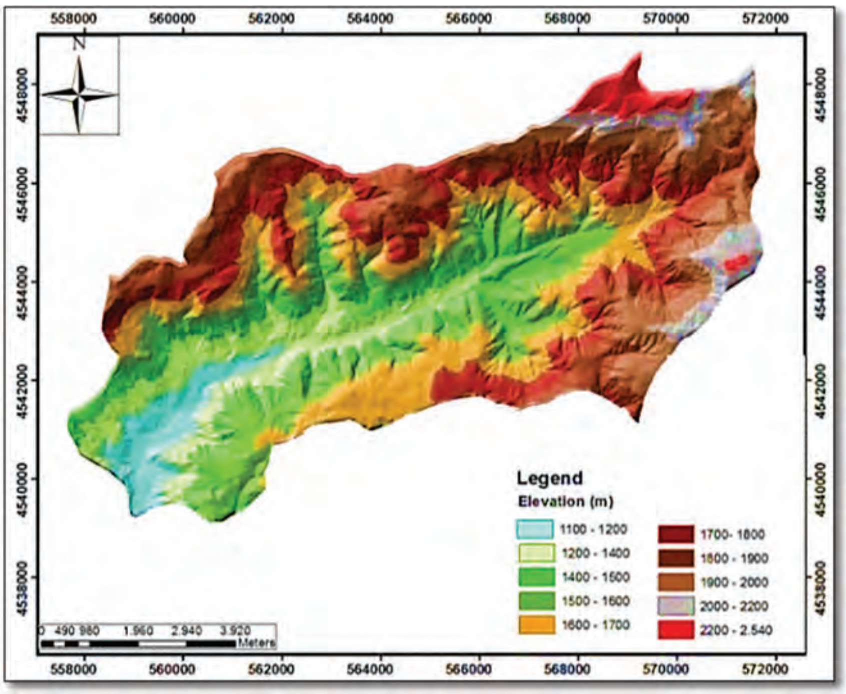

Figure 1. Location of study catchment (Atalay, 2014) and digital elevation map

Slika 1: Lokacija istraživanog slivnog područja i digitalna karta visina (Atalay, 2014)

the quality of soil (Irshad et al., 2015; Jaiarree et al., 2011). The relationships among various land use type's forests, agricultural areas, and grasslands could be considered as plant – soil – water relationships on a large extent. Then, to clarify these relationships, it is necessary to get familiar with the soils in the catchment and determine the characteristics of the soils, which support and develop the plant life in the first place, and store and transmit the water. Many studies (Deng et al., 2016; Franzluebbers and Stuedemann, 2010; Mohawesh et al., 2015) indicate that strong and statistically significant relationships between soil quality and land use type. For example, improper agricultural practices and overgrazing reduce the soil to the forces of erosion (Alkharabsheh et al., 2013; Conant et al., 2016; Recanatesi, 2015). Effects of land use changes on soil properties is inherently regional and highly dependent on the soil type (Abu – Hashim et al., 2016; Göl and Dengiz, 2007), climate (Teferi et al., 2016), and topography (Başkan et al., 2016). So, there is need to assess the effects of land use/cover changes have on soil properties in different ecological regions.

The study area of this research, Gökdere catchment has a rich flora and is important in terms of water production and forest resources; therefore, it was necessary to research this region. There are different land use types and the human factor plays an effective role in the catchment. Moreover, the main reasons for choosing this catchment as the research area are the excessive destruction and annihilation of the natural resources within the catchment.

MATERIALS AND METHODS
MATERIJALI I METODE RADA

Study Area – *Područje istraživanja*

Gökdere catchment is located on the south backward of Ilgaz Mountain that forms the north Anatolian mountain range. It is located within the transition zone between the humid climate of the Black Sea and the semiarid climate of the Central Anatolia. The Gökdere catchment is located between 40° 59′ – 41° 04′N and 33° 42′ – 33° 51′E longitudes on the southern slopes of the Ilgaz mountain range. The altitudes of sampling area ranges between 1100 m and 2540 m (Fig. 1)

According to the Ilgaz Meteorology Station data (Anonymous, 2016) the climate of study area is subhumid and semiarid in Black Sea backward region. The mean annual temperature is 10.2 °C and precipitation is 436.6 mm (Anonymous, 2016). Topography and slope show great variations and hilly and rolling physiographic units are particularly common in the study area. The study area is characterized by crystallized limestone series in general (Ketin, 1962).

