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Short communication

Availability of wind resource at few prospective locations of Bangladesh

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An early study[1] showed that off-shore islands have sufficient wind speed to produce electricity from wind in Bangladesh. Potential assessment of wind energy in Bangladesh has been slow mainly due to lack of adequate wind data. Recent measurements in some places have shown significant wind energy potentials in Bangladesh. Annual average wind speed at 30 m height along the coastal belt is above 5 m/s and northeastern parts is above 4.5 m/s while inland wind speed is around 3.5 m/s for most part of Bangladesh [2]. In the present study wind speed data from Sustainable Rural Energy (SRE) of Local Government Engineering Department (LGED) for Kutubdia, Sitakunda, Khagrachari, CUET and Kuakata from June 2005 to December 2006 have been assessed to find out potential of wind power generation.

In general, daily and seasonal changes as well as wind direction are important considerations while sitting wind systems. From five LGED stations it was found that the average annual wind speed values at different heights for the five wind stations vary from 1.73 m/s to 4.17 m/s. The highest average annual wind speed (4.17m/s) was observed in Kuakata and the lowest value (1.32 m/s) was observed at Khagrachari. The analysis showed that highest wind speed was found during summer at Kutubdia and Kuakata. The annual cycle of monthly average wind speed shows fairly large seasonal variation, the appearance of which is typical for measurement sites, with minimum values in winter (October–March) and maximum values during summer (April–September, Fig. 1.a). Similar variations also observed for BCAS Kutubdia and Kuakata stations [3, 4.] The analysis of the daily cycle of the wind speed at different time instants, however, suggests that the dominance of daytime winds over night winds that is characteristic of mainland measurement sites also contributes to this feature (Fig. 1.b).

While there is almost no dependence of the wind speed on the measurement time for Kuakata and a weak maximum becomes evident at afternoon for all stations. Such a variation is similar to that observed for at BCAS wind monitoring station of Kutubdia and Kuakata wind measurement sites[3,4]. A part of this cycle is obviously due to the local sea breeze. The typical spatial scale for changes of the diurnal cycle apparently depends on many factors such as the area covered by sea breeze, the geometry of the coastal region, or the mutual orientation of the land and sea, and the direction of air flow. From the above analysis it might be concluded that the daily cycle of wind speed should be taken into account when a wind farm is planned in the vicinity of a specific site. The design of a wind farm is sensitive to the shape of the wind rose for the site. In some areas, particularly in areas where the wind is driven by thermal effects, the wind can be very unidirectional. The coastal and mainland wind are less directionally homogeneous and only show a slight prevalence of south-east and north winds respectively. The coastal winds are mostly driven by large-scale atmospheric dynamics and are less affected by local orography and obstacles where as the inland sites (CUET and Khagrachari) are strongly effected by orography and obstacles. In this study the Weibull parameters were calculated by least square method[5]. It is found that the value of k during summer for all stations is higher and that of winter is lower. A small value of k indicates widely dispersed data, i.e., the data tend to distribute uniformly over a relatively wide range of wind speed. If mean wind speed is low, this has a negative implication on wind power generation because the station does not experience enough wind speed to operate a wind turbine. For large values of k, the majority of wind speed data tend to fall around the mean wind speed, and if the mean wind speed is high, then the station experiences enough wind speed to operate a wind turbine at least for a short period of time. Wind power density is considered to be the best indicator to determine the potential wind resource, which is critical to all aspects of wind energy exploitation, from the identification of suitable sites and predictions of the economic viability of wind farm projects through to the design of wind turbines themselves. Monthly and diurnal variations of wind power density are shown in Fig. 1 c&d. As wind power density depends on the cube of speed $\overline{v^3}$ the available wind energy is much higher during the windy months. Maximum wind power density is observed during June and July. Maximum wind power density was in Kuakata (88kW/m^2) at height 30m and minimum in Khagrachari (13kW/m^2) at a height 10m heights.

