J. Agr. Sci. Tech. (2012) Vol. 14: 919-928

Investigation of Sand Drift Potential (Case Study: Yazd – Ardakan Plain)

T. Mesbahzadeh[1*], and H. Ahmadi[1]

ABSTRACT

Erosion by wind is one of the most important factors in desert environment. Prevailing winds can shift sand dunes and affect their accumulation. Also, wind regime determines the direction of sand dune mobility. The aim of this research was to investigate sand drift potential using sand movement models. For this research, wind data between 1986 and 2005 from the meteorological station of Yazd were acquired to examine sand drift potential (DP), and erosive storm winds through different methods. The sand drift potential values show that the resultant drift direction (RDD) is from southwest-west towards northeast-east. The unidirectional index value is 0.47. The Yazd – Ardakan plain is under the influence of a low energy wind regime (DP< 200 VU). The *DP* index should be considered for planning and development projects and conservation work. Calculations show that under a low energy wind regime, the amount of sand drift flow is 15.74 m^3 m^{-1} $year^{-1}$. The angular direction of *RDD* is 77°, measured clockwise from the geographical north. The trend of sand movement is observed following a clockwise pattern. With regard to the monthly sand rose, it is seen that the resultant drift potential is low in September and October (1.91-2.1) while the highest resultant drift potential occurs in May. The results obtained from the analysis of wind rose data indicated that the direction of prevailing winds in the Yazd basin is generally from west to north-west, and the storm winds have been generally directed northwest, and the frequency of winds of a velocity less than 6 m s^{-1} (threshold velocity) is 93.79% as observed from Yazd meteorological station.

Keywords: Fryberger method, Sand dunes, Sand rose, Storm rose, Wind regimes, Wind Rose.

INTRODUCTION

Prevailing winds can shift sand dunes and affect their accumulation (Saqqa and Saqqa, 2007). Also, wind regime determines the direction of sand dune movement (Pye and Tsoar, 1990; Lancaster, 1995). Having a regional knowledge of the magnitude of aeolian processes, we can assess the powerful influence of sand dune mobility on residential areas and infrastructure (Khalaf and Al-Ajmi, 1993). Three parameters, including the frequency, magnitude and directional modality of aeolian processes, have a very important impact on the morphodynamics and form of sand dunes (Pearce and Walker, 2005). For the identification of wind ablation regions, wind regime is a useful method, as there is a strong correlation between wind regimes and sand dune forms (Lancaster, 1999; Jeffrey and Zobeck, 2002). Plotting sand rose, wind rose and storm rose is an easy, fast and most accurate method for the identification of wind ablation (Jeffrey and Zobeck, 2002).

Processes of wind regimes have been examined by many researchers who believed that investigating wind regimes and sand dune

[1] Department of Range Science, Faculty of Natural Resources, University of Tehran, Karaj, Islamic Republic of Iran.
Deapartment of Natural Resources, Science and Research Branch, Islamic Azad University, Tehran.
[*] Corresponding author, email:tmesbah@ut.ac.ir

mobility gives a measure of drift potential (DP) (Saqqa and Saqqa, 2007). To estimate *DP*, wind speed–direction data from meteorological stations are used. Many formulae and software applications have been suggested but among these formulae, Fryberger's is the best and has been widely used since 1984 (Bullard, 1997; Tsoar and Blumberg, 2002; Pearce and Walker, 2005).

Another important factor that determines the morphology and dynamic of sand dunes is grain size (Cooke and Warren, 1973). Furthermore, the grain size characteristics of the dune sands are closely related to factors such as, sand accumulation, density of vegetation, sand availability, and the transportation distances from the source zones (Folk, 1971; Pye and Tsoar, 1990; Wang *et al.,* 2003). Also, grain-size distribution characteristics of dune sands are closely related to dune morphology. The main objective of this research is the investigation of sand drift potential based on wind data from Yazd meteorological station.

