**FEASIBILITY AND ECONOMIC ASPECTS OF WIND FARM INSTALLATION IN THE STATE OF JHARKHAND**

ABSTRACT

 Governments worldwide are constructing clean energy infrastructure, including wind, solar energy, hydroelectricity, biomass, and geothermal energy facilities, with the aim of generating power. In the past year, the issue of warming temperatures has gained significant prominence. As a result of implementing environmentally friendly policies aimed at reducing costs, the globe has generated a surplus of energy from renewable sources in comparison to its use. Green energy encompasses several sources such as hydroelectricity, wind power, geothermal energy biomass, and hydropower facilities. India is recognized worldwide as the world's fourth greatest power generator, regardless of the inclusion or exclusion of hydroelectric plants. India is positioned as the third-largest consumer of energy globally. According to the data report of 2009, it is found that... In the current global landscape, there is a discernible trend towards embracing clean energy sources, fostering economic advancement, and striving for a more sustainable trajectory for future generations. In light of climate change, the escalating demands for power resulting from economic growth and rising populations necessitate that sources of clean energy not just meet the present energy requirements but additionally anticipate demands in the future.

 **1. Introduction**

The generation of electricity by means of wind turbines is not a brand-new concept. Since the beginning of time, it has been put to use by people for a variety of purposes, including agriculture, domestic chores, and other activities. Up until the later part of the nineteenth century, it was common practice to use wind energy to power pumps that moved water, grain, and boats. The wind turbine was put to use in order to produce electric power. Recent developments in fields like as mechanical engineering, electrical engineering, aerodynamics, control technology, and electronics laid the groundwork for the creation of wind turbines, which are now widely deployed in commercial and residential settings.

**2. Wind power plant and its working**

by utilising a wind power plant that is capable of converting the kinetic energy of air that moves into usable electrical power. The rotating part, which converts the kinetic energy into mechanical energy, and the generator, which converts this mechanical energy into electrical energy, are the two primary components that are responsible for the power extraction process. turbine farms consisting of thousands of windmills must be built, which may be done on land or out in the ocean areas. In the past few decades, these massive structures have grown into an inevitable part of the environment.



Fig (a) Working of wind power plant

A vane located within the nacelle is used to adjust the position of the windmills so that they face the path where the air is blowing. From that point on, the power of the wind's electrical currents will begin to set in motion the three primary components of a windmill, which are as follows:

* The rotating part is made up of multiple wings & a bushing which links them together in one piece. Its purpose is to harvest the kinetic energy of the wind and transform it into mechanical rotational energy.
* Increase the rotational speed of the engine between Thirty rotations every minute (rpm) to fifteen hundred rpm with the help of the multiplier, which is a device that is linked to the motor through a rotating shaft and serves the purpose of increasing the rotational speed.
* The generator is the component that is accountable for transferring the mechanical energy created by spinning into the form of electrical energy.

A wind energy facility is made up of a collection of individual windmills that are connected to one another by beneath the earth wires that deliver the generated power to a converter station. Through the numerous distribution chains of the many power providers, it is then carried from there to homes, factories, or schools, among other receivers, between various locations. There are three categories of wind turbines.

Fig (c):Offshore power plants Fig (d):Onshore power plants Fig (e):Near Shore power plants

 **3. Challenges and Opportunity**

Firstly, we lack the ability to erect windmills in every available location. The variable speed of the wind also raises the possibility of encountering a difficult situation. To find solutions for such problems, the enterprise developed windmills of various ratings & dimensions. This made it possible to install wind generators at a place based on the standard wind speed of that area. This continues to be the most significant issue, which also has an effect on renewable energy endeavours.

2. When in comparison with traditional generators, wind turbines provide a greater risk of pollution in the natural world with sound and causing difficulties with visibility. Wind-generating installations do not have a big influence on the surrounding natural environment. However, the noise created by the blades of the turbine, as well as the aesthetic impact on the surrounding surroundings.

3. The erecting of windmills should be permitted only on land that is already being used for another reason. The possibility exists that it might be used to produce some amount of energy.

4. Windmill projects do significant damage & harm to the animals in the area around them. A significant number of birds are being killed every year after colliding with the moving blades of wind turbines. There are quite a few things that could be done to reduce the number of birds that are killed by wind turbines, including using radians, coating the blades of the turbines, and placing wind-generating installations in the most beneficial areas. As a consequence of this, the birds are likely to steer clear of the rotating turbine blades after getting a good look at the hues from far away. As a direct result of this, the lives of a great number of bats and bird species have been preserved.