Wind Rose analysis shows that the most probable wind directions for Kutubdia and Sitakunda are NE and SE. Between the two islands Wind Power Density is higher in Kutubdia and is around 150W/m^2 in summer at 20m height. Among the stations in the inlands WPD is highest in Sitakunda at the same height of 20m. Hence the wind resources assessment study reveals that Kutubdia and Sitakunda are the best potential sites for wind energy extraction. Based on this resource assessment study at the wind monitoring positions off grid wind farms or hybrid energy systems at these locations or grid connected wind farm at Sitakunda can be developed after necessary feasibility studies on technical and economical parameters.

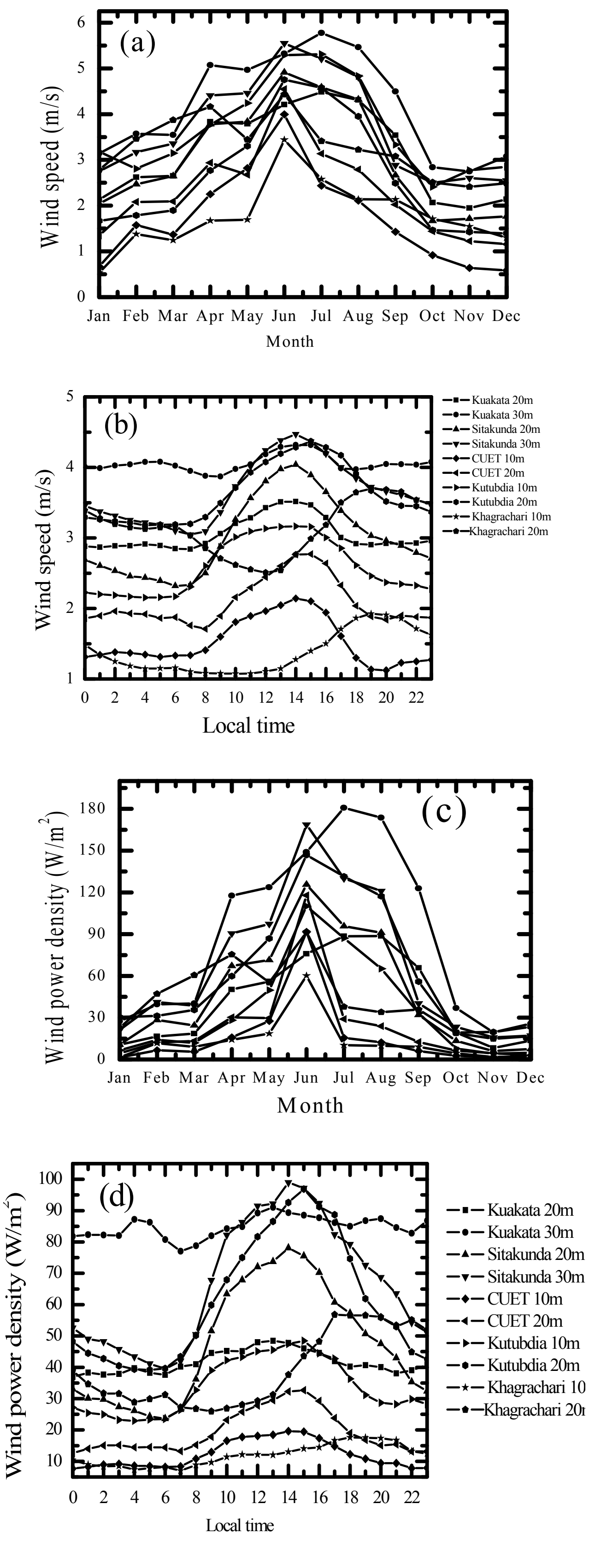

Fig .1: (a) Monthly (b) diurnal variation of wind speed for sites at different heights, (c) monthly and (d) diurnal variations of wind power density

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