The average altitude and slope of the Gökdere catchment are 1714 m and 20 %, respectively (Fig. 1). Very steep and highly inclined terrains constitute approximately 70 % of the catchment. The catchment area is mostly covered by degraded forest (60 %) and productive forest (10 %). Dominant tree species of forest are Uludağ fir (*Abies bornmulleriana* Mattf), scotch pine (*Pinus sylvetris* L), and Anatolian black pine (*Pinus nigra* subsp. *pallasiana,* Arnold). Dry farming is done using traditional farming methods in 9 % of the catchment (Anonymous, 2015). In general, agriculture is done in marginal areas within the catchment. Agricultural areas are located in steep regions converted from forests and grasslands. In the catchment, grazing takes place in and under the forest (Table 1).

Some catchments characteristics were determined and evaluated by using ArcGIS 10 in this study (Fig. 2 a-b, 3).

Table 1. Land use types/land cover (LUTLC) spatial distribution of the research area (Anonymous, 2015)
Tablica 1: Prostorna raspodjela načina korištenja zemljišta/vegetacije (LUTLC) u istraživanom području (Anonymous, 2015)

Land use types / land cover Prostorna raspodjela načina korištenja zemljišta / vegetacije	Area / Područje (ha)	(%)
Uludağ Fir (*Abies bornmülleriana* Mattf) Jela	1268.44	18
Scots pine (*Pinus sylvetris* L) Obični bor	2416.87	34
Anatolian black pine (*Pinus nigra* subsp. *pallasiana* Arnold) Anatolski crni bor	787.79	11
Degraded mixed forest Degradirana mješovita šuma	733.37	10
Forest opening Otvorenost šume	751.42	10
Grassland Pašnjaci	617.94	8
Cultivated area Obradive površine	668.02	9
Total Ukupno	7243.85	100

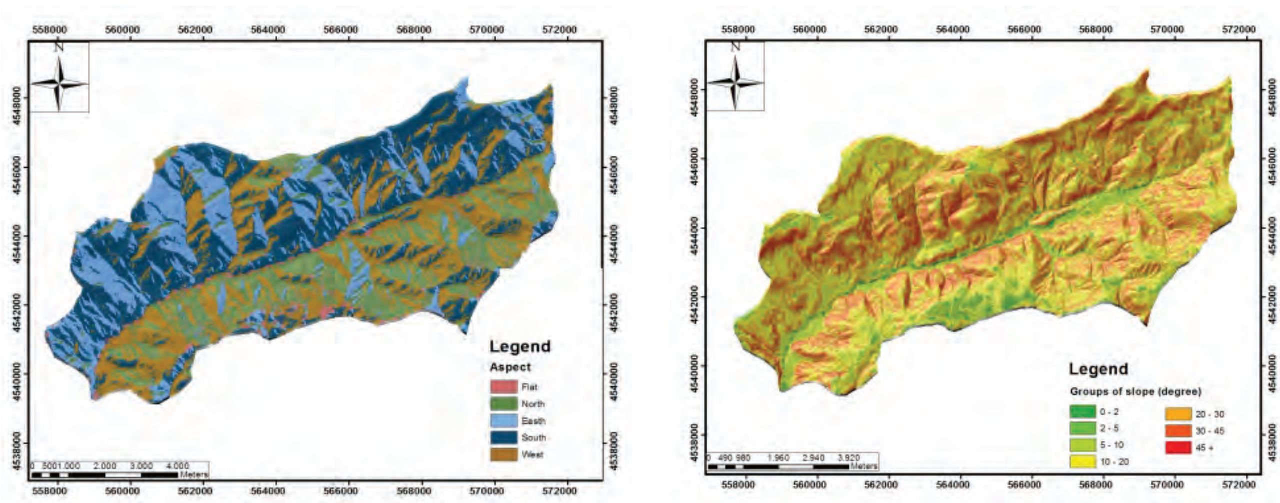

Figure 2. a – Aspect group map of catchment; b – Slope groups map of catchment
Slika 2. a – Karta slivnog područja po ekspoziciji; b – Karta slivnog područja po nagibu

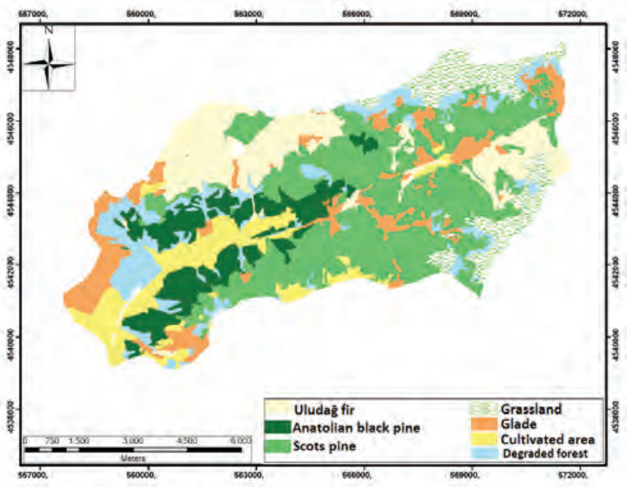

Figure 3. Land use type/land cover (LUTLC) map of the study area
Slika 3. Karta slivnog područja prema načinu korištenja zemljišta/vegetacije (LUTLC)

