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Investigating the Effect of Land Use and Soil's Physio-chemical properties on Wind Erosion Threshold Velocities via Data Mining

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Extended Abstract

Introduction: Wind erosion is a phenomenon that causes severe environmental changes in arid and semi-arid climates. As surface soil texture is very effective in soil erodibility, identifying soil erodibility index is important and efficient. Mismanagement greatly contributes to the development of wind erosion. The velocity that makes the first particles of soil move from the surface is called the erosion threshold speed. Measuring the factors involved in wind erosion has always been difficult and costly. Therefore, using wind tunnels is suggested as an alternative method. This study investigated the physical and chemical properties of soil and their effects on wind erosion.

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Materials and Methods: The Meybod wind canal is located at 32° 07′ 00"- 32° 11′ 00" and 35° 56′ 00"-54° 06′ 00". Using satellite images derived from Google Earth and the GIS software and the data gathered via field visits, a study border was designated for the region. Based on the area's characteristics and the existing facies, a forty-points sampling network was randomly applied to the study area. As for the threshold speed test, first the wind erosion measuring device was placed on the desired point, and the wind speed was increased slowly to reach the erosion threshold speed; then the intended samples were collected from the surface soil (0-5 cm of soil surface). The soil's physical and chemical properties including sodium, calcium, magnesium, organic carbon, organic matter, salinity, sodium absorption ratio, sand, clay and silt, gravel percentage, as well as soil moisture and texture were measured in the laboratory. In the next step, the Weka 3.8 software was used to determine the role of each physical and chemical parameter on the erosion threshold speed.

Results:

- Land use

Using the decision tree algorithm, the relationship between land use characteristics of all points with threshold speed was investigated and the results were extracted. The effect of each parameter on the velocity of the erosion threshold was also obtained. Data mining results showed a high correlation between land use parameters and the erosion threshold speed. It was also found that the land use characteristics had a greater impact on the secondary threshold speed.

- Physical parameters

The results of data mining indicated a significant correlation between physical parameters and the threshold speed. According to the obtained statistical results, it was found that physical properties had the greatest effect on the secondary threshold speed. Therefore, the secondary threshold velocity had been used to examine the correlation and trend.

- Chemical properties:

The results of data mining suggested a high correlation between chemical parameters and the threshold speed. According to the obtained statistical results, it could be found that chemical properties had a greater effect on the secondary threshold speed; Therefore, to investigate the correlation and the effect of each parameter on the threshold speed, the secondary threshold speed was used. Based on the significant correlation between threshold velocity and erodibility index, it was found that the erodibility index had an effect on the erosion threshold speed. It was also found that the threshold speed decreased with an increase in erodibility index.

Discussion and conclusion: This study investigated the effect of physical and chemical properties, and land use on erosion threshold speed using data mining with decision tree algorithm. Moreover, the SPSS software was used for discovering the correlation between those factors and erosion threshold. The results of land use data mining showed that land use characteristics, including surface pavement, cultivation status, and canopy status affected the threshold speed.

The results of physical properties' data mining indicated that soil saturation percentage, Special

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Weight and sand and silt percentage, soil texture, surface gravel percentage, and moisture were respectively effective up to 40%, 20%, 90%, 30%, and 100% on the threshold speed. On the other hand, the results of chemical properties' data mining suggested that the sodium adsorption ratio could be effective up to 90% on the threshold speed. It was also found that organic carbon and organic matter were 100% effective on the erosion threshold rate. However, calcium and magnesium were found to affect the erosion threshold only by 10%. This study's findings are consistent with those found by Lee (2007), Lee et al. (2008), Mahmoudabadi and Rajabpour (2017), Azimzadeh et al. (2002) and Nourozzadeh Haddad and Bahrami (2015).

Physical parameters' statistical results showed that parameters such as the percentage of gravel, silt, and sand had the greatest effect on the velocity threshold, and that the special weight and clay percentage were least effective in this regard. These findings are consistent with those found by Zare Arnani (2014), Azimzadeh et al. (2004). Furthermore, the statistical results of soil's chemical parameters suggested that sodium and magnesium had the least effect on wind erosion threshold speed, while the highest impact belonged to the percentage of organic carbon and organic matter, which could be attributed to the high adhesion of soil particles in the presence of organic matter and organic carbon. These findings are consistent with those found by Ekhtesasiet al. (2003), Azimzadeh et al. (2004) and Zahrabi et al. (2019).

Keywords: wind erosion meter, Soil properties, Decision Tree Algorithm, Geomorphological facies.