American-Eurasian Journal of Scientific Research 1 (1): 52-54, 2006
ISSN 1818-6785

The Wind Potential in Coastal Areas of Balochistan, Pakistan

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Abstract: The wind energy potential in coastal areas of Balochistan, Pakistan is examined using 3-hourly wind data. The speed duration and frequency curves are represented graphically to read its extreme wind speed and total number of hours for a particular wind speed every year. Annual mean wind speed for a period of five years (1999-2003), energy and power are determined; the mean wind speed ranging 3.2 m s^{-1} mentioned in Table 1. The analysis of this data indicates that the wind energy potential is high in coastal areas of Balochistan, Pakistan. The high potential is used and suitable for the use of wind energy for windmills and electricity for light for scattered population.

Key words: Wind energy potential · coastal area · frequency curves · mean wind speed · wind mills · electricity for light

INTRODUCTION

Balochistan is a province of Pakistan, lies between 24°55′ and 32°04′ latitude and 61°00′ and 70°15′ longitude and is the biggest province of Pakistan in term of area. More then 50% of the area is covered by high dry mountain and hills. Many parts of the Balochistan province are barren either due to shortage of surface water or due to non-availability of power. The population in this area is scattered and spread over large and distant areas, where the power supply from the mains is un-economic, the use of oil engines is limited due to lack of transportation facilities and the heavy expense.

Abidi [1] and Raja [2] have examined solar energy source, but wind energy has not been thoroughly exploited yet. Wind energy is not only renewable but is a clean and non-polluting source.

Nasir [3] carried out a preliminary study to estimate the monthly and mean yearly energy and power for observatories in Fig. 1 in Balochistan. The analysis indicated that wind energy can be used for wind mills generating electricity in the high potential areas.

RESULTS AND DISCUSSION

Wind data from the observatories as shown in Fig. 1 for a period of five years from 1999 to 2003 are analysed. Routine wind data for these stations are recorded at a height of 8-12 m above the ground level for 3 h intervals. Wind data measured in knots are converted into m s^{-1}. In our present study, this is aimed to report the prevailing wind speeds, their frequencies, duration power and energy for 7 stations of coastal areas of Balochistan, Pakistan. We calculate the frequencies of yearly mean wind speed, power and energy [3].

The following relationship [4] is used to determined the yearly mean wind speed,

Here u_i refers to the ith hourly wind speed, m_i refers to observed frequencies and N or $\sum m_i$ gives the total number of hours per year.

Estimated energy and power [5, 6] as given in Table 1 is obtained by using the formula for power for each square meter of area swept by a rotor;

$$P = 0.1 \times V^3 \ (W\ m^{-2})$$

Where; V is the wind speed in m s^{-1}. The frequency of occurrence of wind speeds is essential in assessing the energy potentials of a given station. Figure 1 shows the speed duration curves for all the 7 stations. Here the horizontal axis is in hours per year, while total number of hours per year is 2920 (with 3 h). The vertical axis gives the wind speed. Figure 1 indicate that most part of the province receives about 2-3 m s^{-1} in the range which is exceeded by 900-2100 h per year for different stations.

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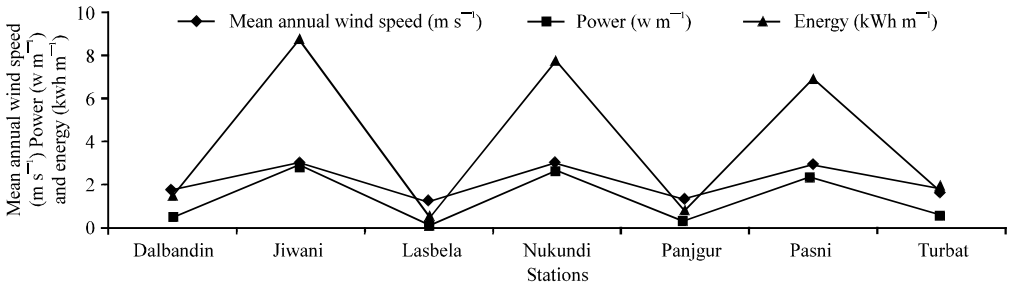

Fig. 1: Mean annual wind speed for different stations

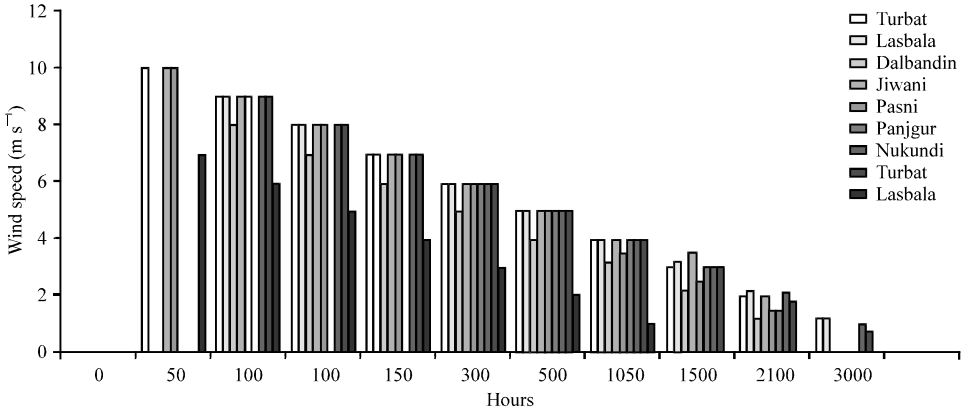

Fig. 2: Wind speed of Costal area of Balochistan, Quetta, Pakistan

Table 1: Mean annual wind speed for different stations

S. No.	Station	Mean annual wind speed (m s^{-1})	Power (w m^{-1})	Energy (kWh m^{-1})
1.	Nukundi	3.0	2.7	7.9
2.	Lasbela	1.2	0.2	0.6
3.	Turbat	1.8	0.6	1.8
4.	Dalbandin	1.7	0.5	1.5
5.	Jiwani	3.1	3.0	8.8
6.	Pasni	2.9	2.4	7.0
7.	Panjgur	1.4	0.3	0.9

About 4 m s^{-1} wind speeds are noted for Pasni and Jiwani for 900-1200 per year. Figure 2 shows the frequency curves. From these curves the most frequent wind speed and number of hours per year can be easily determined for each station as well as the mean wind speed. Considering Fig. 2 Pasni, Jiwani and Nukundi which shows the annual shortest time of calm spells around 496, 400 and 325 h, respectively and the maximum annual calm spells 1047 h occurred in Turbat. Here, the most important is frequency of occurrence of usable wind speed. All wind speeds can be used for power generation although they may be low to rotate the windmill.

CONCLUSIONS

Our analysis of wind speed and wind energy distributions in different coastal areas of Balochistan, Pakistan is represented. Some areas are exposed to winds of high speed most of the time while others have low wind speeds for long periods. Sites having good wind speeds are very useful for modern wind mills which require a minimum wind speed. If wind mills were installed in the high producing wind energy for drinking water, irrigation and electricity for small houses.

ACKNOWLEDGEMENTS

I am indeed very thankful Prof. Dr. T.N. Veziroglu, Director, Clean energy institute, University of Miami for providing me research facilities and supervision during my visit.

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