Field sampling and laboratory analyses – *Uzimanje uzoraka na terenu i laboratorijska analiza*

The investigations were carried out within a catchment in there different adjacent LUTLC namely, natural forest (scots pine forest), grassland, and cultivated land (dry farming) at two aspects apart: one on a north – facing slope and one on a one on a south – facing slope. The distributions of sampling plots in the grid system (50 x 50 m) are total 180 soil samples (3 land use types x 2 aspect facing slopes x 30 surface soil samples) for all three different adjacent LUTLC at two aspects (north – south). Soil samples were collected at surface soil (0 – 30 cm depth) (because of effective depth of soil organic matter accumulation in the study areas). The undisturbed soil samples were taken by a steel core sampler of a 100 cm^3 volume for dry bulk density analysis (180 samples) and 400 cm^3 volume for saturated hydraulic conductivity analysis (180 samples).

Particle size distribution was determined by the hydrometer method (Bouyoucos, 1951). A wet sieving method was used to determine the coarse fragments and water stable aggregates (WSA) (Kemper and Rosenau, 1986). Soil water retention field capacity (FC), wilting point (WP) and available water capacity (AWC) at 0.33 and 15 bar tension were determined using a pressure plate (Blake and Hartge, 1986). Dry bulk density (BD) was calculated by dividing the oven dry mass at 105°C by the volume of the core (Cassel and Nielsen, 1986). Saturated hydraulic conductivity (Ks) were determined by the core method (Cassel and Nielsen, 1986). Soil pH and electrical conductivity (EC) were measured on a 1:5 soil to water ratio suspensions by a pH/conductivity meter (Rhoades, 1996). Total nitrogen (TN) was determined by Kjeldahl method (Bremner, 1996). Carbonate ($CaCO_3$) was determined by pressure calcimeter method (Richard and Donald, 1996). The concentration of soil organic matter (SOM) was determined by using the Walkley and Black method (Nelson and Sommers, 1996). The soil infiltration rates were measured at each sampling point of three LUTLC using tension disc infiltrometer (Perroux and White, 1988) as described by Moret and Arrúe (2007) for structured soils and by Ankeny et al. (1988) and Reynolds and Elrick (1991) for other soils. The measurements with tension infiltrometer were made in summer, and conducted on a total of eighteen sample plots: principally distributed in three replicates on three different LUTLC with north and south facing slopes.

All data were analyzed using SPSS® 20.0 (IBM corporation software) statistical software. Analysis of variance (ANOVA) was used to detect the significant differences in the measured variables ($p < 0.01$ and $p < 0.05$) among land use types or between north and sought aspects. Differences among means of LUTLC and between north and south aspects were considered significant at the $p < 0.01$ and $p < 0.05$ level using the least standard difference (LSD) multiple comparisons test.

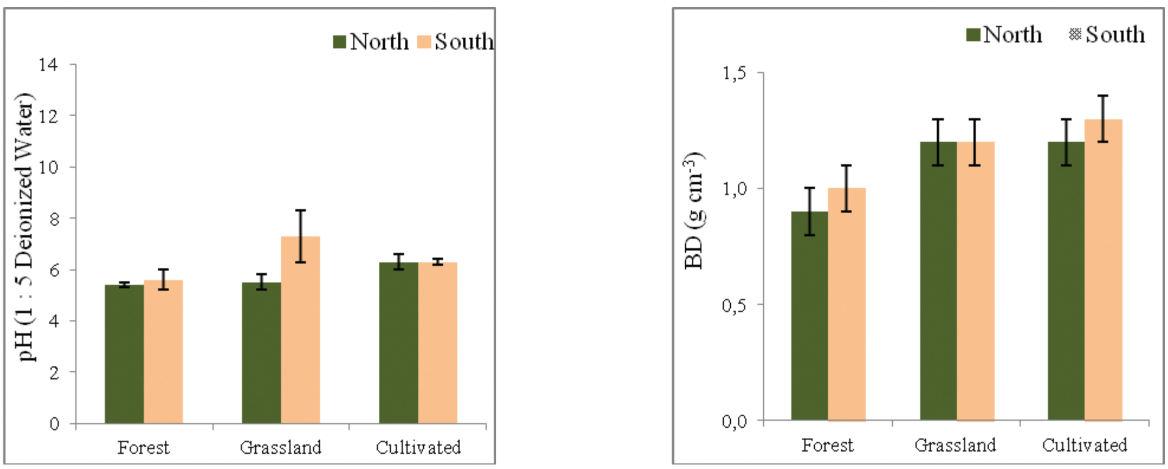

Figure 4. a – Soil reaction (pH), b – Dry bulk density (BD)
Slika 4. a – Reakcija tla (pH), b – Gustoća tla (BD)

