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Prospects of Wind Energy in Jammu and Kashmir

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***Abstract**: Jammu and Kashmir is one of the energy starving states despite of having tremendous potential for utilization of green energy. The natural energy sources like sunshine, wind, water flow, biomass and other biological wastes are abundantly available in the region yet are not being fully harnessed resulting in very low per capita energy availability compelling people to use conventional sources of energy resulting into deforestation and pollution. Wind energy is one the most important renewable resource of energy. It is distinguished for beingpollution free source. The state of Jammu and Kashmir experience good wind energy potential. The main setback in the use of wind energy in J&K is the extreme climatic conditions especially during winters. To cater these phenomena, several techniques are now being invented, making wind turbines possible even in cold regions. This article throws light on the prospects of wind energy in Jammu and Kashmir and also the technological advances that could be implemented in the field.*

***Key Words:**Wind energy, Potential Source, Green Energy, Wind Turbine.*

Introduction

The developing economies are heavily dependent on imports for all of their chemical fertilizer, petroleum and coal requirements. So, is the case with India and Jammu and Kashmir is no exception. The ever increasing population is pushing to more and more use of conventional sources of energy (forest and agricultural waste) beyond the sustainable generation capacity of the existing forest and farm lands. Fossil fuels account for 78% of India's commercial energy consumption. India has a very great potential for harnessing renewable energy sources and ranks fifth in the world in terms of installed renewable energy capacity, with more than 6% of the world's capacity in 2011. India aims to have 175GW of renewable energy capacity by 2022, accounting for 9% of future worldwide renewable capacity. The Jammu & Kashmir State, which has the immense potential for the renewable energy ventures. However, there is a wide gap between the estimated potential and aggregate realizations achieved so far. The state of Jammu and Kashmir is located between 33^0-37^0 North latitude and 72^0-80^0 East longitude. The state covers around 2.22 lakh $km^{2,}$ of which about 27% is under cultivation. Despite the limited geographical area the region is bestowed with diverse agro-climatic conditions, topography and natural resources. (Fig.1) The mean ambient temperature throughout the year ranges from 13^0 to 32^0 C in Jammu region. 1^0 to 25^0C in Kashmir region and —8^0 to 17^0C in Leh region.Low ambient temperature gives rise to the huge energy demands which is usually met by coal/electricity firewood or in combination. Wind energy is certainly a favorable source of energy. Jammu and Kashmir has an installable wind energy potential of 5311 MW at 50m altitude and 5685 MW at 80m.

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Most of the areas of Jammu and Kashmir comprise of hilly terrain. The region is located in the northern part of India and is housed by a package of scenic beauty. Being a hilly terrain and also housed by variety of flora and fauna it would be better if sources like wind energy are used to meet the energy deficiency.

