Wind Power Potentiality Analysis with Respect to Wind Direction Percentage in Bangladesh

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***Abstract*—This paper tries to investigate the wind power potentiality in Bangladesh based on wind direction percentage data. For this purpose wind direction percentage data are collected for three different locations considering the data for the year range of 2000 to 2004. From the analysis, it is seen that around 43.30% wind direction flow is occurred in Cox's bazaar which is comparatively higher than Dhaka and Chittagong.**

Index Terms*— *Wind direction percentage, wind power, power generation.

I. INTRODUCTION

The present study is a part of the overall research carried out to locate most prospective windy sites by analyzing statistically the wind characteristics of some coastal regions of Bangladesh. In this regard, primarily wind speed data of 11 coastal areas namely: Kuakata, Munshigonj, Khagrachari, Kishorgonj, Naogaon, Pakshey, Panchagarh, Rauzan, Sitakunda, Kutubdia (Cox's Bazar) and Teknaf (Cox's Bazar) have been chosen for investigation. Comparing with the local needs, it is observed that the wind speed of Sitakunda matches very well for installing wind pumping systems (WPS)for irrigation in that area [19,20] but there are sudden gusty wind speeds [21].

Early wind wheels just produced couple of kWh; new turbines now can produce millions of kWh a year with rated power up to 6 MW [15]. Today, statistics from highly developed countries show that standards of living can increase independently of energy consumption if energy efficiency measures are introduced. The global demand for electricity at 2000 was about 15,391TWh and at 2010, it was 20,037TWh. This demand was met mainly through fossil fuels and nuclear power. Renewable energies other than big hydropower plants only had a 1.9 % share. This marks a slight decrease compared to 1999, which means that total demand increased faster than renewable energies were being developed[16-18].

Now the wind power potentiality in Bangladesh is growing up gradually. For detection of sites in respect of wind power potentiality, wind direction percentage data are manipulated for three different locations in Bangladesh.

II. WIND POWER POTENTIAL IN BANGLADESH

Low-income developing countries like Bangladesh are very much susceptible to the setbacks arising from the ongoing energy crisis. Natural gas lies at the heart of the country's energy usage, accounting for around 72% of the total commercial energy consumption and 81.72% of the total electricity generated [1, 2].However, the waning gas resources suggest that the country will face deficit of 142 million cubic feet per day (mmcfd) in 2011 and it will rise to 1714 mmcfd by 2019 -20. Even if Bangladesh's GDP growth remains as low as 5.5 percent till 2025, the country will need to add 19,000 MW of additional power, causing the gas demand to spiral up to 4,567 mmcfd by 2019 -20 [3].

Different government, semi government and nongovernment organizations (NGOs) have been working separately or jointly to disseminate renewable energy technologies (RET) throughout the country over a significant period, as has been reported in the recent literature [5, 6].

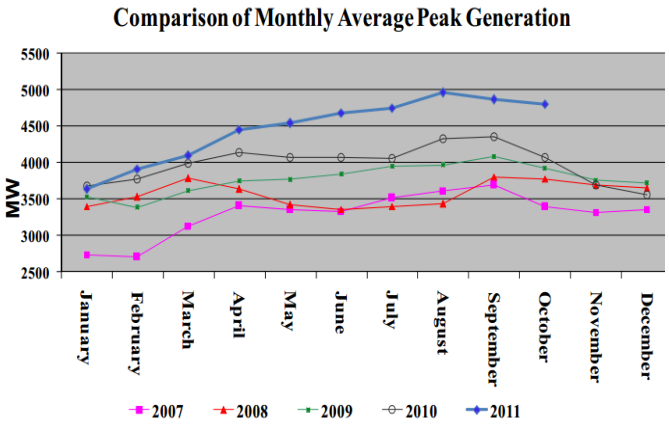

Fig. 1: Monthly average peak power generation data in Bangladesh for the year range of 2007 to 2011.

Electricity access rate and utilization of energy are the indicators economic growth of a country. Densely populated Bangladesh has a population of almost 160 million people with electricity access rate of about 50%. Presently electricity

demand growth is about 10%. At this moment power demand in Bangladesh is about 7500MW, whereas the generation ranges only 5000-6000MW. Demand is estimated to exceed 10,000 MW by 2015 [4].

From fig. 1, it is seen that the maximum peak power generation was 5000MW on August 2011 in Bangladesh.