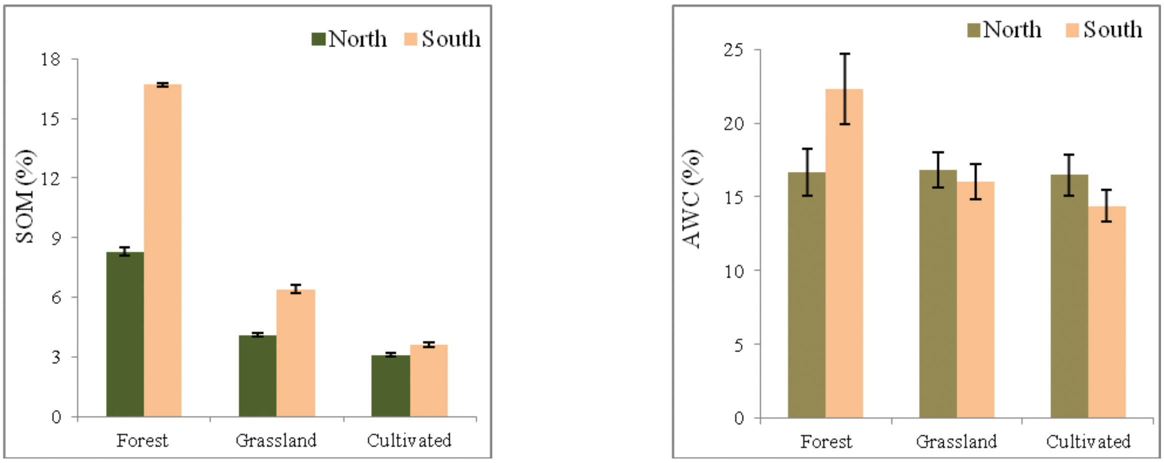

Figure 5. a – SOM of two aspect and different LUTLC soils; b –Available water capacity (AWC) two aspect and different LUTLC soils
Slika 5. a – Organska tvar u tlu (SOM) na dvije ekspozicije i različita tla LUTLC; b – Dostupni kapaciteti vode (AWC) na dvije ekspozicije i različita LUTLC

RESULTS
REZULTATI

Soil texture classes are clay loam, sandy clay loam, sandy loam, silt clay loam and clay in all land uses. The pH values of the forest, grassland and cultivated lands varied significantly from 5.4 to 7.3 (Fig. 4a). Agricultural and forest soils were found to be statistically significantly different in terms of pH values ($p < 0.05$).

When the dry bulk density (BD) values under different land use types are compared, the lowest value (0.95 g cm^{-3}) was measured in forest soils and the highest value (1.36 g cm^{-3}) was measured in agricultural lands. The differences in BD values of all LUTLC were found to be statistically significant with respect to the land use type ($p < 0.05$). This difference was not easily explainable but might be ascribed to the compaction of the topsoil due to overgrazing of the grassland (Fig. 4 b). On the other hand, it is also important to highlight that bulk density strongly correlates with SOM and organic carbon content (Hollis et al., 2006). Soils with higher SOM such as forest soils have lower bulk densities.

When the SOM amounts of the soils in the study area were compared, the differences between all LUTLC (forest – grassland, forest – cultivated area, and grassland – cultivated area) were found to be statistically significant ($p < 0.01$). The highest amount of SOM was measured in forest soils (16.7 %) and the lowest (3.1 %) was found in soils of cultivated lands. The differences in SOM amounts of forests and grasslands located in the north and the south aspects were found to be statistically significant ($p < 0.01$). Göl and Dengiz (2007) indicated that the aspect had an effect on the accumulation of SOM. The difference between SOM amounts of agricultural soils in both aspects was not significant.

The highest available water capacity (AWC) value (22.3 %) was measured in forest soil and the lowest value (14.4 %) in cultivated area soil (Fig. 5 b). The average value of AWC was measured to be 22.31 % in forest soils, 16.03 % in grassland soils, and 14.44 % in agricultural soils (Fig. 5 b).

