ABSTRACT

Characterization of renewable energy resources is considered as prerequisite for their large-scale utilization. Wind has been placed in number one amongst the renewable energy sources, if its world-wide growth is considered. However, its utilization has not reached its potential. Moreover, spatial disparity exists as far as utilization of this resource is considered. The assessment and characterization of wind resources needs to be aggravated for further increase in its growth. Weibull parameters have been considered as proven estimates for characterization of wind data. There are different methods for estimation of Weibull parameters having distinguishing suitability for a given spatial data set. The present investigation considers five available methods for estimation of Weibull parameters for nine months wind data available in Mao (Manipur), ten years (1997-2006) wind data available in East Siang District of Arunachal Pradesh (India) and one year wind data available in Tezpur (Assam). The methods considered for the present investigation are (a) least square linearization method, (b) maximum likelihood method, (c) standard deviation method, (d) power density method and (e) Justus approximation. For the wind data considered in the present investigation, maximum likelihood method is found to be the best fitted with k and c values as 1.27 and 3.69 m/s for Mao, 1.51 and 3.43 m/s for Pashighat and 1.48 and 2.12 m/s for Tezpur. The most probable annual speed, mean annual wind speed and the wind speed corresponding to maximum power have been found as 1.09 m/s, 3.42 m/s and 7.77 m/s for Mao, 1.67 m/s, 3.09 m/s and 5.99 m/s for Pashighat and 0.99 m/s, 1.91 m/s and 3.77 m/s for Tezpur respectively. The power availability per meter square has been assessed. The seasonal variability of wind data has also been assessed based on best set of Weibull parameters for Pashighat. Based on the Weibull parameters the four seasons in Pashighat may be ranked in decreasing order of wind energy potential as winter (December-February), autumn (September-November), spring (March-May) and summer (June-August).

An attempt was made to design for demonstrating the utilization of wind energy at low wind speed. The design was based on the wind speed of 4 ms^{-1} and to develop a power of 9.0 W. The design coefficient of performance was taken 0.25 at a tip speed ratio of 0.7. The highest value of estimated COP has been 0.05 corresponding to the velocity (4.22 and 4.5) m/s at a tip

speed ratio of 0.65. The reason of lower COP achieved for this case may need further investigation.

Keywords: Weibull distributions, Weibull parameter, Wind speed data, Wind energy