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

ABSTRACT

 Governments all around the globe are building renewable energy facilities such as solar, wind, hydro, biomass, and geothermal power plants to generate electricity. As global warming continues to take main stage in 2018, the world creates more renewable energy than it consumes as a consequence of cost-cutting measures enacted by green regulations. Wind, hydro, geothermal, biomass, and hydroelectric plants are all examples of renewable energy. Whether hydroelectric facilities are included or not, India is the world's fourth largest producer of electricity. India ranks third in the world in terms of energy usage. (Source: Enevdata 2009) Where the world is shifting in favour of renewable energy, economic progress, and a more sustainable future. Renewable energy must not only provide today's energy needs, but also those of the future in a world where economic development and population increase are driving up need for energy due to global warming

A wide gathering of the records of winds power generation will be attempted performed. A rigorous study about the Feasibility and existence of wind power energy in the state of Jharkhand. Finally, the study of wind power generation in the state of Jharkhand in particular regions with the efficient production of power will be performed.

**1. Introduction**

 Wind turbines are not a novel technique for generating power. People have been utilizing it for thousands of years in agriculture, household tasks, and so forth. Wind energy was seen to be utilized to pump water, grains, and boats until the latter decade of the nineteenth century. The wind turbine was used to generate electricity. Advances in Mechanical Engineering, Electrical Engineering, Aerodynamics, Control Technology, and Electronics created the technological foundation for wind turbines that are routinely utilized today. Professor James Blyth pioneered wind power in 1887.

**2. Wind power plant**

Wind energy is an environmentally friendly kind of energy that is available all over the world. Wind turbines are intended to optimize the use of this natural resource. Wind turbines may operate at wind speeds ranging from 10km/h to 90km/h and are widely utilized all over the world. The wind power plant is used to generate energy in high wind locations using wind turbines. Wind energy accounts for around 2% of all solar energy that hits the planet. The wind is caused by the uneven heating of the earth's surface, which creates separate low-pressure zones and air molecules to flow from the high-pressure zone to the low-pressure zone. The wind traces a random route all around the planet due to the rotation of the earth and surface defects. The wind is extracted at the wind power services and then utilized to turn generators that generate energy.

**2.1 Working and Construction**

Air-generated electricity is produced when the force of the wind pushes on the turbine's blades, forcing them to revolve and produce mechanical energy. The spinning blades, which connect to a hub and a low-speed shaft, turn in tandem with the blades. The revolving low-speed shaft is linked to a gearbox, which in turn is linked to a high-speed shaft on the other side of the gearbox. This high-speed shaft has a connection to an electrical generator, which turns the mechanical energy from the blade rotation into electrical energy. Each turbine, usually spins between 11 and 20 twice per minute, can generate a maximum of 1.5 megawatts of electricity, enough to power more than 500 residences on average.



Fig (a) Working of wind power plant

Wind turbines are used in wind power features to generate energy in high wind destinations. It is wind-dependent and can't produce power without it. How a wind turbine is built and how it generates strength. A great deal of instruments are required while building a wind turbine. In the beginning, its basic foundation is referred to as a tower. This tower might be created through multiple stages. So that a few of towers may be readily constructed. This structure is hollow on the inside. So that the cable may be put within it, alongside the steps, so that in the case of a technical problem, they can be developed from under the tower. If the tower was not built firmly, it would have grown quite heavy, would have required a lot of employment to erect, and would have cost money. That is why wind turbines have low towers. The height of the tower is determined by the area. The weather area is urban, rural, or hilly, for example. Wind turbines can feature three blades with blade lengths of up to 60-70 ft. It is a difficult effort to install. The area determines the length of the blade and the height of the tower. The rotor hub houses these three blades. Its spinning produces power. But there's a catch: its blades rotate very slowly. At a rate of 10-20rpm.When the wind gathers considerable tempo, the poet slows down and changes the way they are going. Such a challenging Endeavors.

This blade may also be adjusted in many different Kind of ways. Either place the nickel component first, followed by the rotor hub. One blade can be introduced with the aid of a crane, or all three blades can be planted in the ground simultaneously with the help of a large crane. The nickel is the most essential ingredient of this. The gearbox, brakes, and alternator are installed first, followed by the rest of the machine. The rotor is attached to the gearbox shaft. The gearbox's role is to either increase or decrease the rpm depending upon what happening. It has a 1:90 to 1:100 ratio. This suggests that if the rotor spins once, the gearbox makes it spin 100 times faster. The wind speed varies between 11 and 90 miles per hour. We employ brakes to regulate the high wind speed so that the blade prevents Overspeed. The shaft behind the gearbox is sometimes referred to as a generator or red. There is a magnet outside and one within the alternator. And the shaft is fastened to that very little magnet, which creates magnetic flux as it turns. An anemometer is employed to figure out what direction the wind is blowing.