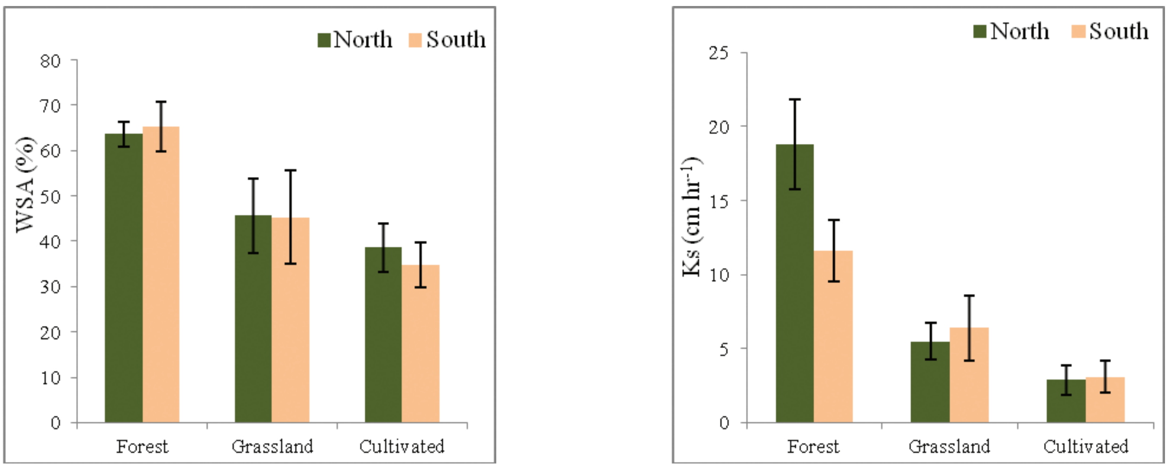

Figure 6. a – Water stable aggregates (WSA); b – Saturated hydraulic conductivity (Ks) values of soil
Slika 6. a – Stabilnost agregata u vodi (WSA); b – Vrijednosti hidrauličke provodljivosti (Ks) tla

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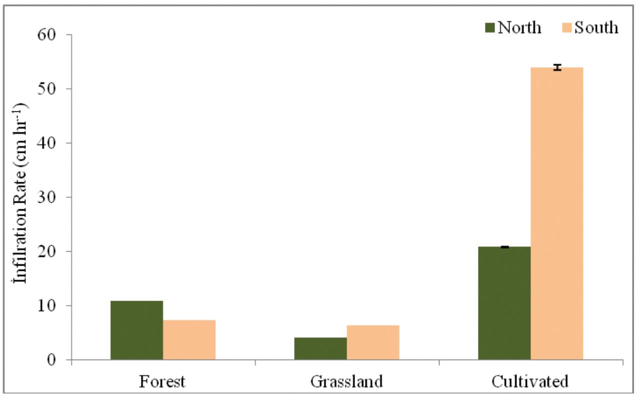

Figure 7. Infiltration rate values of LUTLC soils
Slika 7. Vrijednosti stope infiltracije LUTLC tla

While the differences between forest soils and grassland soils, and forest soils and agricultural soils were found to be statistically significant ($p < 0.05$), the difference between agricultural and grassland soils was not significant. The values of water stable aggregates (WSA) were influenced by LUTLC and aspect, with a significant interaction (Table 2). The soils of cultivated land were statistically less stable. The values of WSA were significantly larger in the forest and grassland soils than in the cultivated soils (Fig. 6 a).

When the infiltration rates in both aspects were compared; the highest infiltration rate (54.0 cm h^{-1}) was measured in agricultural surface soils and the lowest rate (4.01 cm h^{-1}) was measured in grassland soils (Fig. 7).

When the infiltration rate was statistically analyzed, differences found in terms of all land use types were statistically significant at $p < 0.01$ (Table 2). Due to higher litter accumulation and higher availability of materials such as lignin, polyphenol, and resin that give soils hydrophobic characteristics in the surface of forest soils in the southern aspect, the infiltration rate in the southern aspect was measured to be lower (7.4 cm h^{-1}) than the northern aspect (10.9 cm h^{-1}) (Table 2). Moreover, the infiltration rate of grassland soil in the southern aspect was measured higher than the grassland soils of northern aspect owing to higher levels of compaction from over grazing animals in the pluvial depending on the soil moisture of grassland. In agricultural soils on the other hand, again, depending on the moisture content, the infiltration rate was measured to be higher in the southern aspect than the northern aspect due to cultivating the soils in the northern aspect during the wet period. Except the extreme case of forest soils, the infiltration rates of soils of grassland and cultivated lands in the south facing slope were measured to be higher.

