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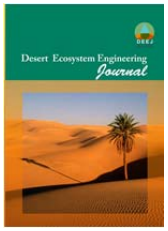

Monitoring Changes in the Wind Regime and Trend of Sand Drift Potential in Iran's Southeastern Coastal Deserts (Konarak-Chabahar)

Mohammad Reza Rahdari[1]

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Extended Abstract

Introduction: Wind erosion is a phenomenon that involves various complex factors that are not yet fully comprehended. Its study requires knowledge of multiple disciplines, including atmospheric sciences, fluid dynamics, soil science, environmental and agricultural science, and land management. The desert areas of Iran are geographically classified into two general categories: internal and coastal deserts. However, Iran's coastal deserts, which are spread as an east-west strip from Gwatar Bay to Khuzestan, have been under-researched. Considering the importance of the wind regime in the coastal areas, this study set out to evaluate the trend of sand drift potential changes in southeastern Iran.

Materials and Methods: Initially, the wind data collected from the Chabahar and Konark synoptic stations were processed and prepared for further analysis. According to Fryberger's studies, the wind erosion threshold equals 12 knots. Moreover, WR Plot and MATLAB software were used to perform relevant analyses. Also, standard wind speed classes were used to calculate sand drift potential using the Fryberger method. Finally, the trend of the changes was evaluated using the Mann-Kendall and Sen's slope statistical tests.

Results: The average wind speeds in Chabahar and Konarak synoptic stations were found to be 6.05 and 5.01 knots, respectively. Furthermore, the evaluation results of calm wind percentage revealed that Konarak station enjoyed a higher frequency than Chabahar. Also, the annual calm wind percentage in the Chabahar and Konarak synoptic stations was reported as 19.83% and 47.95%, respectively. Based on the annual scale, the southeast (15.55%), the west (13.64%) in Chabahar, and the southwest (11.57%) and south (11.27%) had the highest direction abundance in Konarak. On the other hand, the investigation of the seasonal wind regime indicated that southwest and west winds were more frequent in winter and spring in Chabahar and Konark, respectively. However, the highest frequency of southeast and southern winds occurred during the summer and autumn in both regions, respectively. Moreover, the results of annual sand drift potential showed that the occurrence of sand drift potential was more likely in Konarak than in Chabahar. In addition, the sand drift potential is directed towards the northeast in both regions, indicating the greater significant influence of coastal winds that blow from the Oman Sea towards these two areas. Furthermore, the results of non-parametric statistical tests such as Mann–Kendall and Sens slope which were performed to assess the trend of changes in sand drift potential suggested that according to both statistical tests, in all the studied months, the trend of changes was negative in Chabahar and positive in Konarak. On the other hand, the analysis of trend findings revealed that the sand drift potential was significant in Chabahar and Konarak at 99% and 90%, respectively.

1. Department of Nature Engineering and Medicinal Plants, Faculty of Agriculture, University of Torbat Heydarieh, Torbat Heydarieh, Iran; Email: Rahdarimr@torbath.ac.ir

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Discussion and Conclusion: The investigation of the wind regime's frequency in the study area indicated the dominance of southeast, south, southwest, and west winds on an annual scale. Also, seasonal changes were observed in the Chabahar and Konarak due to the nature of the coastal winds blowing there. It was also found that while southeast winds blew more frequently during the summer, southwest and west winds were more frequent throughout other seasons. In a study on the southeastern coast of Iran, the significance of wind erosion has been emphasized, considering the fact that wind erosion processes constitute one of the main factors involved in changing coastlines. Over time, the inconsistency of air and dryness has brought about significant consequences, causing the sand dunes to move. The findings of this study are consistent with other studies conducted on the wind regime of the Oman Sea's coasts. As mentioned in other studies, this region is affected by two types of wind regimes: 1) western winds and 2) monsoon winds blowing from the south and southwest. In similar studies carried out in the Iranian coastal areas, including the coast of Jask, sea-to-shore winds (anabatic) have been found to have contributed more critically to forming sand dunes than land-to-sea (katabatic) winds. In the current study, the statistical analysis of the changing trend in Chabahar indicated a negative trend which was totally different from the positive trend found in Konarak. What was mentioned above may be regarded as the origin of the wind regime formation in Chabahar and Konarak.

Several studies have found that changes in air pressure gradient cause changes in wind speed, being able to affect erosion processes in coastal areas. In a study conducted in the Northern Hemisphere, the general trend of wind speed was negative from 1980 to 2016, which is consistent with the results found in the current study for Chabahar. Another similar study reported that the western regions of Pakistan were affected by a positive trend in wind speed, arguing that the decrease in soil moisture in the western areas of Pakistan over time has altered the wind regime of those areas. Therefore, due to the proximity of Konarak to the western part of Pakistan, these areas may possess a similar positive trend, as mentioned in the results of the current study. As mentioned in similar studies, if relevant governmental officials do not set appropriate plans for combating wind erosion, the phenomenon may bring about harmful consequences for human societies, transportation, etc. Moreover, there is an urgent and necessary need to study wind erosion processes in different regions of the world, including coastal areas. One of the main limitations of this study was the lack of data on wind speed and wind direction at a short time scale (for instance, minutes). Therefore, it is recommended that a more detailed study be conducted in this regard. Wind measuring stations should also be established and operated along the coasts of southeastern Iran. Finally, it is suggested that satellite images taken during the long-term period be used to perform a more precise analysis of the anemometer data in the region and to investigate their influence on the formation of sand dunes, seeking to obtain more accurate information concerning the movement direction and speed of coastal sand dunes.

Keywords: Wind direction, Mann–Kendall, Sens Slope, Chabahar, Konarak.