MATERIALS AND MTHODS

This study was conducted in the Yazd-Ardakan plain which is located in the northern part of Yazd province in the center of Iran. The plain is located in the world belt of wind erosion as wind action is the most dominant geomorphologic agent in this area extending between 31°13' to 32°48' N latitude and 52°57' to 54°59' E longitude. It also occupies an area about 159, 5,000 ha. Rainfall is very rare and occurs mainly in winter. The average annual precipitation is 62.1 mm while the annual potential evaporation is 3,483 mm. The climate is hyperarid-cold, with frosty winters and hot summers (Khalili, 1992). Maximum and minimum elevations are 2,873 and 1,131m above sea level, respectively. The general slope of the region is from northwest to southeast at the Siyah Koh plateau with a mean slope value of 6%. There are the oldest and newest formations in this plain from Precambrian to Quaternary. The main rocks are limestone, Shir koh granite, shale and sandstone. Sand dune forms in Yazd-Ardakan plain are often barchan, barchanoid, and seif (Figure 1).

To achieve the aims of this study, the followings were used:

-Topographical maps at the scale of 1:50000 in order to prepare a regional base map as well as to determine physiographical characteristics including slope and hypsometric study.

- Geological maps at the scale of 1:250000 to determine the regional lithology.

-Satellite images at the scale of 1:100000 to consider geomorphologic characteristics of the region as well as boundaries of sand dune forms. Alignment and forms of sand dunes are effective criteria for the determination of wind direction.

-Aerial photos at the scale of 1:50000 for interpreting the morphological characteristics of the sand dunes.

-The anemometric data for calculating sand wind, wind storm and storm rose from 1986 to 2005.

- The method proposed by Fryberger (1979) for determining sand drift potential (DP).

- Sand Rose Graph software (3): This software is a computer program accessible for estimating sand drift potential (DP) by winds, resultant drift potential (RDP) and Uni Directional Index (UDI) and for plotting sand roses.

- WRPLOT software: This software uses several meteorological data formats to plot wind rose and storm rose. A wind rose is the

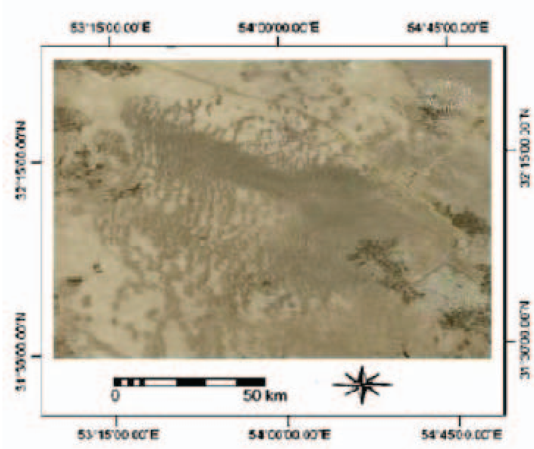

Figure 1. The location of the study site.

most common way to display statistical information on the relationship between wind speed and direction at a particular site. Basically, the frequency of occurrence of winds from different directions is calculated from a dataset, and then a polar plot is constructed (similar to a bar graph) with length out from the center proportional to relative frequency. Storm rose is one kind of wind rose that shows wind speed more than threshold (about 6 m s^{-1}). Wind roses are used in many applications, such as wind energy development, sailing, and air quality management. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram; eight or sixteen directions are used. The branches are divided into segments of different thickness and color, which represent wind speed ranges from that direction. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction. In this research, anemometric data of a duration period of about 20 years (1986-2005) from the synoptic station of Yazd have been taken and analyzed through WRPLOT software.

-WD convert: This software converts data from meteorological stations to Lakes format. The wind data come in a standard format and represent the annual average of the percent of hourly occurrence of surface wind measured at 10 m height above ground and are arranged into 12 wind speed classes in 12 directions.

-Analyzing grain size characteristics of dune sands in the study area. The sampling was completed over sand dunes through different sites over a regular grid (500 by 500 m) and after sieving, cumulative and scattered diagrams of sand diameters are drawn and mean diameter is calculated (Ahmadi *et al.,* 2001).

The Sand Rose Graph Software

Sand Rose Graph software is a simple computer program that can read wind speed – direction data from meteorological stations. It is a program accessible for estimating sand drift potential (DP) by winds, resultant drift potential (RDP) and unidirectional index (UDI) and for plotting sand roses. It shows wind velocity and frequency and direction changes in the meteorological station. This software was written using Microsoft Visual Basic and was provided by Yazd University. Wind data available in various formats had to be converted to Lake Format before being used by this software. There are many equations such as the Lettau and Lettau (1978), Bagnold (1941), Zingg (1953) and Hessu (1973) equations that can be used for estimating *DP* for creating this computer program. In this research, we used the Lettau and Lettau (1978) equation (Equation (1)). There is some difference between wind rose and sand rose. Wind rose shows the direction and velocity whereas sand rose shows the direction of sand transition and is related to wind speed and gives the wind energy and erodibility.

