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# Investigation of the effect of natural windbreaks on flowing sandy soils and determining the type of optimal windbreak using the method (DBA) (Case study of Sistan and Baluchestan province)

M. H. Taghavi Parsa[1*], S. Ahmadi[2]

[1] Civil Engineering Department, Imam Hossein University, Tehran, Iran
[2] Civil Engineering Department, Khajeh Nasir Toosi University, Tehran, Iran

**ABSTRACT:** Sistan and Baluchestan province is located in the southeast of Iran and has a dry and unfavorable climate. Due to environmental changes such as the drying up of Lake Hamoon and the occurrence of so-called 120-day winds, suitable conditions have been provided for wind erosion of the soil and the occurrence of dust storms and the movement of sand dunes at high speed. One way to prevent this is to use natural windbreaks. Windbreaks are defined as barriers that reduce wind speed and usually use vegetation as a barrier. The function of windbreaks is to reduce wind speed, change the direction and angle of the wind around the windbreak area. By locating and constructing windbreaks, the movement of flowing hills can be prevented to a large extent. The purpose of this study is to determine the appropriate plant species in the province for the construction of natural windbreaks and select the optimal sample using the distance-based method.

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## 1- Introduction

Sistan and Baluchestan province with an area of about 181532 square kilometers, equivalent to 11.5 percent of the area of Iran. The province is desert and arid in terms of climatic classification. Sistan is a dry land with very little rainfall. The Sistan region is one of the regions where extreme events such as floods and droughts occur in abundance and its special hydraulic-hydrological and spatial conditions give unique characteristics to that region. Located at the end of a closed catchment, the complex hydraulic system of the Helmand River and Hamoon Wetland, the hydrological conditions of the Chahimeh Reservoir have created conditions that make this area have a special position [1]

## 2- Methodology

Planting trees as windbreaks creates beauty as well as tourist attraction [2]. Studies have also shown that the use of native plants and green belts by 94% and 95.3%, respectively, and dust by 64.5% and 68.4%, respectively, have reduced the annual rate of moving sands [3]. The first step in creating a tree windbreak is to prepare a list of trees and suitable places for them to grow, which is a great guide for managing and distributing trees to create a windbreak [4].

- **Specifying the type of soil in the area**

To select the type of plant species, first the type of soil in the area and its characteristics must be determined, and then the types of species that can be planted in this type of soil must be determined. According to the results of these experiments, it was determined that the soil of the region is poorly granulated. This type of soil is very suitable for plant species such as Haloxylon.

- **Plant species of Sistan and Baluchestan province**

The size of the province and the diversity of the climate have led to the diversity of vegetation and the richness of renewable natural resources. Vegetation of this province is often scattered due to low rainfall, soil erosion, floods and uncontrolled consumption. Climatic diversity in the province, the composition of forest species is also different in the province. Due to the importance of height, width and growing conditions of trees, their information is shown in Table 1.

The world, is sand dunes [5]. Sand dunes A hill of sand accumulation in the form of a hill is affected by the earth's gravity [6]. The importance of studying sand dunes is due to

*Corresponding author's email: dr.parsa@ihu.ac.ir

**Table 1. Plant species information**

| Irrigation required | Suitable growth temperature | Height (m) | Species name |
|---|---|---|---|
| Less | 50 | 6-8 | Acacia Nilotica |
| Less | 10-25 | 4 | Prunus Scoparia |
| Very Less | High resistance to temperature | 6-7 | Tamarix |
| Less | 16 | 4-5 | Haloxylon |
| Normal | 45 | 7 | Pistaciaatlantica |

**Table 2. The final values**

| Species name | SUM | CD | Rank |
|---|---|---|---|
| Acacia Nilotica | 5.84 | 1.074 | 1 |
| Prunus Scoparia | 6.85 | 1.560 | 3 |
| Tamarix | 2.50 | 1.671 | 5 |
| Haloxylon | 3.88 | 1.613 | 4 |
| Pistaciaatlantica | 8.14 | 1.323 | 2 |

the effects they have on water and soil resources, plant and animal life, and facilities and communication routes [7].

One of the types of natural hazards that cause a lot of damage every year, especially in arid and desert areas of

A windbreak is defined as a barrier that can reduce wind speed [8] Usually vegetation is used as a barrier. The effective performance of windbreaks depends on factors such as height, width or width of the windbreak, porosity and windbreak angle with respect to the wind.

In this research, the plant species of Sistan region and the soil of Mirjaveh region are studied and then, using

- **Select the optimal windbreak using the method DBA[1]**

The distance-based method (DBA) starts with defining the optimal state of the overall goal and identifies good values of the traits in the process. For practical purposes, the optimal value for the attribute is defined as the best values that exist within the attribute value range. In order to implement the DBA method, assume that a set of n options are available in a statistical study. Each of these options has m properties, based on which one option should be selected as the optimal option among all n options [9].

The distance-based method is used to define the optimal state of different objectives. The AP vector is represented as a set of optimal properties. Optimal values can be identified as the best values available in this range. The AP vector should consist of the best possible values of attributes that are very difficult to obtain [10].

Finally, the DBA method is used to determine the range A, which is the closest point to A.

[1] Distance based approach

## 3- Results and Discussion

In the study of windbreaks, 5 types of windbreaks with 5 characteristics including height, irrigation ratio, price ratio, ratio of appropriate number of planting and temperature have been studied. To determine the optimal type, a matrix of standard values is formed. Then standardized values are formed using existing relationships. Finally, after forming a table of standardized values, according to Table 2, in the final stage, the optimal windbreak is determined using the compound distance relationship:

Finally, the data are sorted from the least compound distance to the maximum value, respectively. The lowest value of the distance means that the desired feature is the most optimal option to use, and increasing this value indicates moving away from the optimal mode. In this study, the Acacia Nilotica tree as the most optimal option were obtained using the distance-based method.

## 4- Conclusion

This research is an experimental study based on field observations from Sistan and Baluchestan region. In this study, the effect of natural windbreaks on sandy soils was investigated. After studying the plant species of the region and then using the mathematical method, statistical analysis of the characteristics based on distance, the following results were obtained:

1) Due to the characteristics of windy sand soil and the movement of sand dunes, the existence of windbreaks is very important. Also, choosing a natural windbreak will be very environmentally friendly. Disadvantages of windbreaks include the need for protection in the early years, the emergence of insects and some vermin.

2) In the laboratory study, the soil of Mirjaveh region was selected as a sample. After the laboratory study, the type of loamy sandy soil was determined. The maximum porosity was 1.63 and the minimum density was 1.387 and the minimum porosity was 1.34 and the maximum density was 1.561. Finally, the results of the three-axis experiment showed that the amount of soil adhesion is equal to 7 kPa and the amount of internal friction angle is equal to 39 degrees.

3) The results of the present study show that the appropriate distance for using a windbreak is 2 to 3 times the height of the windbreak.

4) The DBA method is a distance-based method that determines the most optimal option according to the available parameters. In this method, suitable plant species in the

eastern part of the province were determined, respectively Acacia Nilotica, Pistaciaatlantica and Prunus Scoparia, each of which can be used according to the suitable climate and weather of each part.

5) Using DBA method Acacia Nilotica and Pistaciaatlantica species were determined as the most optimal tree species for planting in terms of height characteristics, irrigation ratio, price ratio, ratio of suitable number of planting and temperature.

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