Fig 3.1: Challenges in wind generation

 **4. Literature Survey**

* Their investigation of the progress being made in the field of wind electricity in India, focused the nation's ability to increase the contribution it makes to meeting the growing demand for energy that the nation has. The publication provides a comprehensive breakdown of India's progress to achieving a position among the leading five worldwide suppliers of wind power. This article also discusses the grants, projects, legislation, and manufacturers or successes in India that are related to wind power installation. All of the possibilities, challenges, and potential ways out of impasses that stand in the way of continued expansion are being investigated.
* The power output within the entire state of Jharkhand amounts to an overall of 7321 MW, however, the amount of electricity used in Jharkhand is recorded at 3300 MW. The remaining power is sent to neighbouring states to meet the demands of both general and home use. In situations where a significant financial gain is involved. In Jharkhand, an estimated 810 MW of power is produced through clean energy sources. Based on the above information, it may be inferred that the event or situation in question is in close proximity. While the entire state of Jharkhand achieves complete liberation from fossil fuel-based power sources? The impending arrival of that day is imminent. As a result, the significance of the occupation will be amplified twofold compared to its previous state
* According to what was said, in order for the government to meet the increasing energy requirements faced by society at a price that is reasonable, traditional sources of energy ought to be developed. The depletion of petroleum, and coal & the ensuing ecological challenges have brought into further focus the urgent need for innovative and environmentally friendly approaches to the provision of energy. The majority of India's energy needs are satisfied by coal and oil, which contributes to a rise in the creation of greenhouse emissions, as well as smog and acid rain. Over the past quarter of a century, there has been a frenzy of activity in India in the areas of energy study and development, energy production, and energy distribution. The production of wind energy in India has undoubtedly had an effect on the rest of the world.
* Outlined the current situation as well as future plans for the growth of wind power in India. a discussion on the prospects and obstacles facing the growth of wind power in this nation, as well as the many strategies that may be used to boost and broaden the utilisation of renewable energy. For a very long time, people were able to harness the power of the wind to perform useful labour, such as milling cereals pump water, and sailing ships. Wind power is becoming important in today's world as a source of electricity generation. Wind power is one of the renewable sources of energy available, and India possesses a significant amount of prospective wind energy assets (102 GW at 80 metres heights and 302 GW at 100 metres heights).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S/No** | **Districts** | **Population** | **Density** | **Area** **(Km^2)** | **Longitude** **(E)** | **Latitude** **(N)** | **Elevation** **(M)** |
| 1 | DHN (Dhanbad) | 2,684,487 | 1,284 | 2,075 | 86.43 | 23.79 | 246.2 |
| 2 | RNC (Ranchi) | 2,914,253 | 557 | 7,974 | 85.33 | 23.35 | 651 |
| 3 | BKSC (Bokaro) | 2,062,330 | 716 | 2,861 | 86.15 | 23.67 | 210 |
| 4 | DEO (Deoghar) | 1,492,073 | 602 | 2,479 | 86.69 | 24.48 | 254 |
| 5 | GRD (Giridhi) | 2,445,474 | 497 | 4,887 | 86.30 | 24.18 | 289 |
| 6 | HZB  | 1,734,495 | 403 | 4,302 | 8.79 | 47.83 | 610 |
| 7 | RAH (Ramgarh) | 949,443 | 684 | 1,212 | 85.52 | 23.63 | 1518 |
| 8 | DMU (Dumka) | 1,321,442 | 300 | 4,404 | 87.25 | 24.27 | 137 |
| 9 | KHU (Khunti) | 531,885 | 215 | 2,467 | 85.27 | 23.07 | 611 |
| 10 | GHU (Gumla) | 1,025,213 | 193 | 5,327 | 84.54 | 23.04 | 652 |
| 11 | LAD(Lohardaga) | 461,790 | 310 | 1,494 | 84.68 | 23.43 | 647 |
| 12 | PM (Palamu) | 1,939,869 | 381 | 5,082 | 85.95 | 23.83 | 377 |
| 13 | JMT (Jamtara) | 791,042 | 439 | 1,802 | 86.80 | 23.95 | 155 |
| 14 | PKR (Pakur) | 900,422 | 498 | 1,805 | 24.63 | 87.85 | 75 |
| 15 | SMD (Simdega) | 599,578 | 160 | 3,750 | 84.52 | 22.62 | 418 |
| 16 | GHD (Garhwa) | 1,322,784 | 497 | 4,064 | 58.41 | 17.63 | 203 |
| 17 | GODA (Godda) | 1,313,551 | 622 | 2,110 | 87.22 | 24.83 | 77 |
| 18 | CTR (Chatra) | 1,042,886 | 275 | 3,700 | 84.85 | 24.15 | 463 |
| 19 | SBG (Sahibganj) | 1,150,567 | 719 | 1,599 | 87.64 | 25.23 | 39.74 |
| 20 | KQR | 716,259 | 427 | 1,312 | 85.59 | 24.46 | 390 |
| 21 | LTHR | 726,978 | 310 | 3,630 | 84.50 | 23.75 | 387 |
| 22 | SKW | 1,065,056 | 390 | 3,750 | 85.92 | 22.70 | 182.3 |
| 23 | ESB | 2,293,919 | 648 | 3,533 | 86.49 | 22.48 | 94 |
| 24 | WSB | 1,502,338 | 209 | 7,186 | 85.43 | 22.36 | 352 |

**5. Jharkhand Biography**

Table 5.1: Jharkhand Information Table

**6. Mathematical Calculation of Wind Velocity**

A Daily averaged wind speed velocities of (Kth) regions in the (Nth) month

 The total amount of days in the (Nth) month

Where exactly

K = the district for which the mean wind speed is being determined N is the month that a wind speed calculation has to be done for.