ABBREVIATIONS
KRATICE

N – north, S – south, pH – soil reaction, ECe – electrical conductivity, WSA – water stable aggregate (%), SOM – soil organic matter (%), TN – total nitrogen (%), AWC – available water capacity (%), BD – dry bulk density (g cm^{-3}), IR – Infiltration rate (cm hr^{-1}), Ks – saturated hydraulic conductivity (cm hr^{-1})

Lower case letters indicate statistically significant differences among soil properties affected by the different LUTLC ($p < 0.05$)

Upper case letters show statistically significant differences between land use for the cases that there were interactions between land use type and aspect ($p < 0.05$)

The same letter means that land use types are not statistically different, A > B > C, a > b > c

N – sjever, S – jug, pH – reakcija tla, ECe – električna provodljivost, WSA – agregat stabilan u vodi (%), SOM – organska tvar u tlu (%), TN – ukupni dušik (%), AWC – dostupni kapaciteti vode (%), BD – gustoća tla (g cm^{-3}), IR – stopa infiltracije (cm hr^{-1}), Ks – zasićena hidraulička provodljivost (cm hr^{-1})

Mala slova ukazuju na statistički značajne razlike među svojstvima tla na koje utječu različiti LUTLC ($p < 0.05$)

Velika slova pokazuju statistički značajne razlike između korištenja zemljišta u slučajevima kada je bilo interakcija između načina korištenja zemljišta i ekspozicije ($p < 0.05$)

Isto slovo znači da nema statistički značajne razlike između načina korištenja zemljišta, A > B > C, a > b > c

Table 2. Changes in soil properties in response to LUTLC at two aspects
Tablica 2. Promjene svojstava tla kao posljedica LUTLC na dva aspekta

LUTLC	Aspect	Number	pH	EC_e	WSA	SOM	TN	AWC	BD	IR	Ks
	Ekspozicija	Broj	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Means ± SD
Forest	N	30	$5.4\pm0.1^{A}_{b}$	$1.1\pm0.1^{A}_{a}$	$63.6\pm2.7^{A}_{a}$	$8.3\pm0.2^{B}_{a}$	0.3 ± 0.0	$16.7\pm1.6^{B}_{a}$	$0.9\pm0.0^{B}_{b}$	$10.9\pm0.0^{A}_{b}$	$18.8\pm3.0^{A}_{a}$
Šuma	S	30	$5.6\pm1.4^{A}_{c}$	$1.6\pm0.3^{A}_{a}$	$65.3\pm5.5^{A}_{a}$	$16.7\pm0.1^{A}_{a}$	0.1 ± 0.0	$22.3\pm2.4^{A}_{a}$	$1.0\pm0.1^{A}_{c}$	$7.4\pm0.1^{B}_{b}$	$11.6\pm2.1^{B}_{a}$
Grassland	N	30	$5.5\pm0.3^{B}_{b}$	$0.6\pm0.1^{A}_{a}$	$45.6\pm8.1^{A}_{b}$	$4.1\pm0.1^{B}_{b}$	0.2 ± 0.0	$16.8\pm1.2^{A}_{a}$	$1.2\pm0.1^{A}_{a}$	$4.1\pm0.0^{B}_{c}$	$5.5\pm1.2^{B}_{b}$
Pašnjak	S	30	$7.3\pm1.0^{A}_{a}$	$0.8\pm0.1^{A}_{a}$	$45.3\pm10.3^{A}_{b}$	$6.4\pm0.2^{A}_{b}$	0.1 ± 0.0	$16.0\pm1.2^{A}_{b}$	$1.2\pm0.1^{A}_{b}$	$6.4\pm0.0^{A}_{c}$	$6.4\pm2.2^{A}_{b}$
Cultivated	N	30	$6.3\pm0.3^{A}_{a}$	$0.6\pm0.1^{A}_{a}$	$38.6\pm5.4^{A}_{c}$	$3.1\pm0.1^{A}_{c}$	0.4 ± 0.0	$16.5\pm1.4^{A}_{a}$	$1.2\pm0.1^{B}_{a}$	$20.9\pm0.1^{B}_{a}$	$2.9\pm1.0^{A}_{c}$
Obrađeno	S	30	$6.2\pm0.1^{A}_{b}$	$0.6\pm0.0^{A}_{a}$	$34.7\pm5.0^{A}_{c}$	$3.6\pm0.1^{A}_{c}$	0.2 ± 0.1	$14.4\pm1.1^{A}_{c}$	$1.3\pm0.1^{A}_{a}$	$54.0\pm0.5^{A}_{a}$	$3.1\pm1.1^{A}_{c}$