The Fryberger Method

For calculating sand drift potential**,** the Fryberger method uses wind speed and direction data. Drift potential (DP) is estimated for all possible wind speed-directions (Pearce and Walker, 2005). Lettau and Lettau (1978) estimated the rate of sand drift, using the follow equation:

$$q= (C'' \rho/g)\ V^{*2}(V^{*} - V^{*}_{t}) \qquad (1)$$

where q is the rate of sand drift; g is the gravitational acceleration; C'' is the dimensionless constant based on grain diameter; ρ is the density of air; V^* is the shear velocity of wind; and V^*_t is the impact threshold shear velocity of wind. Fryberger simplified this equation (Al-Awadhi *et al.,* 2005) to:

$$Q\ \alpha\ u^2 (u-u_t)\ t \qquad (2)$$

Where, Q is a proportionate amount of sand drift in vector units, u is the average wind velocity measured at a height of 10 m and u_t is the impact threshold wind velocity. The threshold velocity (u_t) for sand movement is

[DOR: 20.1001.1.16807073.2012.14.4.1.7]

estimated as 12 knots under dry conditions (Fryberger, 1979), and t is the time the wind blew as a percentage of the total record.

The combination of u^2 $(u\text{-}u_t)$ t is termed a 'weighting factor', in which strong winds are given higher weightings and weaker winds lower weightings (Al-Awadhi, 2005). In order to calculate the weighting factor, we need the threshold velocity which was taken as 12 knots at 10-meter height as suggested by Fryberger (1979) and Bagnold (1994). The value of u^2 $(u\text{-}u_t)$ t is divided by 100 to lower the magnitude of the WFs and simplify plotting of sand roses (McKee, 1979; Bullard, 1997). A worked example for the derivation of WFs (McKee, 1979) is shown in Table 1.

Table 2 is an example that illustrates an output of vector units (VU) along N wind direction sand drift for Yazd meteorological station from 1961 to 2005.

Then, with regard to frequency values in wind speed classes, the *DP* values were calculated for each given speed of each direction, and the sum of *DP* was considered as the *DPt.* Because each class is a part of meteorological standard wind classes and their frequency are available, they were selected by Fryberger (1979) method.

When drift potential values were calculated for all wind speed–direction data (wind direction was categorized into the 16 compass points: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW and NNW), they were used to determine a resultant drift potential (RDP). This *RDP* describes the net sand transport potential when winds from various directions interact. If this value is more than 50 mm, the length is scaled by a reduction factor called reduction factor (RF), and *RDD* expresses the angle between *RDP* and the north (Rajabi *et al.,* 2006). This is used to show the direction. The results are graphed as sand rose. A sand rose is a circular vector diagram representing sand drift potential in the entire compass ordinates (Figure 2). The scaling factor in the center of the circle is for comparison and ease of presentation.

RDD and total drift potential were summed from all directions. Fryberger (1979) classified the wind regime of various desert areas using *DP* and the ratio of *RDP* to *DP*. This index expresses the directional variability of the wind regime (Table 3).

RESULTS AND DISCISSION

Average seasonal and monthly sand *DP*

Table 1. An example to demonstrate the calculation of WF using Fryberger (1979) equation (data from McKee, 1979, Table 14).

Wind speed	Mean velocity	U^2 $(U\text{-}U_t)$	Weighting factor category (knots) of winds	U^2 $(U\text{–}U_t)/100$
17–21	19.0	361.0	7.0	25.3
22–27	19.0	600.3	12.5	75.0
28–33	30.5	930.3	18.5	172.1
34–40	37.0	1369.0	25.0	342.3

* *U*t taken as 12 knots at *Z*= 10 m.