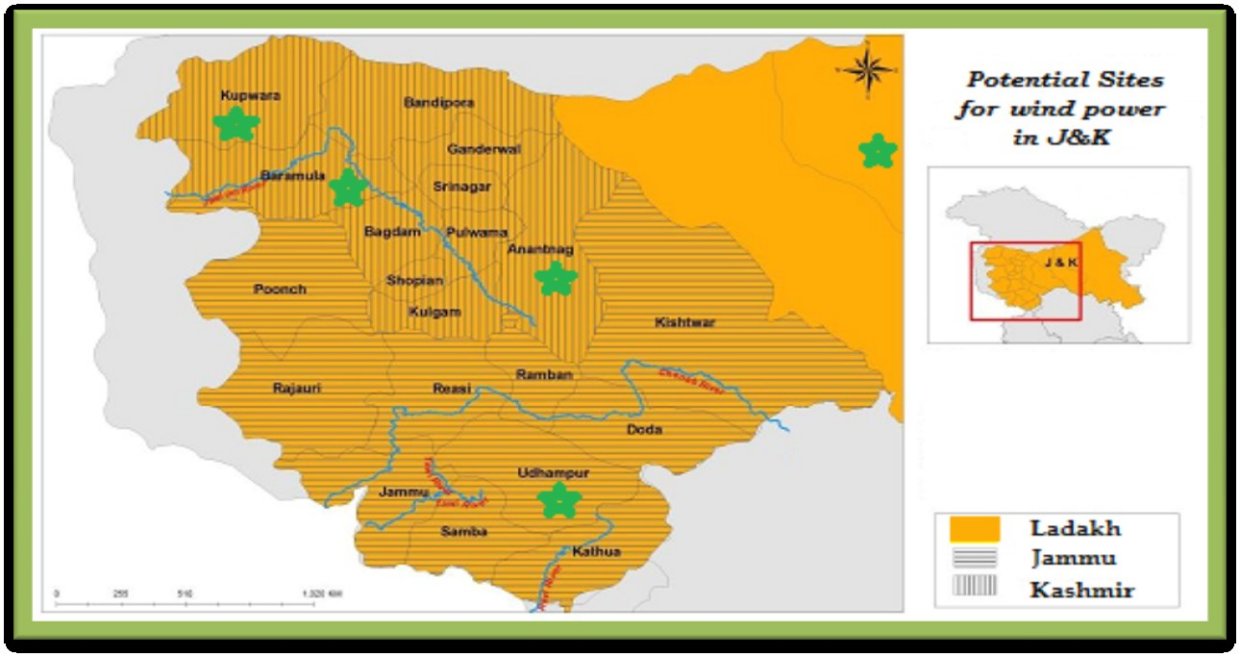


Fig.1 Study Area And Potential sites.

Methodology

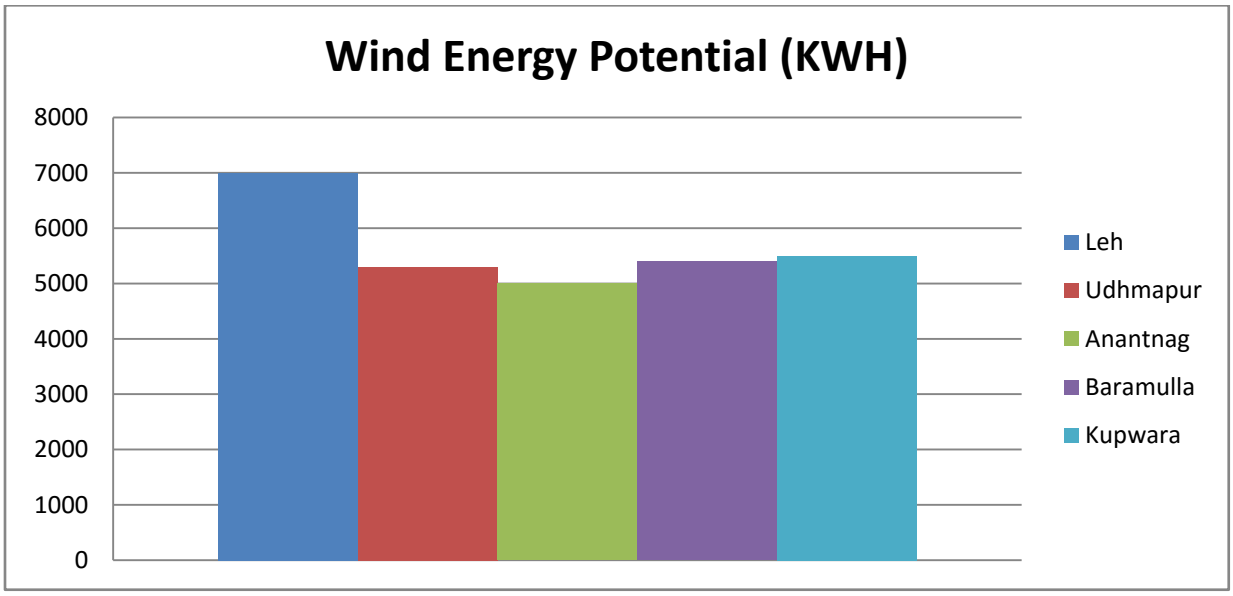
Both primary and secondary data sources were used in the preparation of this paper. These included:

- Annual reports from relevant ministries at the state level;
- List of relevant agencies, areas of operation;
- Policy documents (e.g., India's Electricity Act 2003, India's New and Renewable Energy Policy Statement 2005) as well as documents stating quotas, tax requirements, procurement requirements, foreign investment policy, and master plans for technology development in different sectors;
- Statistical documents containing installed capacity, energy balance, consumption, etc.;
- Five-Year Plans and ministerial long-term development plans; Annual Reports of relevant corporations;

Wind Energy Potential in Jammu and Kashmir

The wind energy industry is one of the fastest growing sectors. Denmark has been generating around 40% of its electricity from wind, More than 100 countries are actively pursuing wind energy continuously; though considered as a moderate wind regime, India has excellent wind speed suitable for micro wind turbines across several parts of the country and stands at the 4th spot in terms of installedwind energy capacity. Tamilnadu, Gujarat, Maharashtra, Goa, Rajasthan. Madhya Pradesh, Jammu and Kashmir, Utrakhand, Himachal Pradesh. Arunachal Pradesh, coastal Orissa, Andhra

Pradesh, Karnataka, is considered to be some of the best zones for micro wind turbines. Jammu and Kashmir State is fairly untapped in the field of wind energy however there is a significant scope of harnessing wind energy in different districts.A wind energy assessment has evaluated the wind energy potential in different areas of Jammu and Kashmir. The assessment is shown in Fig2.