Mathematical example and analysis of the typical wind speed in the Khunti district during the month of January in the year 2017.

12.3+12.3+8.7+4.7+6.5+4.7+10.5+8.7+12.3+10.5+12.3+12.3+10.5+6.5+10.5+12.3+4.7+10.5+12.3+15.9+14.0+8.7+12.3+10.5+8.7+4.7+8.7+12.3+12.3+14.0+12.3

31

= 317.5/31

= 10.24

Table 6.1: An average annual wind velocity for twenty-four districts of Jharkhand in the year 2K17.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 7.94 | 16.4 | 9.6 | 2.91 | 2.84 | 2.9 | 2.84 | 2.84 | 2.91 | 2.84 | 2.9 | 2.84 |
| RNC (Ranchi) | 10.4 | 13.6 | 12.9 | 13.2 | 15 | 17.2 | 23.6 | 18.2 | 19.2 | 14.2 | 13 | 15 |
| BKSC (Bokaro) | 10.0 | 14 | 12.3 | 12.8 | 13.9 | 15.8 | 23.2 | 15.7 | 18.5 | 14.8 | 13 | 14.9 |
| DEO (Deoghar) | 6.7 | 19 | 10.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GRD (Giridhi) | 7.51 | 19.5 | 10.57 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB  | 9.88 | 13.7 | 12.7 | 13.1 | 15 | 16.6 | 23.6 | 18 | 19.4 | 14.8 | 13 | 15 |
| RAH (Ramgarh) | 10.2 | 13.7 | 12.9 | 13.2 | 15 | 17.2 | 23.6 | 18.2 | 19.2 | 14.8 | 13 | 18.6 |
| DMU (Dumka) | 6.36 | 19.5 | 8.9 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 10.2 | 13 | 12.9 | 13 | 15 | 15.2 | 23.6 | 18.2 | 19.3 | 14.8 | 13.6 | 14.2 |
| GHU (Gumla) | 5.87 | 17.3 | 9.04 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LAD(Lohardaga) | 10.2 | 13.5 | 12.9 | 13.8 | 15 | 17.2 | 23.6 | 18.2 | 19.2 | 14.8 | 13 | 15 |
| PM (Palamu) | 7.61 | 23 | 12.5 | 5.11 | 5.38 | 4.62 | 4.28 | 4.78 | 4.01 | 3.95 | 1.46 | 2.04 |
| JMT (Jamtara) | 5.3 | 4.36 | 4.97 | 3.25 | 3.97 | 4.95 | 4.16 | 4.03 | 4.23 | 3.53 | 2.58 | 3.28 |
| PKR (Pakur) | 8.06 | 15.4 | 11.9 | 6.17 | 5.9 | 5.37 | 4.97 | 4.85 | 5.56 | 5.31 | 3.81 | 4.54 |
| SMD (Simdega) | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.86 | 15.6 | 14.2 | 9.51 | 10.24 | 8.91 | 27.2 | 24.2 | 22.7 | 21.3 | 20.7 | 19.4 |
| GODA (Godda) | 5.36 | 4.99 | 6.43 | 3.99 | 4.72 | 5.61 | 6.32 | 5.42 | 6.41 | 4.57 | 3.27 | 4.76 |
| CTR (Chatra) | 14.3 | 17.3 | 18.5 | 20.7 | 19.9 | 19 | 15.3 | 18.2 | 17.2 | 14.9 | 13.3 | 10.3 |
| SBG (Sahibganj) | 12.2 | 13.8 | 19.9 | 18.3 | 21.2 | 18.6 | 18 | 17 | 23.3 | 14.3 | 14.5 | 21.2 |
| KQR  | 14.6 | 17.4 | 19 | 19.8 | 20.4 | 19.7 | 16.5 | 17.7 | 17.2 | 14.9 | 13.3 | 10.3 |
| LTHR  | 5.84 | 17.6 | 11.4 | 5.29 | 5.19 | 4.62 | 4.29 | 4.79 | 4.15 | 3.97 | 1.46 | 2.14 |
| SKW | 7.3 | 9.29 | 11.3 | 14.8 | 12.6 | 10.38 | 11.7 | 12.8 | 11.3 | 8.32 | 7.45 | 7.22 |
| ESB | 6.53 | 9.51 | 12.52 | 13.99 | 11.57 | 9.46 | 10 | 10.82 | 11.02 | 8.9 | 6.5 | 6.54 |
| WSB | 7.11 | 8.32 | 12.11 | 14.7 | 13.6 | 8.42 | 9.42 | 9.83 | 10.97 | 9.46 | 8.27 | 7.25 |