** Wind speeds> 40 knots are very rare and not computed.

Table 2. *WF, T* and *VU* for *N* wind direction, Kerman meteorological station (1961-2005**).** Yazd**.**

	Wind speed (in Knots)				
	11-16	17-21	22-27	28-33	34-40
WF	2.7	25.3	75	172.1	342.3
T	3.32	0.94	0.15	0.038	0.0052
VU	8.964	23.782	11.25	6.54	1.814

$\sum$ VU= 52.35

[DOR: 20.1001.1.16807073.2012.14.4.1.7]

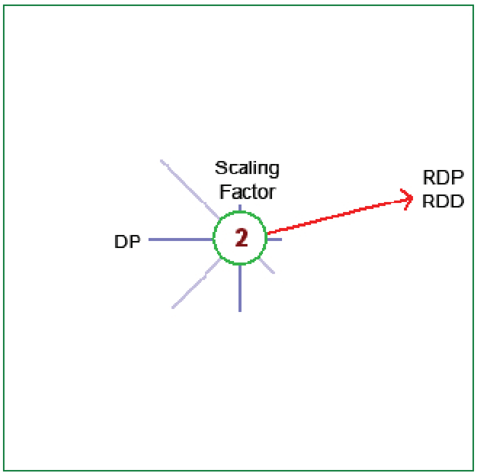

Figure 2. An example of sand rose showing sand drift potential (DP) in 8 wind directions, the resultant drift potential (RDP) vector is aligned in the resultant drift direction.

estimated in the 8 directions, for Yazd station are shown in Figure 3. The resultant of annual drift direction is from the southwest-west towards the northeast-east.

The annual sand *DP* amount of the study area is 118.5 VU (calculated by software using the Lettau-Lettau equation). The greatest *DP* occurs during spring, followed by winter whereas the lowest *DP* occurs during autumn (Figure 4).

DP values are high in March to May and nearly zero in September. The obtained results show that the northwest, southwest and west winds have the highest drift potential (Figure 5).

The *RDD* from January to April is toward north-east (45° from N-direction), while it varies during other months. The unidirectional factor was seasonally and monthly calculated. It varied from 0.43 to 0.54. The autumn and spring usually have the lowest *RDP/DP* ratio, implying the intermediate variable wind direction. Also, it was observed that October had the highest value with a value of 0.67 while November had the lowest index value (0.35). Regarding to Fryberger (1979) classification, this means that the variations are very extensive. Annual UDI value (0.47) also indicates that intermediate directional variability dominates the Yazd-Ardakan plain. In addition, because the value of *DP* was 92.39, according to the classification of Fryberger (1979), this area belongs to the group of low energy wind environment (Tables 4 and 5, Figure 6).

Results obtained from the Wind Rose Plot software (WRPLOT) analysis indicated that the direction of prevailing winds in Yazd basin was generally from west to north-west (W-NW). The southeast (SE) direction comes next in level (Figure 7). Interpretation of aerial photos and satellite imagery show that sand dunes (the most important of them being barchans, barchanoid, and seif) were formed along these predominant winds. These kinds of dunes have two sides with different slopes. The low slope side (the upwind side) shows the direction of predominant wind (Figure 8).

Among the anemometric data employed in this research, the frequency percentage of calm winds with a velocity of less than one knot (0.54 m s^{-1}) was estimated to be 39.64%.

Results obtained, after determining and drawing the storm rose, indicate that based on the minimum threshold velocity (about 6ms^{-1}), storm winds in Yazd plain have been generally directed northwest. The other west sector winds, including those towards west and southwest direction, were almost of the same nature, while southeast winds played a

Table 3. Fryberger's (1979) classification of wind energy using *DP* and *RDP/DP*.

DP (Vector units)	*DP*(m^3 m^{-1} *year*$^{-1}$)	*RDP/DP*	Energy of wind direction	Probable category
< 200	< 17	< 0.3	Low	Complex/Obtuse bimodal
200-400	17-33	0.3–0.8	Intermediate	Obtuse /Acute bimodal
> 400	>33	> 0.8	High	Wide/Narrow unimodal

RDP/DP= 1 stands for unidirectional wind whereas *RDP/DP*= 0 characterizes multidirectional winds, which vectorially cancel each other (Yizhaq *et al.,* 2008).

