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Wind Resource Land Mapping using ArcGIS, WAsP and Multi Criteria Decision Analysis (MCDA)

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ABSTRACT

The wind power potential in India estimated by the Centre for Wind Energy Technology (CWET), Chennai, India using a meso scale model at 50 m level is around 48,581 MW. This is based on the assumption that 1% of wind resource land is available for wind farm development. Subsequently the installable capacity was reevaluated at an 80 m level on an assumption that 2% of wind resource land is available and this was found to be around 1,02,788 MW. Even though this was the best attempt and effort a more precise estimation of the wind potential land in India considering the wind resource, electrical grid infrastructure, physical, socioeconomic and environment factors would improve the estimation accuracy. The wind resource land has been found to be around 15% in this study by using WAsP, ArcGIS tools and Multi-Criteria Decision Analysis (MCDA) techniques.

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Keywords: ArcGIS; Classification; Flicker; Grid Infrastructure; Land Use/Land Cover; MCDA; Noise; Pair wise comparison; WAsP Wind Power Density; Wind Speed; Weighting.

INTRODUCTION

This paper strives to emphasize the fact that for realistic estimation of wind resource potential, land which meets specific criteria is of key importance. The novelty of this scheme is that various parameters over and above the wind resource components of wind speed and wind power density have been considered. It attempts to throw light on the evaluation methodology by firstly prospecting the wind resource of the area using an industry standard wind resource prediction model (WAsP) and secondly by converting all the parametric data into spatial layers and evaluating them by specifying their importance in ArcGIS using Multi-Criteria Decision Analysis (MCDA) techniques. The realistic and feasible quantum of land available in four classes of extremely suitable, highly suitable, moderately suitable and exclusions has been determined. Further, this would also assist the policy makers in planning and implementing enabling grid network infrastructure, energy mix and spinning reserves to achieve targets envisaged. For a realistic estimate of wind resource, land is one of the main challenges for wind power development and should be overcome in the initial stages prior to deployment of wind energy. This will ensure development of wind energy as a sustainable, clean and effective source of energy since the barometer of sustainability of wind energy is not only on its clean renewable identity but also in its capability to mitigate impacts.

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A. Materials and Methodology

The methodology is demonstrated by using a study area as shown in Fig.1 of around 47x 47 sq kms around Kaluneerkulam, Tirunelveli District, Tamilnadu, India. The district of Tirunelveli is located in the southern part of Tamilnadu and lies between 8°05' and 9°30' north latitude and 77°05' and 78°25' east longitude. The district has complex mountainous and low land plain terrain conditions and the area selected for the study is typical of these features. Its physical features include sandy soil and fertile alluvium, a variety of flora, fauna and protected wildlife. The district has a population of around 3 million and largely the economy is driven by agriculture and this makes it ideal for the study as the quantum of land available for the deployment of wind energy has been investigated incorporating mitigation techniques of the possible effects on the physical, environment and socio-economic features.

Fig.1. Study Area

The height contours of the area are shown in Fig.2 and the parameters used for the study in the land use/land cover map as shown in Fig.3 are settlements, roads (National Highway, State Highway and Village roads), water bodies and agricultural land.

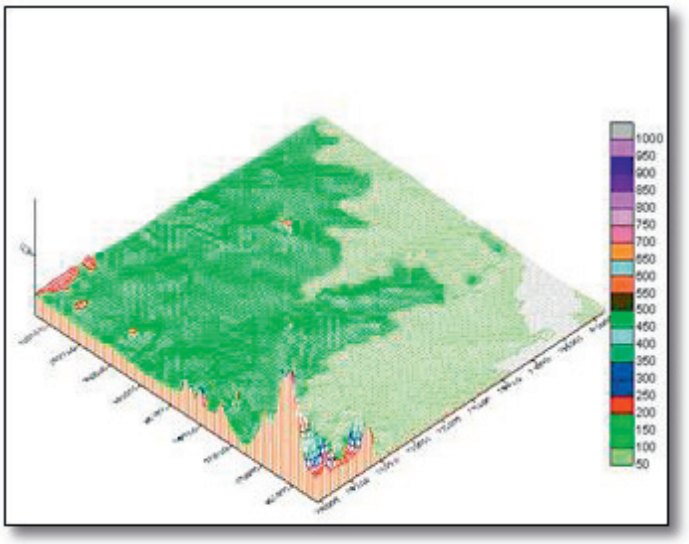

Fig.2. Elevation map of the area

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