From Fig.2 it is evident that Leh region has comparatively higher potential for wind energy. From meteorological data, the average wind velocity in Leh does not fall below 4m/s. Individual wind turbine capacity has increased from 55 kW in the mid-1980s to 2,000 kW today. India already manufactures wind electric generators with up to 1,650 kW per unit capacity domestically and expertise in the subject continues to grow. Enercon (India) Ltd., Vestas RRB India Ltd., and Suzlon Energy Ltd lead the industry, but a full list of electric generators installed through 2006. To harness the projected potential, new technologies with higher capacities are needed in the country. These technologies may include wind power systems greater than 1–2 MW, wind machines for low-wind regimes, and better designs for rotor blades, gear boxes, and control systems. Hence, the following specification of wind turbines will find suitable for the region:

- Number of Wind Turbines required = 27
- Rotor Diameter = 1.75 m
- Mean Wind Speed = 4 m/s
- Cut in speed = 4m/s
- Cut out speed = 10 m/s
- Turbine Efficiency = 35%
- Weibull Shape Parameter = 2
- Energy from one turbine = 513 kWh

So 27 turbines of the specification gives above can harness the entire wind energy potential of Leh. Similar designs can be suggested for other regions.

Wind Turbines to withstand cold regions

The state of J&K is located in the Himalayan belt and receives abundant rain, snowfall and experience very cold temperatures during the winter. The Ladakh region of Jammu and Kashmir experience low temperature upto-23^{0}C. The temperature profile of Ladakh is as shown in Fig.3

Conventional wind turbines when used in these conditions would definitely undergo

deterioration in its physical behavior. Thetemperature profile confirms that the region is snowy for 3 months of the year. If wind turbines are used for energy production in the region, they will definitely undergo deterioration in its features. Major complications include:

- The wind turbine blades can be hit by snow, which will definitely be a hazardous activity for the surroundings.
- Accumulation of ice on wind turbine blades resulting in reduced power output and increased rotor loads.
- If snow or cold air breezes, the wind blade profile will undergo a slight change and hence change the aerodynamic nature of the blade.
- If wind turbine possesses adjustable blade tips; it will definitely affect the system.
- Corrosion in the blades will be excessive if exposed continuously to rain and snow.
- The static and dynamic load on the rotor-turbine set will be affected. This may cause failure of the wind turbine and may fall down.

Principle of Wind Turbines in Cold regions

The cold region of our planet tend to have both low population density and high wind speeds, and accordingly the capacity for wind power generation in these regions is unusually high. Locating wind power projects in cold regions also makes sense form a physical perspective. Cold air is denser than warm air, so for a given wind speed, cold wind contains more kinetic energy, and can therefore potentially drive wind turbines more efficiently. But there are also significant drawbacks to sub- zero wind power. Most of today's wind turbines are designed to operate optimally in temperatures down to around -20^{0}C. But when temperature drops below that for significant lengths of time, the build-up of ice on turbine blades can hamper their performance, leading to power losses of between 3 and 16 percent per year. But recent technological improvements could help overcome the problem of turbine icing, potentially facilitating the future development of wind power in earth's coldest regions. Siemens has recently begun producing wind turbines with integrated electrical heating elements, while Enercon has developed a turbine which uses percolating hot air within the blades, both of which can offset or eliminate the production losses associated with ice formation.The use of anti-icing technology is still limited in the wind energy sector. But the development of wind power in cold climates is growing regardless. Wind turbine manufacturers are increasingly recognizing the impacts of cold climate operation and are building turbines better equipped to handle winter conditions. With the installation of "cold weather packages" which provide heating to turbine components such as the gearbox, yaw and pitch motors and battery, some turbines can operate in temperatures down to -30^{0}C.Various types of rotor blade de-icing and anti-icing mechanisms, such as heating and water-resistant coatings are currently being employed, as well as operational strategies to limit ice accumulation. Installation of ice sensors can also be a few measures that can be taken into consideration and can beused in cold regions of Jammu and Kashmir.

Challenge of Wind and snow Storm in J&K

One of the biggest challenges in the implementation of wind turbines in the state of Jammu and Kashmir is the occurrence of wind and snow storms in the state. A recent development to cater wind storms affecting the wind turbines is to put typhoon wind

turbines. A typhoon wind turbine has been developed in Japan to produce power without failing even during storms. This will best suit the conditions of Jammu and Kashmir.

Conclusion

This paper presents an overview of the possible prospects of wind energy in Jammu and Kashmir. J&K has an excellent source of wind potential and can be harnessed with appropriate technology.

Also, measures to cater the cold temperatures of the region have been discussed. If proper measures are taken to bring about a change in the energy scenario of Jammu and Kashmir, the scope for Wind Energy discussed can become a reality in the near future.

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