Table 6.2: An average annual wind velocity for twenty-four districts of Jharkhand in the year 2K18.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 7.66 | 16.2 | 9.6 | 2.92 | 2.83 | 2.93 | 2.82 | 2.84 | 2.91 | 2.84 | 2.95 | 2.83 |
| RNC (Ranchi) | 9.87 | 13.5 | 12 | 13.5 | 14.3 | 17.4 | 22.6 | 18 | 19.5 | 14.3 | 13.2 | 15.1 |
| BKSC (Bokaro) | 9.53 | 13.5 | 12.2 | 12.7 | 14 | 15.3 | 22.5 | 16.2 | 17.5 | 14.8 | 12.9 | 14.7 |
| DEO (Deoghar) | 7.6 | 18.7 | 11.1 | 9.12 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GRD (Giridhi) | 7.31 | 19.3 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB  | 9.81 | 12.8 | 12.6 | 13.2 | 15.4 | 16.7 | 23.2 | 17.5 | 19.5 | 14.7 | 13.2 | 15.3 |
| RAH (Ramgarh) | 10.2 | 13.8 | 13.2 | 13.2 | 14.9 | 17.1 | 23.6 | 18.3 | 19.3 | 15.3 | 12.8 | 18.8 |
| DMU (Dumka) | 6.33 | 19.6 | 9.11 | 5.65 | 2.31 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 10.3 | 13.2 | 12.6 | 12.9 | 14.6 | 15.3 | 22.8 | 18.3 | 19.7 | 14.5 | 12.8 | 13.4 |
| GHU (Gumla) | 6.22 | 17.2 | 8.64 | 4.87 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LAD(Lohardaga) | 10.2 | 13.3 | 13.2 | 13.6 | 14.8 | 17.5 | 23.2 | 17.6 | 20.2 | 15.2 | 12.9 | 14.8 |
| PM (Palamu) | 7.62 | 22.3 | 12.3 | 5.12 | 5.68 | 4.65 | 4.32 | 4.86 | 3.91 | 3.92 | 1.47 | 2.03 |
| JMT (Jamtara) | 5.3 | 4.36 | 4.97 | 3.25 | 3.97 | 4.95 | 4.16 | 4.03 | 4.23 | 3.53 | 2.58 | 3.28 |
| PKR (Pakur) | 7.92 | 14.3 | 11.2 | 6.27 | 5.38 | 5.38 | 4.93 | 4.87 | 5.35 | 5.32 | 3.75 | 4.31 |
| SMD (Simdega) | 1.91 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.81 | 15 | 14.4 | 9.53 | 10.28 | 8.95 | 26.5 | 24 | 22.9 | 21.2 | 20.3 | 19.5 |
| GODA (Godda) | 5.32 | 4.87 | 6.67 | 3.84 | 4.76 | 5.62 | 6.52 | 5.41 | 6.42 | 4.53 | 3.22 | 4.66 |
| CTR (Chatra) | 14 | 17.2 | 18.3 | 20.2 | 19 | 18.7 | 15.8 | 18.4 | 17.6 | 15.2 | 14.3 | 10.32 |
| SBG (Sahibganj) | 12.3 | 13.6 | 19.2 | 18.2 | 22.2 | 18.2 | 17.6 | 15.9 | 22.7 | 14.5 | 15.6 | 22.3 |
| KQR  | 13.6 | 16.6 | 18.6 | 19.3 | 20.2 | 19.2 | 16.3 | 16.6 | 17 | 14.7 | 13.4 | 10.32 |
| LTHR  | 4.68 | 13.3 | 11.2 | 5.21 | 5.21 | 4.87 | 4.21 | 4.55 | 4.11 | 4.92 | 1.47 | 2.11 |
| SKW | 6.99 | 9.33 | 11.7 | 14.5 | 12.3 | 10.31 | 11.3 | 13.2 | 11.2 | 9.31 | 7.21 | 7.21 |
| ESB | 6.64 | 10.55 | 12.8 | 13.32 | 11.84 | 9.87 | 9.97 | 10.87 | 10.91 | 8.61 | 6.51 | 6.52 |
| WSB | 7.31 | 7.85 | 12 | 14.2 | 13.4 | 8.41 | 9.37 | 9.87 | 11.01 | 9.41 | 8.28 | 7.24 |