Saturated hydraulic conductivity (Ks) of soils is affected by texture, structure, bulk density, soil organic matter, and the compaction problem (Göl and Dengiz, 2007). Results of this study have shown significantly higher values of Ks in soils of forest (18.73 cm^3 h^{-1}) compared to grasslands soils (5.59 cm^3 h^{-1}), and cultivated area soils (2.26 cm^3 h^{-1}), (Table 2, and Fig. 6 b). The values of Ks were significantly greater in the forest soils than in other LUTLC. This indicates a specific significance of natural forest in regards to water transport processes in landscape. Results of the analysis indicate that conversion from natural forest to grassland or cultivated land decreases the value of Ks. The Ks values of the soils in the catchment changed depending on the SOM, BD values and compaction problem in grassland soils. The LUTLC has statistically significant ($p < 0.01$) effects on the Ks. According to the results of the study, there are statistically significant differences between the land use types of forest-grassland and forest-agricultural land. The differences between the LUTLC of agricultural-grassland were found to be statistically not significant ($p > 0.05$). In catchment scale thus, forest areas may positively influence from relevant hydrological functions like infiltration and percolation.

When the Ks values in the northern aspect were analyzed, Ks values were measured to be lower in the northern aspect due to higher compaction depending on the higher soil water content. In the wet periods, the animals continuously rambled due to lower grass yield of the pasture and compaction the soil. In forest soils, higher amounts of SOM accumulated in the southern aspect; however, the Ks values were measured to be lower in the southern aspect. Again, hydrophobic properties of soils also affected the Ks values. However, Ks did not change as much as the infiltration rate.

Ks were influenced by LUTLC and aspect, with a significant interaction (Table 2). Ks soils of could be ordered as forests > grassland > cultivated area. Ks correlated significantly with BD and soil texture. Soils under cultivated area and grassland have higher BD than the adjacent soils under forests for two aspects. The natural forest soils has the lowest BD value at the north aspect, whereas, the grassland and cultivated area soils has the highest BD values at the either aspect.

DISCUSSION AND CONCLUSION
RASPRAVA I ZAKLJUČAK

The cultivation and over grazing affected adversely on soil properties and resulted in significant decreases in the SOM, WSA, BD, Ks, and infiltration rate. The values of BD were affected by the land use type. Kobal et al. (2011) indicated that the BD correlated strongly with SOM and carbon concentration in different land use. The amounts of SOM have changed according to the LUTLC and aspect. In their studies, Göl and Dengiz (2007) and Kobal et al. (2011) indicated that the aspect had an impact on the SOM. The difference between SOM amounts of agricultural soils in both aspects was not significant. SOM enhanced the available water capacity. Each 1 % of SOM adds about 1.5 % to available water capacity (Xiao et al., 2014). BD plays an important role through its control of the pore space that retains available water. High bulk densities for a given soil tend to lower the available water capacity (Chen et al., 2007; Fu et al., 2000; Fu et al., 2003). Many studies had been done to study the seasonal changes in soil moisture and vertical soil moisture distribution across different land uses (Wang et al., 2013; Zhang et al., 2006; Zhang et al., 2013).

The infiltration capacity was measured to be the lowest in grassland soils and the highest in agricultural soils. Although many researchers (Plaster, 2014; Pritchett, 1980) reported that the infiltration capacity was the highest in forest soils and the lowest in agricultural soils, the findings from Gökdere catchment were the exact opposite. The measurement of lower infiltration capacity in forest soils could be related with the quality of the SOM in the topsoil. Indeed, Priha (1999) reported that soils under scotch pine (*Pinus sylvestris* L) forest formation included high amounts of lignin, polyphenol, and resin; therefore, the litter decomposed difficultly and consequently upper soils became hydrophobic. The forest soils chosen for infiltration testing in the Gökdere catchment are under scotch pine formations. Therefore, depending on the hydrophobic nature of top soils, the infiltration rates of forest soils were measured to be lower than that of agricultural soils. In fact, Jones (1994) and Morgan (2005) indicated that hydrophobic characteristics of forest soils reduced the infiltration capacity and did not allow water to permeate in the soil. Moret and Arrúe (2007) indicated that the loosening of surface soil by tillage operations increases the total soil porosity and improve the hydraulic functioning of structured soils. The infiltration capacity of grassland soils is lower due to the compaction caused by animals compress over the soils. Indeed, Thurow et al. (1988) established the significant impact of the grazing intensity on the infiltration. Thurow et al. (1988) indicated that animals compressed the soil with their hooves and reduced the infiltration capacity. Okatan and Reis (1999) determined that hydro physical characteristics of grazing and non-grazing soils were different. Many studies (Bodhinayake and Cheng Si, 2004; Pirastru et al., 2013) determined that the change in LUTLC affects the hydro physical properties of soil. In agricultural land, the infiltration rate of the surface soil is high. Due to excessive compaction in the plow plan, water cannot be carried further down the soil. Therefore, the water entering the soil through infiltration is accumulated at 0 – 30 cm depth. Due to higher litter accumulation and higher availability of materials such as lignin, polyphenol, and resin that give soils hydrophobic characteristics in the surface of forest. Infiltration was affected adversely by over grazing in the wet period depending on the soil water content. In agricultural soils on the other hand, again, depending on the soil water content, the infiltration rate was measured to be higher in the southern aspect than the northern aspect due to cultivating the soils in the northern aspect during the wet period. Except the extreme case of forest soils, the infiltration rates of soil in the southern aspect were measured to be higher in all other land use types.