[DOR: 20.1001.1.16807073.2012.14.4.1.7]

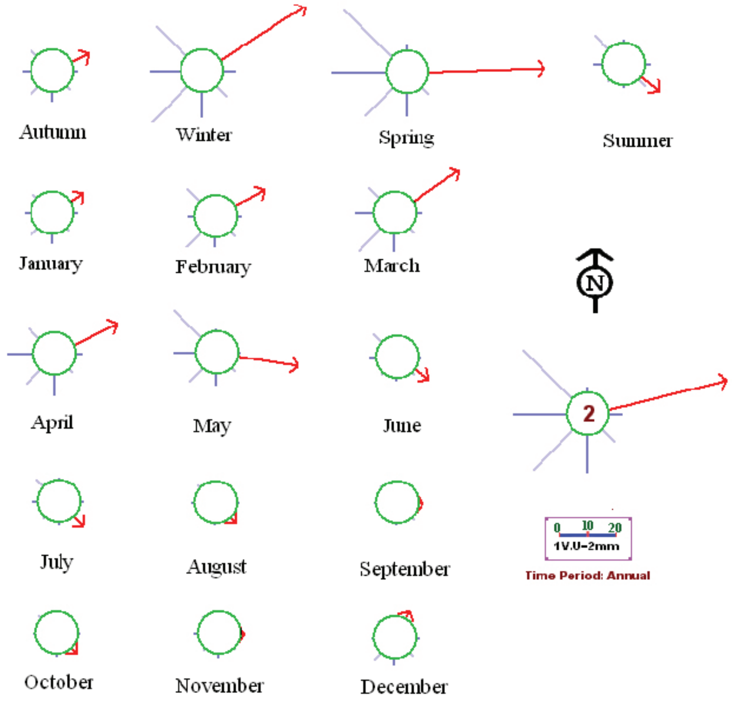

Figure 3. Average annual, seasonal and monthly sand *DP* (1986-2005)

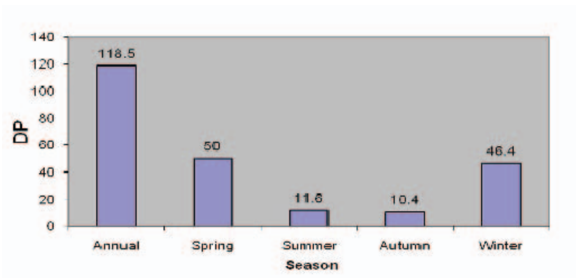

Figure 4. Annual and seasonal drift potential (in VU) (1986-2005). Drift potential (DP).

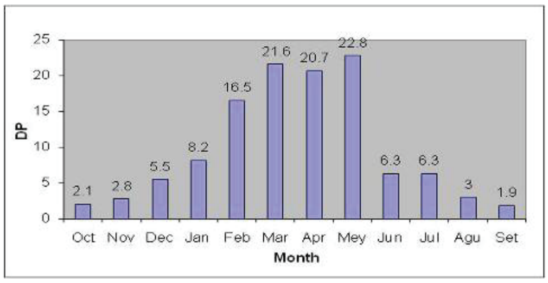

Figure 5. The values of *DP* in different months (in VU) (1986-2005). Drift potential (DP).

less important role. Based on the storm rose, the frequency of winds of a velocity less than 6 m s^{-1} (threshold velocity) is 93.79% as observed from Yazd meteorological station, and the frequency of dust storm winds is reduced to 6%.

The analytical results of the grain size show that the mean grain sizes vary between 180 and 300 µm (about 280 µm), and the values of sorting and Skewness are 1.4 and -0.17, respectively.

The sorting values suggest that the Yazd-Ardakan dune sands have been subjected to little transport from the source area to the

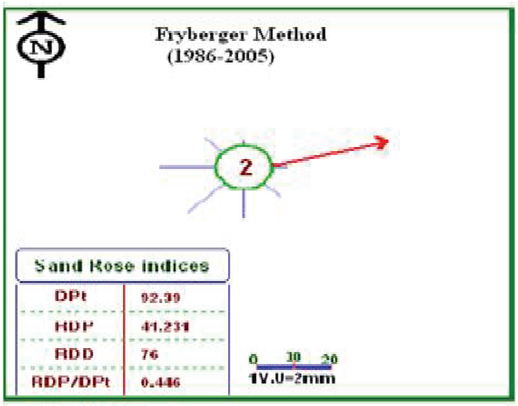

Figure 6. Average annual sand *DP* using the Fryberger method.

Table 4. Wind speed values (in knots) within wind speed–direction categories.