III. WIND POWER ADAPTABILITY ON POWER SYSTEM

Over the last decade, researchers have made significant effort to evaluate the impact of wind generation on the operations and cost of power grids. Grubb [7] addressed the integration of renewable energy into large power system. Hatziargyriou and Zervos [8] described more recent state and prospects of wind power in Europe. Strbacet al.[9] assessed the costs and benefits of wind generation on the U.K. electricity system based on assumed different levels of wind power capacity. Persaud et al.[10] studied the potential impact of significant wind power capacity on generator loading levels, system reserve availability and generator ramping requirements, and found that wind power generation did not significantly increase the ramping duty on the studied system. Holttinen [11] estimated the increase in hourly load-following reserve requirements based on real wind power production and synchronous hourly load data in the four Nordic countries. The result demonstrated an increasing effect on reserve requirements with increasing wind power penetration. Kirby and Hirst [12] discussed the economic efficiency and equity benefits of assessing charges on the basis of customer-specific costs, focusing on regulation and load following, and determined the extent to which individual customers and groups of customers contribute to the system's generation requirements for these two services. The long-term target of European Union is to increase the share of renewable energy resources to 22% [13]. The current policies imply the use of wind turbines with good grid compatibility and integrated measures for grid reinforcement [14].

IV. DATA ANALYSIS FOR SITE SELECTION IN BANGLADESH

For determining the site potentiality in Bangladesh, wind direction percentage data are collected for taking the comparison in various locations of Bangladesh. From the data analysis, seven different types of figures are obtained. From fig. 2, it is seen that the maximum wind direction percentage was 69% in Chittagong in the north direction whether it was 42%, 44%, 40% and 42% in south direction in Cox's bazar as shown in fig. 3, fig. 4, fig. 5 and fig. 6 respectively. But for the south-east direction, the maximum wind direction is 19% in Cox's bazar, 24% in Chittagong, 21% in Dhaka, 23% in Dhaka, and 27% in Dhaka as shown in fig. 2, fig. 3, fig. 4, fig. 5 and fig. 6 respectively. Furthermore a comparison study is done taking wind direction percentage data from 2000 to 2004 for three specific locations in Bangladesh. And from this statistic study, it is seen that maximum wind direction percentage in south direction is 42% in Cox's bazar as shown in fig. 7. Finally it is seen that maximum portion of wind direction percentage is existing in Cox's bazaar taking comparison with other two locations as shown in fig. 8.

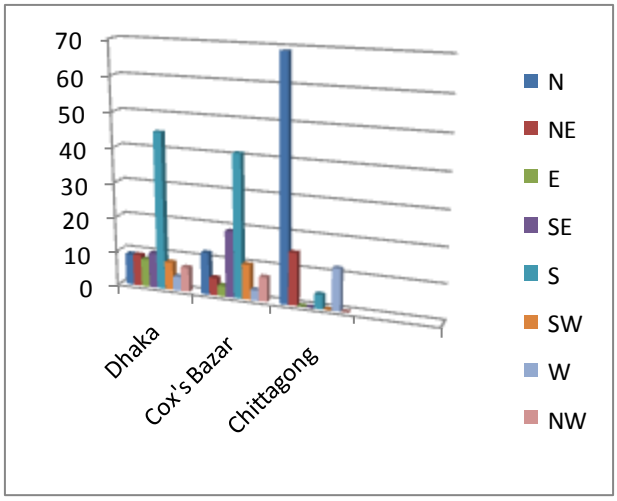

Fig. 2: Wind direction percentage covered in three various locations in the year of 2000.

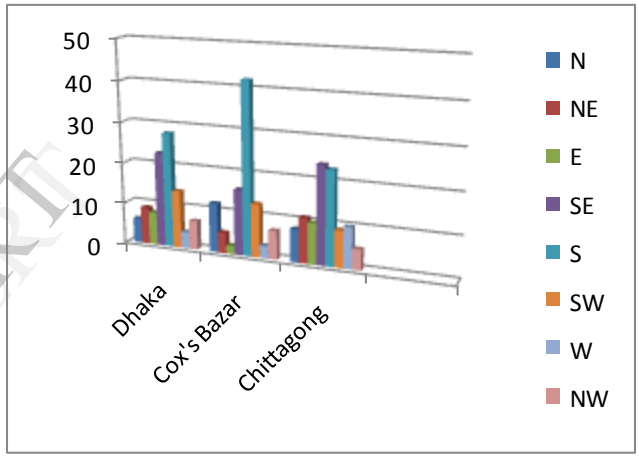

Fig. 3 : Wind direction percentage covered in three various locations in the year of 2001.

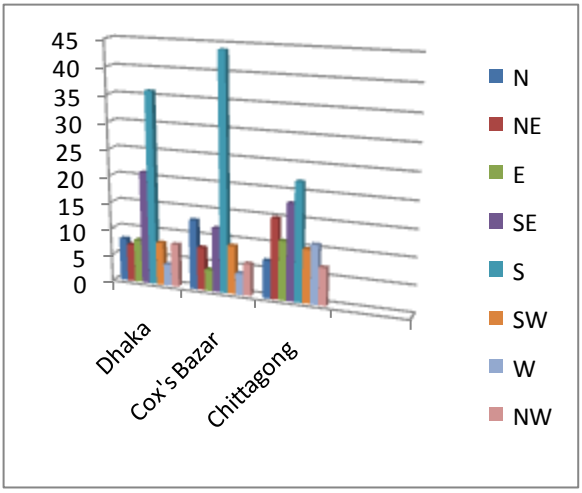

Fig. 4: Wind direction percentage covered in three various locations in the year of 2002.

