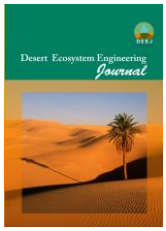
DEEJ (2024) 13 (2) 1-2

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Investigating the Influence of Rain and Wind on Runoff Production and Interrill Erosion under Laboratory Conditions

Mahin Kalehhouei[1], Seyed Hamidreza Sadeghi[2*], Abdulvahed Khaledi Darvishan[3]

Received: 29/09/2024 Accepted: 04/012025

Extended Abstract

Introduction: Characterized by 25% global biodiversity, the soil is known as the unique substrate sustaining Earth's inhabitants. On the other hand, soil erosion caused by water is a primary factor in land degradation. Approximately 75 billion tons of soil and living organisms are removed from soil ecosystems annually due to soil degradation and erosion. Moreover, soil erosion may endanger the quality and health of soil and water. The primary determinants of water erosion are static topographical features such as steepness and slope direction, and dynamic climatic factors, including precipitation and wind, which may cause changes in soil's hydrological processes, indirectly or indirectly affecting other environmental factors. The main point concerning the initiation of water erosion is the impact of raindrops on the soil surface. However, processes affected by the raindrops from the time of descent to the impact on the soil surface have been underresearched, neglecting the influential role of raindrops in creating and changing the behavior of water erosion. Therefore, this study was conducted on the soil collected from the Kojour Watershed in Mazandaran Province, Iran, mainly focusing on the interaction of rain and wind with interrill erosion under laboratory conditions.

Materials and methods: The soil samples, especially those collected from the summer rangelands of the Northern Alborz Range of Kojur Watershed, Mazandaran Province, Iran, were transported to the Rainfall and Erosion Simulation Laboratory of the Faculty of Natural Resources, Tarbiat Modares University. For this o this end, three laboratory plots with dimensions of 0.5 × 1 × 6 m were used at a slope of about 30%. Moreover, the intensity of rainfall was approximately 50 mm h^{-1} with a duration of 30 min under no-wind control conditions and two wind velocities of 3 and 6 m s^{-1} at a slope of 30%. The wind direction of the study area was also considered, opposite the slope (from bottom to top of the plot), as it mainly occurred during the storms in the study region. Furthermore, the wind velocity generated during the experiments was closely monitored using an anemometer to ensure accuracy and consistency throughout the study. Finally, the effectiveness of the interrill erosion process caused by wind-affected rain was demonstrated through statistical comparisons against the control plot.

Results: According to the results of the study, the mean runoff start time varied significantly based on wind velocity. In this regard, the runoff started after approximately 4:19 minutes under calm conditions. Moreover,

1. Former PhD Student, Department of Watershed Management Engineering, Faculty of Natural Resources, Tarbiat Modares University, Noor, Iran

2. Professor (Corresponding Author), Department of Watershed Management Engineering, Faculty of Natural Resources, Tarbiat Modares Resources University, Noor 46417-76489, Iran, Author correspond; sadeghi@modares.ac.ir

3. Associate Professor, Department of Watershed Management Engineering, Faculty of Natural Resources, Tarbiat Modares University

DOI: 10.22052/deej.2025.255449.1078

when wind velocities increased to 3 m s^{-1}, the mean runoff start time was delayed to 7:28 minutes, and the delay extended further to 10:16 minutes at a wind velocity of 6 m s^{-1}. The aforementioned results indicated that the mean runoff volume was influenced by wind velocity. On the other hand, the mean runoff volume was found to be 114.95 l under wind-less conditions. Accordingly, as wind velocity increased to 3 m s^{-1}, the mean runoff volume rose slightly to 123.89 l. However, at a wind velocity of 6 m s^{-1}, the runoff volume slightly decreased to 120.59 l. The runoff coefficients were also found to be 108.33, 114.20 and, 111.27%, respectively.

Furthermore, the study found that the mean soil loss increased under higher wind velocities. On the other hand, the mean soil loss was reported as 1933.88 g under calm conditions. In this regard, when the wind velocity increased to 3 m s^{-1}, the soil loss rose to 2107.25 g, and it further escalated to 2858.58 in cases where the velocity reached 6 m s^{-1}. The sediment concentrations were calculated as 142.20 g l^{-1} under calm conditions, reaching 212.69 g l^{-1} and 410.13 g l^{-1} at wind velocities of 3 m s^{-1} and 6 m s^{-1}, respectively. These results suggest a progressive increase in sediment concentration with rising wind velocities, underscoring the significant influence of wind-induced turbulence on sediment mobilization and transport in runoff. Moreover, the analysis of the results revealed that wind velocity exerted a statistically significant influence on runoff and interrill erosion components at the 5% significance level.

Conclusion: The results of this study confirm that wind-driven rain significantly influences the components of runoff and soil loss. These findings can be a game-changer, providing valuable insights for accurately modeling the water erosion process under natural circumstances. Furthermore, the findings can significantly help executive department managers estimate soil erosion caused by wind storms, thereby fostering sound management and prioritization of erosion-prone areas and soil and water conservation measures.

Keywords: Land Degradation, Rainfall Erosivity, Soil loss, Wind Driven Water Erosion.