This research will help to clarify how LUTLC change affects soil properties and SOM accumulation. The SOM, Ks, BD, infiltration rate, and WSA of soil are strongly correlated with land use management practices. Our research focuses on assessing the impact of LUTLC and aspect on soil properties. Statistically significant differences in SOM, WSA, BD, infiltration rate and Ks were detected among the grassland, forest, and cultivated area soils. These results demonstrated that the effect of LUTLC changed on Ks was confined to shallower depths in the soil profile. Cultivation and grazing led to changes in some of the physical, chemical and hydro physical properties of soils. Soil characteristics affected negatively by tillage practices and over grazing in pluvial period are SOM, WSA, Ks, BD, and infiltration rate. The results indicate converting natural forest to grassland and cultivated area decrement SOM in soils of the all aspect.

The effect of LUTLC change on some soil properties should be accounted in order to examine accurately and simulate ecosystem dynamic in the semi – arid region of Turkey. This study indicated that change of LUTLC affected physical, chemical and hydro physical properties of soil particularly BD, infiltration rate, Ks, WSA, and SOM. So, the main objective of all LUTLC must be protection and maintain of natural resources and soil quality. Consequently, Unsuitable and wrong land use are the major factor for the degradation of soils. In catchment scale, forests areas may be positively influenced by relevant hydrological functions like infiltration, percolation, and base flow that support subsequently effect of water regime and sequestration of SOM in a catchment.

Similar results were obtained in many previous studies on this subject (Alem and Pavlis, 2014; Binkley and Fisher, 2013; Singh et al., 2014). For that reason, planners have to construct an implementation method in accordance with public demands and quality of resources.

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Sažetak

Brojne studije pokazale su da konverzija zemljišta ima raznoliki utjecaj na svojstva tla, pa stoga daljnja istraživanja treba usmjeriti na različite ekološke regije i načine korištenja zemljišta. Ciljevi ove studije su: (1) procijeniti utjecaj korištenja zemljišta na različitim ekspozicijama (sjeverna i južna) na svojstva tla i (2) ispitati utjecaj obrade tla i ispaše na hidrološka svojstva tla. Za ispitivanje svojstva tala odabrana su tri različita načina korištenja zemljišta/vegetacijskog pokrova (LUTLC) na sjevernim i južnim padinama, a to su šuma, travnjak i obradiva površina. Uzorci tla uzeti su sa dubine od 30 cm. U uzorcima tla analizirani su sljedeći parametri: tekstura tla, gustoća tla (BD), organska tvar u tlu (SOM), pH, stabilnost agregata u vodi (WSA), kapacitet tla za vodu, točka venuća, stopa infiltracije i zasićena hidraulička provodljivost (Ks). Rezultati su pokazali da se gustoća tla (BD), stabilnost agregata u vodi (WSA), organska tvar u tlu (SOM), hidraulička provodljivost i stopa infiltracije, značajno mijenjaju s načinom korištenja zemljišta/promjenom vegetacijskog pokrova (LUTLC) te s ekspozicijom. Značajke tala na koje nepovoljno utječu obrada tla i ispaša su organska tvar u tlu (SOM), stabilnost agregata u vodi (WSA), stopa infiltracije, hidraulička provodljivost (Ks) i gustoća tla (BD). Na kraju, rezultati sugeriraju da obrada tla i prekomjerna ispaša u polu-suhom području negativno utječu na svojstva tala, te da prekomjerna ispaša šteti hidrološkim svojstvima površinskog tla.

KLJUČNE RIJEČI: slivno područje, infiltracija, korištenje zemljišta, organska tvar, Turska