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Effects of the land use/cover on the surface runoff and soil loss in the Niğde-Akkaya Dam Watershed, Turkey

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ABSTRACT

Erosion, flood, and overflow events are frequently experienced due to changes in the land use in watersheds where human impacts are intensive. It is important to understand the effects of land use types on erosion at a watershed scale. This knowledge can then be used to manage soil and water resources in watersheds better. The aim of this study is to determine the effects of different land uses/covers on the surface runoff and soil loss by using a rainfall simulator in natural land conditions in the Niğde Akkaya Dam watershed with semi-arid conditions. For this purpose, 5 cultivated lands with different product patterns with similar conditions (apple orchard (A), potato cultivation area (P), bean cultivation area (B), clover cultivated land (CL), abandoned cultivated land (AB), plantation areas (cedar (C) and almond (AL)), and pasturelands covered with *Thymus* sp. (T), *Agropyron* sp. (AG) and *Stipa* sp. (S) were selected for the applications. The applications were carried out in two repetitions on circular test parcels of 0.28 m^2 established in these lands. During the land applications, the characteristics of surface runoff (ponding time, surface runoff start time, average surface runoff rate, runoff coefficient) and the average sediment concentration in the surface runoff water were determined. The data obtained were evaluated by using the ANOVA, Duncan's test, and Pearson correlation analysis test and SPSS statistical program. The results of the study revealed that the surface runoff occurred in the abandoned cultivation area, bean cultivation area, potato cultivation area, and thyme-covered pastureland in a short time. The runoff coefficient values by the land cover are sorted from high to low as B > T > P > A > AB > AL > C > CL > S > AG. The sediment concentration in the runoff water is sorted from high to low as T > P > B > AB > AL > A > C > S. When the situation was evaluated in terms of the soil loss (erosion), it was concluded that the sorting is as P > T > A > AB > B > AL > C > S > CL.

1. Introduction

Erosion, which is of global significance, is shown to be one of the most important areal resources of deterioration and pollution in water resources. Pimentel et al. (1995) report that the annual erosion rate in Asia, Europe, and South America, and developing countries is 30–40 t/ha. When evaluated in terms of our country, it is determined that 750 million tonnes of soil are lost with erosion in our country every year as a result of negative effects such as Turkey's having a very rough topography, wrong agricultural techniques applied, inappropriate land use, forest fires, etc. (Taysun and Uysal, 1996). Given that a great majority of the rural population in our country is engaged in agriculture, it will be better understood how important the protection of soils and water resources is. A large part of the lands in our country is under the threat of water erosion of various intensities (Balcı, 1996).

The kinetic energy of water mostly ensures the transportation of soil in water erosion. It can be said that the primary target in the fight against water erosion is to reduce the water runoff velocity and/or the amount of the surface runoff water and the material transported (url 1). The relationship of surface runoff, climate, land cover/land use, and events such as erosion, land degradation, floods and overflow affected by these are the subjects that have attracted the attention of the society and the science environments in recent years (García-Ruiz, 2010; Llasat et al., 2010). However, there is a lack of data that will create a scientific base in practice in subjects such as the properties of the surface runoff, the amount of the material transported, etc. in most of the watersheds in our country. Knowing these data is crucial in order to effectively combat erosion and sedimentation and to take effective protective measures because the plans to be made without being based on scientific evidence cause both more expenses and the fight to fail.

One of the important results of erosion is the loss of the workable surface of the soil, which results in decreased productivity. Due to the decrease in nutrients, the soil becomes unproductive, and the abandonment process starts in agricultural lands. Furthermore,