Table 6.3: An average annual wind velocity for twenty-four districts of Jharkhand in the year 2K19.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 5.58 | 13.8 | 8.92 | 3.09 | 2.99 | 2.92 | 2.67 | 2.95 | 2.87 | 2.82 | 3.01 | 2.93 |
| RNC (Ranchi) | 10.32 | 13.6 | 11.87 | 13.4 | 14.3 | 17.3 | 24.7 | 19.8 | 19.5 | 14.3 | 13 | 14 |
| BKSC (Bokaro) | 8.92 | 13.8 | 12 | 13.2 | 13.4 | 15.9 | 24.2 | 15.2 | 19.3 | 19.2 | 13.2 | 14.3 |
| DEO (Deoghar) | 5.79 | 16.3 | 9.76 | 1.1 | 1.1 | 2.32 | 1.99 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GRD (Giridhi) | 9.32 | 18.8 | 10.32 | 1.1 | 1.87 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB  | 10.32 | 12.6 | 12.9 | 13.9 | 14.8 | 14.8 | 21.6 | 18.1 | 18.8 | 14.3 | 12 | 15.3 |
| RAH (Ramgarh) | 10.01 | 12.9 | 12.9 | 12.4 | 15.2 | 16.5 | 24.3 | 19.2 | 19.4 | 14 | 13.9 | 19.3 |
| DMU (Dumka) | 7.3 | 14.8 | 9.32 | 8.11 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 11.2 | 11.3 | 12.7 | 12.8 | 15.3 | 15.1 | 19.3 | 18.8 | 19.6 | 13.8 | 13.9 | 13.7 |
| GHU (Gumla) | 6.32 | 16.2 | 9.32 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.99 |
| LAD(Lohardaga) | 9.52 | 13.4 | 12.8 | 13 | 13.8 | 17.9 | 20.3 | 19.3 | 18.9 | 15.2 | 13.2 | 13.6 |
| PM (Palamu) | 7.39 | 21.5 | 14.5 | 4.11 | 4.32 | 4.52 | 4.37 | 4.65 | 3.17 | 3.55 | 1.33 | 1.31 |
| JMT (Jamtara) | 5.36 | 5.22 | 4.27 | 3.22 | 3.52 | 4.87 | 4.65 | 4.11 | 4.22 | 3.09 | 2.96 | 3.09 |
| PKR (Pakur) | 8.11 | 14.6 | 12.3 | 6.19 | 5.86 | 5.31 | 4.34 | 5.31 | 5.39 | 5.66 | 4.27 | 4.26 |
| SMD (Simdega) | 1.46 | 1.32 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.87 | 13.6 | 14.3 | 10.32 | 10.27 | 9.11 | 26.2 | 24.5 | 23.2 | 21.4 | 21.2 | 20.4 |
| GODA (Godda) | 5.82 | 5.02 | 6.87 | 4.32 | 4.39 | 6.71 | 6.25 | 6.51 | 6.33 | 4.34 | 3.57 | 4.09 |
| CTR (Chatra) | 15.3 | 17 | 19.3 | 20.3 | 19.7 | 18.3 | 16.5 | 20.2 | 17.3 | 14 | 14.6 | 14.2 |
| SBG (Sahibganj) | 12.6 | 12.8 | 19.3 | 19.2 | 22.5 | 18.6 | 17.6 | 18.2 | 23.3 | 14 | 14.5 | 21 |
| KQR  | 15.1 | 16.7 | 17.7 | 19.8 | 19.6 | 19.5 | 16.8 | 17.8 | 13.4 | 16.7 | 13.4 | 11.6 |
| LTHR  | 6.11 | 16.5 | 11.2 | 11.2 | 4.98 | 4.34 | 3.87 | 4.55 | 3.66 | 3.37 | 1.96 | 1.99 |
| SKW | 6.32 | 9.34 | 11.6 | 14.6 | 12.8 | 10.55 | 12.3 | 12.6 | 12.4 | 9.12 | 7.72 | 6.99 |
| ESB | 6.65 | 9.52 | 11.5 | 14.1 | 11.3 | 9.33 | 9.69 | 10.66 | 10.5 | 8.66 | 5.63 | 6.31 |
| WSB | 7.06 | 8.93 | 11.3 | 14.6 | 14.3 | 9.51 | 9.55 | 9.62 | 9.86 | 9.61 | 7.69 | 7.53 |