	11-17	17-22	22-28	28-34	34–40	>= 40	Total
N	1.5836	0.8784	0.1381	0	0	0	2.60
NE	0.3959	0.2452	0	0	0	0	0.64
E	2.5429	1.3176	0.5525	0.6208	0	0	5.03
SE	4.4821	1.6113	1.1131	0.6208	0	0	7.82
S	0.9125	2.1960	2.5025	5.0032	1.745475	0	12.3
SW	2.1940	5.4188	5.8418	4.3824	0.581825	0	18.4
W	6.6224	5.3218	4.3143	2.1912	1.16365	0	19.6
NW	7.6424	32	4.03	4.3824	1.745475	0	25.9028
Total	26.376	25.091	18.492	17.200	5.236425	0	92.397

Table 5. Drift potential values calculated using the wind class for the eight compass points.

	11-17	17-22	22-28	28-34	34–40	>= 40	Total
N	0.404	0.0308	0.0017	0	0	0	4.26
NE	0.101	0.0086	0	0	0	0	1.90
E	0.6487	0.0462	0.0068	0.0034	0	0	5.823
SE	1.1434	0.0565	0.0137	0.0034	0	0	13.1
S	0.2328	0.077	0.0308	0.0274	0.0051	0	4.21
SW	0.5597	0.19	0.0719	0.024	0.0017	0.0017	6.56
W	1.6894	0.1866	0.0531	0.012	0.0034	0	14.6
NW	1.9496	0.2841	0.0496	0.024	0.0051	0	13.2
Total	6.7285	0.8798	0.2277	0.0941	0.0154	0.00	63.8

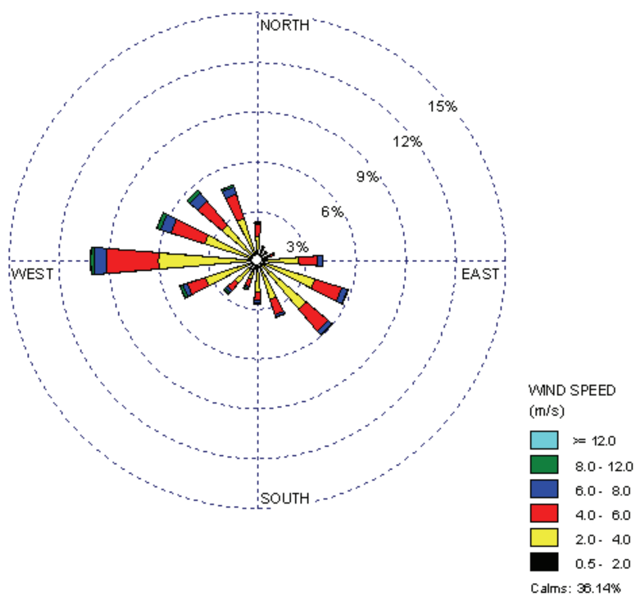

Figure 7. Annual Wind Rose of Yazd station.

[DOR: 20.1001.1.16807073.2012.14.4.1.7]

Figure 8. The direction of wind in a barchan.

dune system. Skewness value suggests that dune sands are coarse skewed.

CONCLUSIONS

Yazd –Ardakan basin is one of the areas exposed to wind erosion and dust storms. Analysis of anemometric data has a special importance for evaluating and distinguishing erosive storm winds. The angular direction of *RDD* is 77°, from southwest- west towards northeast- east, measured clockwise from the geographical north that shows the main winds with more frequency can move more sediments in a year and have a more important role in the formation of sand dunes and sand drift.

The Unidirectional Index value is 0.47, and according to Fryberger and Dean's (1979) classification it is suitable for the formation of linear and transverse dunes. This index is representative of the effect of mutual winds within spring and winter to autumn and summer. The most powerful winds blow in spring and winter seasons and autumn and summer seasons have more peaceful conditions.

With regard to satellite images, the direction of sand flow is the same as the morphology of sand dunes in this area.

Calculations show that under a low energy wind regime, the amount of sand drift flow is 15.74 $m^3\ m^{-1}\ year^{-1}$. With regard to the monthly sand rose, it is seen that resultant drift potential is low in September and October (1.91-2.1) and the most resultant drift potential is relevant to May.

The Fryberger method of classification of DP, RDP and UDI can help interpret and classify aeolian dune landscapes.

The obtained results indicate that the NW, SW and W winds have the most drift potential (DP), respectively, while other winds are of less power for carrying sands. Erosive winds, which match with storm rose diagrams show the northwest direction of sand transition.

The Fryberger method is a useful approach for evaluating sand drift potential by wind and there is negligible difference between *DP* obtained from manual methods and Sand Rose Graph software.

