Determination of the wind energy potential in Mirissa, on the Southern coast of Sri Lanka, using Weibull distribution

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Sri Lanka is currently facing an unprecedented struggle to meet the daily electricity demand of roughly 2,600 MW. Therefore, as a potential solution with regards to power generation, stakeholders of the renewable energy sector have proposed a long-term policy decision to increase renewable energy generation to 70% by 2030. On this basis, we have examined wind data to assess the wind potential of one selected site in Mirissa, Sri Lanka as a renewable energy source that is commercially viable in Sri Lanka. The in-situ wind data were collected from the meteorological station at Mirissa over a period of three years, from 2019 to 2021, measured using a cup anemometer at a height of 10 m. The annual wind energy potential of the location was evaluated based on the Weibull probability density function, and the Weibull scale and the shape parameters was calculated as 3.62 ms^{-1} and 1.60 respectively. The average wind speed and wind power density were estimated to be 3.21 ms^{-1} and 102.20 kWh respectively. Furthermore, the analysis of the wind speeds and seasonal wind roses revealed a maximum wind power density of 376.82 kWh generated during the South West monsoon season and a wind power density of 121.40 kWh during the North East monsoon. The calculations of this study were based on the turbine type RegenVensys 82™ with a rotor diameter of 82 m, the largest rotor diameter commercially used in Sri Lanka at the present context. Based on this study, an estimated 0.39 % of the existing daily electricity demand could be generated using a single turbine. An average of 800 kWh capacity is generated by each turbine on the operational wind farms, Seguwantinu, Nirmalapura and Vidatamunai located in Mullipuram, Puttalam, along the North Western coastal belt of Sri Lanka. Furthermore, a developing wind turbine farm should be able to generate an average wind capacity of 700 kWh per turbine to be economical attractive. Therefore, we can conclude Mirissa, Sri Lanka as a potential economical detrimental area to install a wind farm based on the average wind power capacity of 102.20 kWh. Nevertheless, further assessment of the area is required to conclusively determine its prospects for wind power generation.

Keywords: electricity demand, power crisis, renewable energy, Weibull distribution, wind potential

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