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The nutrient and carbon losses of soils from different land cover systems under simulated rainfall conditions

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ABSTRACT

Nutrient losses constitute an important issue for the protection of both soil and water resources. Organic carbon transport is also important for the global carbon cycle. In this study, it was aimed to determine the amount of nutrients and the total organic carbon which was transported by surface runoff water formed under simulated rainfall conditions from areas with different land cover systems.

Accordingly, 3 cultivated areas having various product patterns under similar conditions (potato field (P), bean-cultivated area (B), abandoned farmland covered with *Noaea* sp. (AB)), 2 plantation areas (cedar (C) and almond (AL)) and 2 rangelands covered with *Thymus* sp. (T) and *Stipa* sp. (S) were chosen for performing applications. The applications were performed in two repetitions on 0.28 m^2 circular experimental plots established in the above-mentioned areas. The collection of surface runoff was performed during land applications. The pH, electrical conductivity, nitrate (NO_3^-), ammonium (NH_4^+), total phosphorus, orthophosphate (PO_4^{3-}), total organic carbon (TOC), and total nitrogen (TN) parameters of surface runoff water were measured. The land cover change affects total nitrogen, nitrate, ammonium, pH, electrical conductivity, total phosphorus, ortho-phosphate and TOC parameters. Nitrate transport was found to be B > P > T > AB > C > AL > S from highest to lowest. Ammonium transport was B > T > AL > C > AB > P > S. The total nitrogen transport was B > P > T > AB > C > AL. The total phosphorus transport was found to be P > B = T > AB > AL > C > S. Ortho-phosphate transport was P > B > T > AB > C > AL > S. In terms of the TOC transport, the order was found to be T > B > P > AB > AL > C from highest to lowest.

1. Introduction

Nitrogen, phosphorus, and carbon transport from soil to water resources constitutes an important environmental and agricultural problem (Favaretto et al., 2006). Erosion and overfertilization mainly lead to water quality deterioration due to nitrogen and phosphorus present in water resources in a watershed (Conan et al., 2003), and these pollutants emerge as a problem of non-point source pollution with ecological consequences that cannot be ignored (Fu et al., 2002; Richard et al., 2002).

Surface flow processes that cause erosion play an important role in the transport of various dissolved and solid matters, including nitrogen and phosphorus (Wu et al., 2012). It is reported that farmlands represent higher susceptibility to soil and water losses when compared to areas with other vegetation types (such as shrub, forest, and herb; Shi and Shao, 2000). The reason for this is the features of crops are different from the features of other vegetation types, as a result of which significant soil erosion occurs on farmland (Cerdà et al., 2009). A significant part of the total watershed sediment and runoff comes from sloped farmland because of human and natural factors (i.e., precipitation intensity, surface soil conditions, geomorphology, subsoil characteristics, and soil management practices), which lead to the degradation of farmland (Keesstra et al., 2016; Zhao et al., 2017). On the one hand, nutrient losses from farmlands lead to a decrease in the fertility level of soils, which influences plant life in a negative way. On the other hand, nutrients coming from fields with runoff and sediments (McDowell et al., 2004) are finally mixed with different water bodies such as rivers, lakes, reservoirs, and groundwater and deteriorate their quality (Sourabh and Akhilesh, 2016). Thus, decreasing N and P losses from land is an important aim of controlling non-point source pollution (Jing et al., 2012). In agricultural areas, a significant part of nutrients was transferred with runoff into surface and subsurface because of the excessive administration of inorganic and organic fertilizers (Zhu et al., 2008).

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Furthermore, higher attention has been paid to soil erosion all around the world due to its influence on carbon geochemical cycles between soils and the atmosphere (Kuhn et al., 2012). There is a significant correlation between the soil organic carbon (SOC) losses and the transport of eroded sediment (Nie et al., 2015). Knowing the transport of SOC by erosion actually gives an idea of changes in the global carbon budget (Nie et al., 2014). Water runoff or wind transports the SOC easily (Lal, 2003). Soil erosion by water has been actually confirmed to take the main part in organic carbon losses (Lal, 2004). If a delivery ratio is assumed to be 10% and the SOC content is assumed to be 2–3%, the total C amount that is displaced by erosion on the Earth can be 4.0–6.0 Pg/year (Lal, 2003). The presence of excess organic carbon in water constitutes an important parameter for organic pollution in water and causes hypoxia (Hale et al., 2016).