Table 6.4: An average annual wind velocity for twenty-four districts of Jharkhand in the year 2K20.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 6.99 | 13.8 | 9.6 | 2.96 | 2.64 | 2.66 | 2.59 | 2.99 | 2.91 | 2.58 | 2.78 | 2.98 |
| RNC (Ranchi) | 10.31 | 11.6 | 13.4 | 13.6 | 16.8 | 20.5 | 18.3 | 20.2 | 14.2 | 12.1 | 12.3 | 14 |
| BKSC (Bokaro) | 9.62 | 13.9 | 12.8 | 12 | 13.8 | 14.6 | 22.4 | 16 | 15.6 | 14.3 | 12.8 | 14.6 |
| DEO (Deoghar) | 7.13 | 17.5 | 9.87 | 3.4 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GRD (Giridhi) | 10.92 | 12.3 | 10.57 | 3.46 | 3.11 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB  | 10.16 | 13.4 | 13.1 | 13.2 | 13.8 | 16.3 | 22.7 | 17.5 | 19.3 | 14.5 | 12 | 13.6 |
| RAH (Ramgarh) | 10.25 | 13.6 | 12.9 | 13.4 | 14.2 | 17.4 | 19.5 | 18.5 | 20 | 14.8 | 13.5 | 17.6 |
| DMU (Dumka) | 6.06 | 16.7 | 8.53 | 1.32 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 9.87 | 13.8 | 13 | 12.6 | 13.7 | 16.5 | 21 | 15.9 | 19.5 | 14.6 | 13.3 | 13.5 |
| GHU (Gumla) | 4.93 | 11.6 | 13.8 | 2.3 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LAD(Lohardaga) | 9.67 | 13.4 | 12.6 | 13.7 | 13.5 | 17 | 24.5 | 18.3 | 19 | 14.6 | 17.5 | 14.3 |
| PM (Palamu) | 7.01 | 21.5 | 12.3 | 6.11 | 5.52 | 4.62 | 4.52 | 4.22 | 3.26 | 3.51 | 1.92 | 1.86 |
| JMT (Jamtara) | 5.3 | 4.56 | 4.31 | 3.14 | 3.28 | 4.24 | 4.29 | 4.66 | 3.28 | 2.87 | 2.32 | 3.11 |
| PKR (Pakur) | 8.12 | 15.3 | 11.2 | 6.16 | 5.9 | 5.64 | 4.34 | 4.68 | 5.52 | 4.99 | 4.11 | 3.27 |
| SMD (Simdega) | 1.22 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.06 | 15 | 14.3 | 9.23 | 10.23 | 9.25 | 26.2 | 23.3 | 22.4 | 22.5 | 20.5 | 18.2 |
| GODA (Godda) | 6.12 | 4.56 | 6.42 | 3.86 | 4.34 | 5.61 | 6.57 | 5.33 | 6.22 | 4.23 | 3.29 | 4.57 |
| CTR (Chatra) | 15.1 | 17.6 | 17.5 | 19.8 | 20.6 | 17.8 | 16.3 | 14.3 | 16.8 | 14.8 | 14.2 | 9.79 |
| SBG (Sahibganj) | 12 | 12.6 | 12.9 | 18 | 22.2 | 18.6 | 18.1 | 21 | 14.9 | 14.8 | 22.1 | 18.5 |
| KQR  | 14.5 | 17.9 | 18.6 | 20.5 | 17.5 | 17.4 | 18.5 | 17.4 | 19.5 | 13.8 | 10.32 | 10.86 |
| LTHR  | 4.66 | 14.6 | 13.5 | 5.22 | 5.68 | 4.22 | 4.24 | 4.34 | 4.05 | 3.58 | 2.31 | 1.99 |
| SKW | 7.42 | 8.25 | 12.4 | 13.8 | 13.6 | 10.66 | 11.6 | 11.9 | 10.66 | 7.25 | 7.23 | 7.24 |
| ESB | 6.22 | 8.23 | 12.3 | 13.8 | 11.3 | 8.99 | 10.58 | 10.74 | 8.24 | 6.5 | 6.44 | 5.62 |
| WSB | 8.12 | 8.64 | 11.7 | 14.2 | 13.5 | 8.68 | 8.75 | 10.03 | 9.69 | 8.31 | 8.01 | 6.59 |

