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Modelling Soil Inherent Wind Erodibility Using Artifical Intellligent and Hybrid Techniques

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Abstract : In recent years, vast areas of Urmia Lake in Dasht-e-Tabriz has dried up leading to saline sediments exposure on the surface lake coastal areas being highly susceptible to wind erosion. This study was conducted to investigate wind erosion and its relevance to soil physicochemical properties and also modeling of wind erodibility (WE) using artificial intelligence techniques. For this purpose, 96 soil samples were collected from 0-5 cm depth in 414000 hectares using stratified random sampling method. To measure the WE, all samples (<8 mm) were exposed to 5 different wind velocities (9.5, 11, 12.5, 14.1 and 15 m s-1 at the height of 20 cm) in wind tunnel and its relationship with soil physicochemical properties was evaluated. According to the results, WE varied within the range of 76.69-9.98 (g m-2 min-1)/(m s-1) with a mean of 10.21 and coefficient of variation of 94.5% showing a relatively high variation in the studied area. WE was significantly (P<0.01) affected by soil physical properties, including mean weight diameter, erodible fraction (secondary particles smaller than 0.85 mm) and percentage of the secondary particle size classes 2-4.75, 1.7-2 and 0.1-0.25 mm. Results showed that the mean weight diameter, erodible fraction and percentage of size class 0.1-0.25 mm demonstrated stronger relationship with WE (coefficients of determination were 0.69, 0.67 and 0.68, respectively). This study also compared efficiency of multiple linear regression (MLR), gene expression programming (GEP), artificial neural network (MLP), artificial neural network based on genetic algorithm (MLP-GA) and artificial neural network based on whale optimization algorithm (MLP-WOA) in predicting of soil wind erodibility in Dasht-e-Tabriz. Among 32 measured soil variable, percentages of fine sand, size classes of 1.7-2.0 and 0.1-0.25 mm (secondary particles) and organic carbon were selected as the model inputs by step-wise regression. Findings showed MLP-WOA as the most powerful artificial intelligence techniques (R2=0.87, NSE=0.87, ME=0.11 and RMSE=2.9) to predict soil wind erodibility in the study area; followed by MLP-GA, MLP, GEP and MLR and the difference between these methods were significant according to the MGN test. Based on the above finding MLP-WOA may be used as a promising method to predict soil wind erodibility in the study area.

Keywords : wind erosion, erodible fraction, gene expression programming, artificial neural network
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