The grain size distributions for the Yazd-Ardakan dune sands are controlled by their closeness to the sediment sources. Also, grain size distributions show that coarse particles are located northwest while finer particles are in the southeast that is coincident with dominant winds in the study area.

Sand encroachment hazards affect man-made infrastructure due to wind regimes. Sand drift potential is a serious hazard to roads, settlements and agricultural lands. This problem is accelerated by the extreme arid conditions that may occur in different seasons.

ACKNOWLEDGEMENTS

The authors appreciate the contribution of Faculty of Natural Resources for funding this project.

REFERENCES

1. Ahmadi, H., Ekhtessassi, M. R., 2001. Investigation on Sand Dunes Resource. *Research Plan Reports*. 155PP.
2. Al-Awadhi, J. M., Al-Helal., A. and Al-Enezi, A. 2005. Sand Drift Potential in the Desert of Kuwait. *J. Arid. Environ.*, **63**: 425- 438.
3. Bagnold, R. A. 1941. The Physics of Blown Sand and Desert Dunes. Methuen, London. 265 pp.
4. Bullard, J. E. 1997. A Note on the Use of the 'Fryberger Method' for Evaluating Potential Sand Transport by Wind. *J. Sediment. Res*. **67(3A)**: 499-501.
5. Bullard, J. E., Thomas, D. S. G., Livingstone, I. and Wiggs, G. F. S. 1996. Wind Energy Variations in the Southwestern Kalahari Desert and Implications for Linear Dune Field Activity. *Earth Surf. Process. Land.* **21**: 263-278.
6. Cooke, R. U. and Warren, A. 1993. Desert Geomorphology. UCL Press, London. 526 pp.
7. Ekhtessassi, M. R. and Ahmadi, H. 1994. Method of Origin Determination of Sand Dune in Iran. *JRWM*, **47**:10-18.
8. Ekhtesasi, M. R., Ahmadi, H., Feiznia, S. and Busche, D. 2005. Wind Erosion, Facies and Damages in Yazd – Ardakan Plain. *Iranian J. Natural Res.,* **57**:567-581.
9. Folk, R. L. 1971. Longitudinal Dunes of the Northwestern Edge of the Simpson Desert, Northern Territory, Australia. 1. Geomorphology and Grain Size Relationship. *Sedimentology* , **16**: 5-54.
10. Fryberger, S. G. 1979. Dune Forms and Wind Regime. In: "A *Study of Global Sand Seas*", (Ed.): McKee, E. D.. Government Printing Office, Washington, US, PP. 137–160.
11. Fryberger, S. G. and Dean, G. 1979. Dune Form Sand Wind Regime. *Professional Paper*, United States Geological Survey, PP. 137–140.
12. Jeffrey, L. and Zobek, T. M. 2002. Climatic Factors Affecting Mobility and Stability of Sand Dunes. *Proceedings of CARS/GCTE-SEN Conference, International Center for Arid and Semiarid Lands Studies*, Texas Tech University, Lubbock, Texas, USA Publication 2002. PP. 423-425.
13. Khalaf, F. I. and Al-Ajmi, D. 1993. Aeolian Processes and Sand Encroachment Problems in Kuwait. *Geomorphology*, **6**: 111–134.
14. Khalili, A. 1992. Arid and Semiarid Regions of Iran. *Proceedings of Seminar on the Problems of Iranian Deserts and Kavirs*, Yazd, Iran, PP. 556-597.
15. Lancaster, N. 1998. Controls on Aeolian Dune Size and Spacing. *J. Arid. Environ.*, **63**: 425- 438.
16. Lancaster, N. 1995. Geomorphology of Desert Dunes. Physical Environment Series. Routledge, New York, NY. 290 pp.
17. Lancaster, N. 1999. Geomorphology of Desert Sand Seas. In Aeolian Environment Sediments and Landforms Goudie AS, Livingstone I, Stokes S (eds). Wiley: Chichester; 49–70.
18. McKee, E. D. 1979. A Study of Global Sand Seas. Geological Survey Professional Paper 1052. United States Department of Interior, Washington, DC.
19. Pearce, K. I. and Walker, I. J. 2005. Frequency and Magnitude Biases in the 'Fryberger Model' with the Implications for Characterizing Geomorphically Effective Winds. *Geomorphology*, **68**: 39–55.
20. Pye, K. and Tsoar, H. 1990. *Aeolian Sands and Sand Dunes*. Unwin Hyman, London. 15: 449-450.
21. Rajabi, M. R., Rohani, F., Ekhtessassi, M. R. and Ghazanfarpoor, N. 2006. Morpho-dynamic Analysis of Wind Faces Using Spatial Sand Rose Model in Zabol and Zahak region, Iran. *Biaban J., 11:* 45-51.
22. Saqqa, W. A. and Saqqa, A. W. 2007**.** A Computer Program (WDTSRP) Designed for Computation of Sand Drift Potential (DP) and Plotting Sand Roses. *Earth Surface Processes and Landforms*. **32**: 832–840.
23. Tsoar, H. and Blumberg, D. G. 2002. Formation of Parabolic Dunes from