If native vegetation is replaced by agricultural plants, a change occurs in the natural cycle, and runoff and sediment erosion may readily transport nutrients (Zuazo et al., 2004). Excessive amounts of nutrients and organic carbon, which are transported by runoff, take a significant part in the process of eutrophication and hypoxia (Wu et al., 2012; Hale et al., 2016).

Eutrophication that originates from the fact that nutrients are present in excessive amounts in different waters constitutes a significant problem all around the world (Ma et al., 2015; Liu et al., 2016). Since freshwater eutrophication is usually limited by P, a reduction of P loss in runoff has become the main objective for bringing the degradation of surface waters to minimum (Carpenter et al., 1998).

Many studies have been conducted recently to understand the interaction between rainfall and soils are better for the purpose of

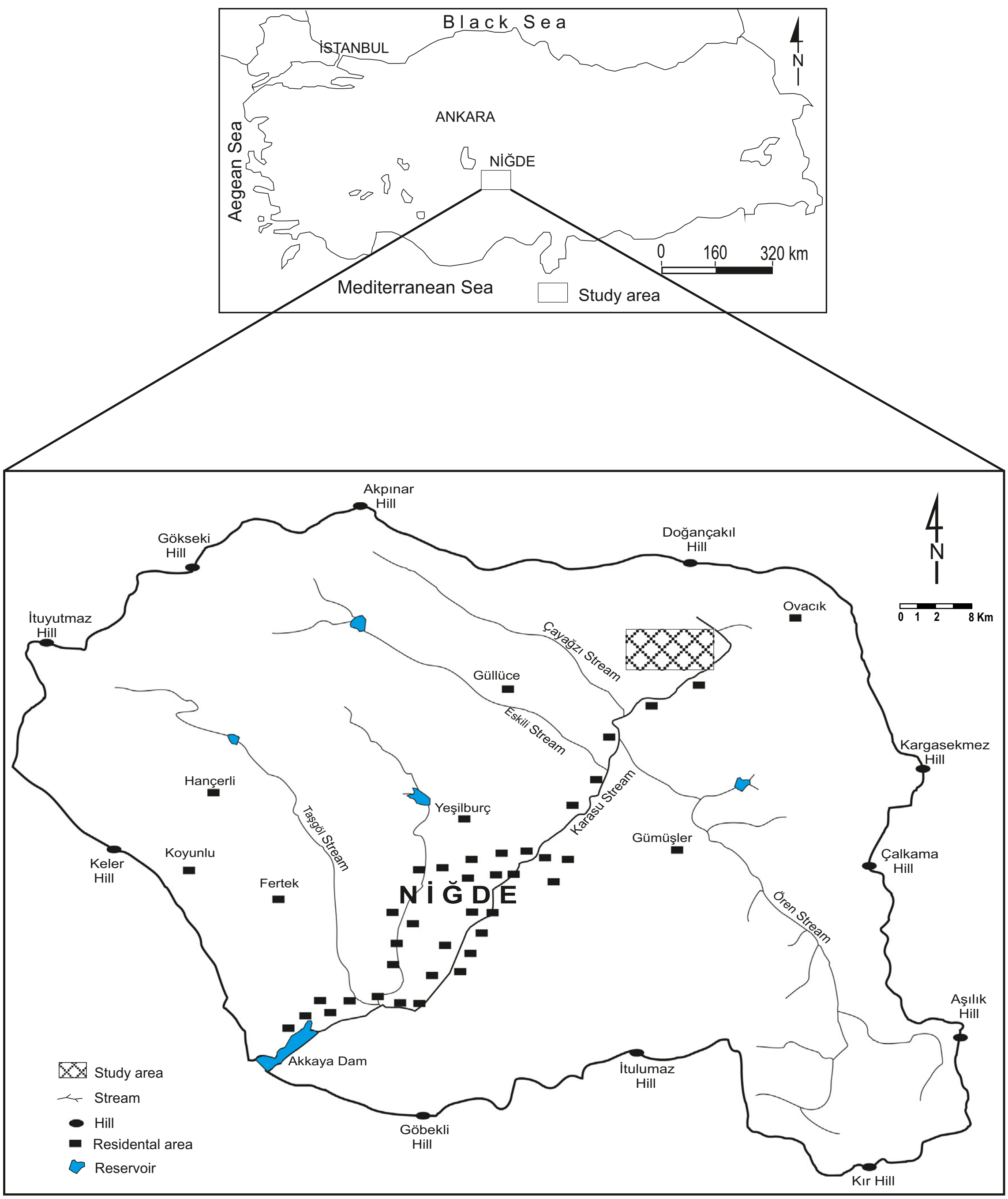

Fig. 1. Location map of the study area.