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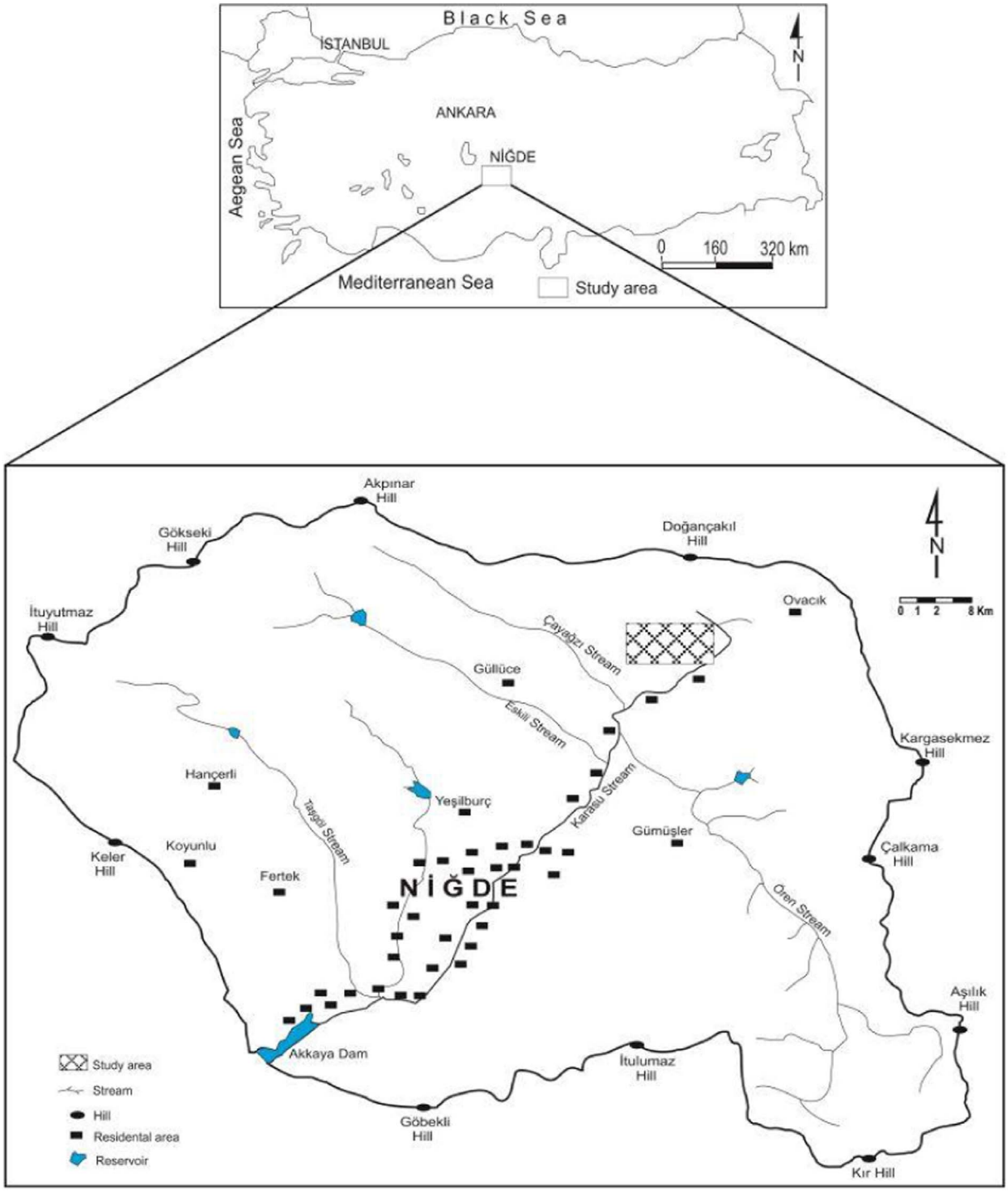

Fig. 1. Location map of the study area.

sedimentation as a result of erosion is a source of pollution in terms of water resources, and it causes eutrophication by increasing especially the nitrogen and phosphorus in water resources (Dimoyiannis et al., 2001; Karamage et al., 2017). Another important result of erosion is the decrease in the capacities of drainage networks, increase in the flood and overflow risk, filling of water reservoirs, and deterioration of water quality as a result of sedimentation in riverbeds (Dimoyiannis et al., 2001).

Changes in the land use damage the natural vegetation cover, increase the erosion rate, the amount of surface runoff and the sediment yield in the watershed scale, which are critical environmental problems in many parts of the world (Ramos-Scharron and Macdonald, 2007). The land use and cover are the most important factors affecting the formation and density of the surface runoff and sediment yield (Chen et al., 2001; Karvonen et al., 1999; Sun et al., 2004; Skaggs et al., 2006). Although the importance of reducing erosion is well-understood, determining the spatial distribution of erosion and reducing the surface runoff velocity are the most important prerequisites for the establishment of erosion management plans in any watershed (Lopez et al., 1998). The land use/cover is an important factor affecting the formation and density of the surface runoff and sediment yield. When the land use and cover are well regulated, soil properties can be improved,