Table 6.5: An average annual wind velocity for twenty-four districts of Jharkhand in the year 2K21.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 7.34 | 13.4 | 8.6 | 3.11 | 2.31 | 2.81 | 2.72 | 2.84 | 2.91 | 2.64 | 3.1 | 2.82 |
| RNC (Ranchi) | 9.42 | 14.3 | 11.8 | 13.3 | 14.8 | 16.3 | 22.3 | 18.6 | 19.4 | 13.2 | 11 | 13.2 |
| BKSC (Bokaro) | 9.87 | 12.8 | 12.7 | 12 | 13 | 15.3 | 22.4 | 16.2 | 17.3 | 15.2 | 12.4 | 15.3 |
| DEO (Deoghar) | 17.8 | 10.01 | 5.32 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 4.31 | 1.1 |
| GRD (Giridhi) | 7.13 | 18.8 | 10 | 8.72 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB  | 8.87 | 13.6 | 12.6 | 13 | 13.8 | 17.3 | 22.8 | 17.6 | 18.4 | 15.3 | 12.4 | 15.5 |
| RAH (Ramgarh) | 9.82 | 13.2 | 12.8 | 13.3 | 13.8 | 16.9 | 24.6 | 17.3 | 20.6 | 13.8 | 13 | 18.5 |
| DMU (Dumka) | 6.38 | 17.6 | 8.15 | 6.7 | 1.1 | 1.1 | 1.1 | 4.31 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 10.32 | 13.2 | 13.4 | 12.2 | 13.8 | 14.8 | 22.6 | 19.5 | 19.3 | 14.9 | 14.1 | 14.3 |
| GHU (Gumla) | 5.32 | 17.8 | 9.22 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LAD(Lohardaga) | 10.25 | 13.6 | 13 | 13.3 | 14.8 | 17.3 | 23 | 18.3 | 20.2 | 14.3 | 12.6 | 14.5 |
| PM (Palamu) | 6.55 | 23.2 | 12.6 | 5.41 | 5.32 | 4.72 | 4.26 | 4.32 | 4.22 | 3.46 | 1.52 | 1.75 |
| JMT (Jamtara) | 5.66 | 4.35 | 4.56 | 3.55 | 4.22 | 4.25 | 4.25 | 4.15 | 4.14 | 3.6 | 3.56 | 2.36 |
| PKR (Pakur) | 7.62 | 15.4 | 11.5 | 6.12 | 5.35 | 5.66 | 4.32 | 3.54 | 6.5 | 3.3 | 3.41 | 3.99 |
| SMD (Simdega) | 1.21 | 1.22 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.33 | 15 | 14.3 | 10.66 | 10.25 | 8.93 | 26 | 24.9 | 23.2 | 21.5 | 20 | 18.3 |
| GODA (Godda) | 4.89 | 4.69 | 6.31 | 4.32 | 4.69 | 5.62 | 6.94 | 5.66 | 6.31 | 4.08 | 3.51 | 3.98 |
| CTR (Chatra) | 13.6 | 19 | 18.4 | 18.6 | 19 | 14.6 | 15.4 | 17.6 | 19.7 | 10.87 | 10.22 | 10.1 |
| SBG (Sahibganj) | 13.4 | 13.8 | 19 | 18.7 | 22.1 | 20.6 | 17.3 | 18.3 | 14.3 | 16.5 | 15.3 | 20 |
| KQR  | 13.6 | 16.7 | 18.9 | 19.4 | 20.3 | 19.5 | 15.4 | 17.5 | 17.3 | 14.5 | 13.5 | 9.99 |
| LTHR  | 11.9 | 15.7 | 10.66 | 5.32 | 5.66 | 5.11 | 5.19 | 4.59 | 4.27 | 3.29 | 3.27 | 3.16 |
| SKW | 6.99 | 8.87 | 10.32 | 14.2 | 12.7 | 10.6 | 11.5 | 11.9 | 11.2 | 7.69 | 7.99 | 7.11 |
| ESB | 6.51 | 9.54 | 9.99 | 13.8 | 12.7 | 9.33 | 9.14 | 11.2 | 11.4 | 8.82 | 6.4 | 6.23 |
| WSB |  7.32 | 8.12 | 12.1 | 14 | 13.6 | 7.35 | 7.99 | 10.34 | 10.58 | 9.25 | 9.24 | 9.06 |

Based on the findings of the study the information was collected on the average speed over the five years prior to it, 2k17–2k18, 2k18–2k19, 2k19–2k20, and 2k20–2k21 respectively.

The average overall speed of the wind in Kth districts

 The average yearly wind speed of (Kth) districts for (Nth) years

 Whole number of years

Where specifically

K is the region where the median wind speed is being estimated. N is the year that the wind's velocity is being estimated for.

An Example of Calculation

Consideration was given to the typical velocity of the wind in the KHU (Khunti) district during the months of January in 2k17–2k18, 2k18–2k19, 2k19–2k20, and 2k20–2k21. The information in each of the tables 3.2, 3.4, 3.6, 3.8, and 3.10 was used.

