

Soil Infiltration Rate and its Controlling Factors of Different Land Uses in the TahamChai Catchment, Zanjan

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Introduction Soil infiltration rate is the major soil hydraulic property which can be affected by the soil physical characteristics and management practices. The use of land can affect various soil properties such as physical and hydraulic properties. Differences of the hydraulic soil characteristics such as infiltration rate in various land uses can affect their potential to runoff production as well as soil loss in the catchment. The knowledge of the physical and hydraulic characteristics of various land uses can help to better management of soil and water in the catchment. It is very essential in the semi-arid catchments where vegetation cover is generally poor, the soils are often instable against erosive factors especially when the rainfalls are consecutive and intensive. Therefore, this study was conducted to investigate the soil physical and hydraulic characteristics in the TahamChai catchment, in a semi-arid region, NW Zanjan. Various land uses consist of pastures, rainfed and irrigated lands can be observed in the catchment, which cover about 62%, 33%, and 5% of the catchment area, respectively. The pastures have been covered with poor vegetation and are intensively exhausted by over-grazing. Rainfed lands are mostly under winter wheat cultivation. Soil erosion and sedimentation were the major environmental problem in this catchment.

Materials and Methods The maps of land use and slope gradient were provided for study area. A total of 20 sites were selected based on the surface area of each land use in the catchment located between 34° 46'-36° 53' N latitudes and 48° 17'-48° 37' E longitudes. The study area consisted of ten sites in the pasture, seven sites in the rainfed and three sites in the irrigated lands. The geographical positions of study sites were determined by a global positing system (GPS). Soil infiltration rates were measured by double rings method at three replications in each site. Variation of soil infiltration rate was determined for each land use. Soil samples were collected at three replications from each site to determine other physicochemical soil properties. Particle size distribution, bulk density, saturation percentage, aggregate mean weight diameter, organic matter, and equivalent calcium carbonate were determined using standard methods in the lab. Mean comparisons of infiltration rate along with other physicochemical soil properties among the land uses were done using the Duncan's parametric method. The Pearson's correlation coefficients were used to determine the relationships between soil properties and soil infiltration rate.

Results and Discussion Based on the results, no significant difference was observed between the land uses in particle size distribution. Soil infiltration rate showed different patterns among the land uses, so that significant difference was observed among them ($p < 0.01$). Pastures showed the lowest infiltration rate among the land uses (about 86 and 66 times lower than that of the rainfed and the irrigated lands, respectively). This result was associated with increasing soil compaction through the over-grazing in the pastures. Positive correlation was found between soil infiltration rate and aggregate mean weight diameter ($r = 0.54$, $p < 0.05$) while its correlation with bulk density was negative ($r = -0.74$, $p < 0.01$). Pastures showed the lowest organic matter content (1.35%) as well as aggregate mean weight diameter (1.12 mm) as compared with other land uses. Since the pastures are located on the steeper slopes, they have the highest intrinsic potential to runoff production and soil erosion as compared to other land uses. As a consequence, the over-grazing is the major factor of soil structure breakdown, soil compaction, and in consequence declining soil infiltration rate in the pasture lands.

Conclusion: Pastures with poor vegetation cover appeared the lowest soil infiltration capacity as compared to other land uses in the catchment. Decreasing soil infiltration rate was associated with increasing bulk density in the area. It seems that overgrazing in the pastures increases soil bulk density and leads to decline the soil organic matter content as well as soil aggregation and aggregate stability. According to the results, pastures have the highest potential to runoff production and soil erosion rather than the other land uses (rainfed lands and irrigated lands). Therefore, maintaining vegetation cover and preventing over-grazing in the catchment is recommended to increase soil organic matter content and decrease soil compaction. These practices improve the

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hydraulic soil characteristics especially infiltration rate and in consequence decrease the catchment potential to runoff production and soil erosion.

Keywords: Irrigated land, Pasture, Rainfed land, Soil hydraulic characteristics, Vegetation cover

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