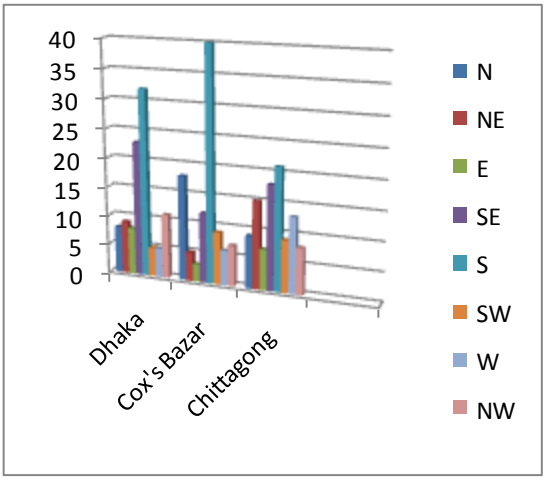

Fig. 5: Wind direction percentage covered in three various locations in the year of 2003.

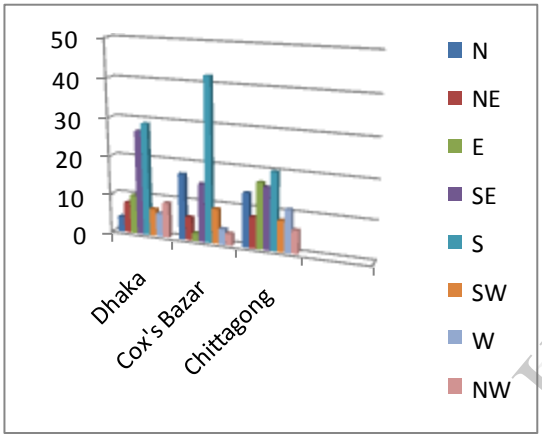

Fig. 6: Wind direction percentage covered in three various locations in the year of 2004.

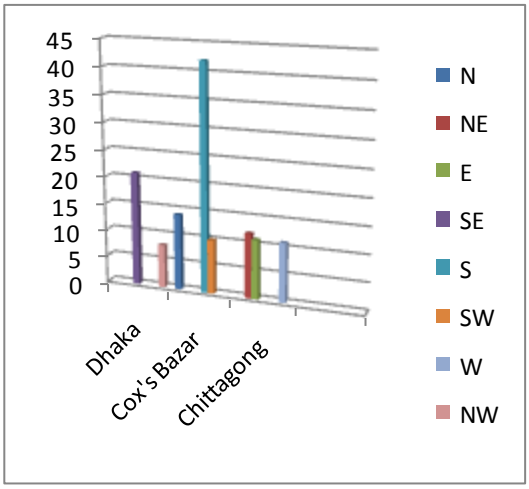

Fig. 7: Highest wind direction percentage in three various locations for the year range of 2000 to 2004.

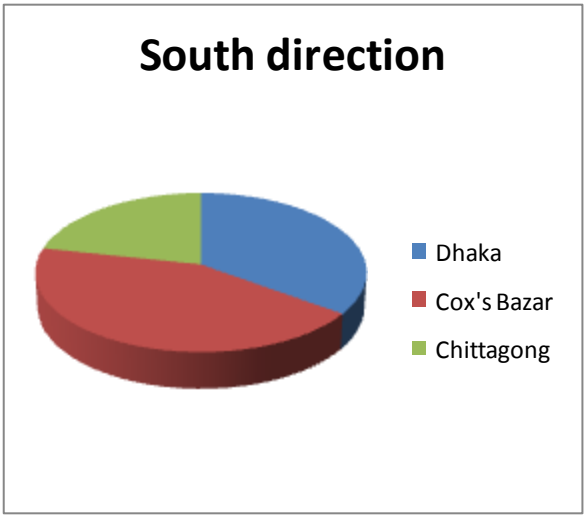

Fig. 8: Highest Wind direction percentage covered in south direction taking comparison of three various locations for the year range of 2000 to 2004.

CONCLUSION

The maximum power with wind turbine is greatly affected by wind speed and its direction. So wind direction percentage data analysis is done for determining the wind power potentiality in various locations of Bangladesh. Overall it is seen that Cox's bazaar is demanding most wind power potentiality with respect to other two locations named as Dhaka and Chittagong in Bangladesh. Furthermore another statistical data analysis is needed for determining the wind power potentiality at various locations in Bangladesh based on wind speed and wind direction percentage simultaneously.

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