 10.2+10.3+11.2+9.87+10.32/ 5

= 51.89/5

= 10.37

Table 6.6: The dataset comprises the mean velocity values recorded during a period of five years, namely from 2K17 to 2K21.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| DHN (Dhanbad) | 6.08 | 14.7 | 9.26 | 2.99 | 2.71 | 2.84 | 2.71 | 2.89 | 2.9 | 2.74 | 2.94 | 2.88 |
| RNC (Ranchi) | 9.59 | 13.3 | 12.3 | 13.4 | 15 | 17.7 | 17.5 | 18.9 | 18.3 | 13.6 | 12.5 | 14.2 |
| BKSC (Bokaro) | 9.59 | 13.6 | 12.4 | 12.5 | 13.6 | 15.3 | 22.9 | 15.8 | 17.64 | 15.6 | 12.8 | 14.7 |
| DEO (Deoghar) | 9 | 16.3 | 9.23 | 3.16 | 1.1 | 1.34 | 1.27 | 1.1 | 1.1 | 1.1 | 1.74 | 1.1 |
| GRD (Giridhi) | 8.43 | 17.7 | 8.51 | 3.09 | 1.65 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| HZB (Hazaribagh) | 9.8 | 13.2 | 12.7 | 13.2 | 14.5 | 16.3 | 22.7 | 17.7 | 19 | 14.7 | 12.5 | 14.9 |
| RAH (Ramgarh) | 10.1 | 13.4 | 12.9 | 13.1 | 14.6 | 17 | 23.1 | 18.3 | 19.7 | 14.5 | 13.2 | 18.5 |
| DMU (Dumka) | 6.48 | 17.6 | 8.8 | 4.57 | 1.34 | 1.1 | 1.1 | 1.74 | 1.1 | 1.1 | 1.1 | 1.1 |
| KHU (Khunti) | 10.38 | 12.9 | 12.9 | 12.7 | 14.4 | 15.3 | 21.8 | 18.1 | 19.4 | 14.5 | 13.5 | 13.8 |
| GHU (Gumla) | 5.73 | 16 | 10 | 2.09 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.27 |
| LAD(Lohardaga) | 9.97 | 13.4 | 12.9 | 13.4 | 14.3 | 17.3 | 22.9 | 18.3 | 19.5 | 14.8 | 13.8 | 14.4 |
| PM (Palamu) | 7.23 | 22.3 | 12.8 | 5.17 | 5.24 | 4.62 | 4.35 | 4.56 | 3.71 | 3.67 | 1.54 | 1.79 |
| JMT (Jamtara) | 5.38 | 4.57 | 4.61 | 3.28 | 3.79 | 4.65 | 4.3 | 4.19 | 4.02 | 3.32 | 2.81 | 3.02 |
| PKR (Pakur) | 7.96 | 15 | 11.6 | 6.18 | 5.67 | 5.47 | 4.58 | 4.65 | 5.66 | 4.91 | 3.87 | 4.07 |
| SMD (Simdega) | 1.38 | 1.16 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| GHD (Garhwa) | 8.58 | 14.8 | 14.3 | 9.85 | 10.25 | 9.03 | 26.4 | 24.1 | 22.8 | 21.5 | 20.5 | 19.1 |
| GODA (Godda) | 5.5 | 4.82 | 6.54 | 4.06 | 4.58 | 5.83 | 6.52 | 5.66 | 6.33 | 4.35 | 3.37 | 4.41 |
| CTR (Chatra) | 14.4 | 17.6 | 18.4 | 19.9 | 19.6 | 17.6 | 12.8 | 17.7 | 17.7 | 13.9 | 13.3 | 10.9 |
| SBG (Sahibganj) | 12.5 | 13.3 | 18 | 18.4 | 22 | 18.9 | 17.7 | 18 | 19.7 | 14.8 | 16.4 | 20.6 |
| KQR (Koderma) | 14.2 | 17 | 18.5 | 19.7 | 19.6 | 19 | 16.7 | 17.4 | 16.8 | 14.9 | 12.7 | 10.6  |
| LTHR (Latehar) | 6.63 | 15.5 | 11.5 | 6.44 | 5.34 | 4.63 | 4.36 | 4.56 | 4.04 | 3.82 | 2.09 | 2.27 |
| SKW (SeraikelaKharsawan) | 7 | 9.01 | 11.4 | 14.3 | 12.8 | 10.51 | 11.6 | 12.4 | 11.3 | 8.33 | 7.52 | 7.15 |
| ESB (East Singhbhum) | 6.51 | 9.47 | 11.8 | 13.8 | 11.7 | 9.39 | 9.87 | 10.85 | 10.43 | 8.29 | 6.29 | 6.24 |
| WSB (WestSinghbhum) | 7.38 | 8.37 | 11.8 | 14.3 | 13.6 | 8.47 | 9.01 | 9.93 | 10.42 | 9.2 | 8.29 | 7.53 |

**7. Result and Comparison**

The mean velocity of the information data throughout the last five years, between 2k17 to 2k21, appears in Graph 6.6. According to graph 7.1, if the wind's speed is higher than 10 kilometres per hour, then it is possible to generate enormous quantities of power. Graph 7.3 When the speed of the wind is under Six kilometres per hour, therefore it would be impossible to create power. Graph number 7.2 If the speed of the wind is between 6 and 9 km per hour, therefore only a small amount of power may be generated. Around thirteenth of Jharkhand's which can produced electricity.

**8. Conclusion and Futures Scope**

Jharkhand possesses significant upside, although its untapped prospects remain unexplored. In order to effectively address and enhance the energy requirements of Jharkhand, the use of wind power is crucial. There are several factors that exert influence on the financial stability and prospective development of Jharkhand. The determining factor between them is the reliance on energy, which determines whether things are self-sufficient. Jharkhand is going to achieve self-sufficiency in nuclear power generations, hence reducing its reliance on foreign nations. The study that was conducted suggests that the use of wind electricity is a viable option in the state of Jharkhand, particularly in important cities like RNC (Ranchi), KHU(Khunti), RAH(Ramghar), BKSC(Bokaro), KQR (Koderma), HZB(Hazaribagh), LAD(Lohardaga), SKW(Saraikela Kharsawan), ESB(East Singhbhum), WSB(West Singhbhum), GODA(Godda), LTHR(Latehar), PKR(Pakur), PM(Palamu), JMT(Jamtara), and DHN(Dhanbad). It may be inferred that wind power has the potential to arise and effectively meet the energy demands of the state of Jharkhand.but these are some districts which produce small amout of electricity such as PM(Palamu), PKR(Pakur), GODA(Godda), LTHR(Latehar), JMT(Jamtara) & DHN(Dhanbad).and rest of thr remaning five districts which cannot able to produce an electricity they are DEO(Deoghar), GRD(Giridhi), DMU(Dumka), GHU(Gumla), SMD(Simdega).which is shown in graph 7.1,7.2,7.3 & 7.4.

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