Barchan and Transverse Dunes along Israel's Mediterranean Coast. *Earth Surf. Processes Landforms*. **27**: 1147–1161.

24. Wang, X., Dong, Z., Zhang, J. and Chen, G. 2003. Grain Size Characteristics of Sand Dunes in the Central Taklimakan Sand Sea. *Sediment. Geol.,* **161**: 1 –14.
25. Yizhaq, H., Isenberg, O., Tsoar, H. and Karnieli, A. 2008. Morphology and Dynamics of Aeolian Mega-ripples in Nahal Kasuy, Southern Israel. *Earth Sci. Rev.,* **57**: 149–165.
26. Zareian, M. 2007. Investigation of the Sand Dune Morphodynamics in the South of Iran. MSc. Thesis, Faculty of Natural Resources, University of Tehran, Karaj, Iran.

بررسی پتانسیل حمل ماسه (مطالعه موردی دشت یزد - اردکان)

ط. مصباح زاده و ح. احمدی

چکیده

یکی از مهمترین فاکتورها در بیابان فرسایش توسط باد است. بادهای غالب می‌توانند تپه‌های ماسه‌ای را جابجا و تجمع آنها را تحت تاثیر قرار دهند. همچنین رژیم بادی مسیر حرکت تپه‌های ماسه‌ای را مشخص می‌کند. هدف از این تحقیق، بررسی تحرک تپه‌های ماسه‌ای با استفاده از گلماسه، گلباد، و گل توفان بود که از جمله آسان‌ترین، سریع‌ترین و دقیق‌ترین روش‌ها برای تعیین فرسایندگی باد می‌باشند. جهت انجام این تحقیق، داده‌های مربوط به باد بین سال‌های ۱۹۸۶ تا ۲۰۰۵ مربوط به ایستگاه هواشناسی یزد برای بررسی پتانسیل حمل ماسه و بادهای فرساینده توسط روش‌های مختلف تجزیه و تحلیل شدند. مقادیر پتانسیل حمل ماسه نشان دادند که مسیر حمل ماسه RDD از سمت غرب و جنوب غربی به سمت شرق و شمال شرقی است. شاخص تغییرپذیری حوزه دشت یزد – ارکان ۰/۴۷ است که نشان می‌دهد منطقه تحت تاثیر بادهای با انرژی کم قرار دارد. شاخص DP باید برای برنامه‌ریزی و پروژه‌های توسعه و عملیات حفاظتی مورد توجه قرار گیرد. محاسبات نشان می‌دهند که تحت رژیم بادی کم مقدار پتانسیل حمل ماسه $m^3\ m^{-1}\ year^{-1}$ ۱۵/۷۴ است. مقدار زاویه حرکت ماسه نسبت به شمال جغرافیایی RDD در حدود ۷۷ درجه و در جهت عقربه‌های ساعت است. با توجه به رسم گلماسه که برای همه ماه‌ها رسم شده است دیده می‌شود که مقدار آن در شهریور و مهر حداقل و به ترتیب برابر ۱/۹و ۲/۱ است در حالیکه بیشترین مقدار آن در فروردین است. نتایج به‌دست آمده از تجزیه و تحلیل گلباد نشان می‌دهند که جهت بادهای غالب از سمت غرب به سمت جنوب غربی است و بادهای توفان زا عموما از سمت شمال غربی می‌وزند و فراوانی بادهای کمتر از سرعت آستانه فرسایش از ایستگاه هواشناسی یزد ۹۳/۷۹ درصد است.

[DOR: 20.1001.1.16807073.2012.14.4.1.7]