The main uses this to turn the entire nickel piece towards the direction of the wind. The alternator generates power, which is sent straight to the generator through the wire. This improves the voltage. The power returns over the bus bars to the substation, where it is distributed in our daily lives. There are three categories of wind turbines.

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

Wind power plants use wind turbines for producing power in high wind regions; their operation is windy-dependent; without wind, turbines cannot generate electricity. Renewable energy sources can be divided into four types: horizontal-axis turbines, vertical-axis turbines, small wind turbines, and airborne wind turbines. Horizontal axis turbines have been found that they are the most successful kind of turbine. A great deal of the world used them to perform commercial energy generating. They feature a low cut-in wind speed at high power coefficient. Yet since the generator and gearbox must be installed at the top of the tower, their design is more complicated and costly. In order to orient them in the direction of the planet, a customized yaw drive will also be added. Its primary elements are. Hub, Nacelle, Power Transmission System, Generator, Yaw Control, Brakes, and Tower are components of a turbine. A cross-wind axis machine is referred to as a vertical axis wind turbine (VAWT). The axis of rotation in these devices is parallel to the wind's direction. Its primary elements are. Tower, blades, and support structure, or rotor shaft.

**2.2 Advantages of Wind Power Plant**

1. When their limbs are cut off, animals groan. There is a potential consequently the number of wind farm sites may grow and that more birds will be killed. When energy originates from the wind and it offers clean air for fossil fuels, there are no additional pollution into the atmosphere.

2. If compared to a single power plant, a wind turbine occupies extremely little space. It allows us to use the remaining land for agriculture.

 3. Renewable energy can be detected in nature. The wind never stops blowing and can Supply

 endless streams of electricity.

4. Produce energy from the largest building, mountain, ocean, or both urban and rural Location

5. This investment is one-time only. There are no extra expenditures other than the occasional need for maintenance. In addition to successful utilisation of space on land

**2.3 Disadvantages of Wind Power Plant**

1. In nature, it is impractical to accurately control the wind, and the wind never blows in exactly the same direction, which makes it impossible to strategically position wind turbines everywhere since the wind does not blow evenly.

2. It costs up to ten lakh Indian rupees to put up a single wind turbine with a nominal power output of one megawatt (MW).

3. Compared to fossil fuels, wind power offers a very small amount of electricity. We need to deploy more applicants wind turbines in order generate the same amount of power. Additionally, wind turbines have limited ability to generate electricity.

 4. Trees are planted every year as a result of the rising need for wind energy.

 5. The noise emitted by a single wind turbine has a similarity to that of a minuscule jet

 engine. As a consequence, nearby individuals and animals suffer difficulties.

**2.4 Manufacturing Top Brand of Windmills**

 1. Vesta Brand (Rank 1, and its capacity is 9.61)

 2. Siemens Gamesa (Rank 2, and its capacity is 8.9)

 3. Gold-wind (Rank 3, and its capacity is 8.26)

 4. GE Brand (Rank 4, and its capacity is 7.38)

 5. Envision Brand (Rank 5, and its capacity is 5.79)

 6. Ming-yang Brand (Rank 6, and its capacity is 4.56)

 7. Win-Dey Brand (Rank 7, and its capacity is 2.07)

 8. Nordex Brand (Rank 8, and its capacity is 1.97)

 9. Shanghai Electric Brand (Rank 9, and its capacity is 1.72)

 10.CSIS Brand (Rank 10, and its capacity is 1.47)

 **3. Challenges and Opportunity**

1. We are unable to put up windmills everywhere. The notion of a challenge is also brought up by the inconsistent wind speed. The business created wind turbines of different capacities and sizes to address these issues, allowing wind turbines to be erected in a location according to wind speed. This is still the most significant problem that impacts wind power initiatives too.

2. Compared to traditional power plants, the wind power plant's turbine could pollute the environment with noise and problems with sight. The natural world is not significantly impacted by wind power facilities. However, the sound made by the turbine blades and the visual effect on the environment.

3. Land with another purpose should be available for the installation of wind turbines. It has some potential in terms of the generation of energy.

4. Wind power plants seriously harm the surrounding wildlife. Large numbers of birds are dying as a result of getting struck by rotating turbine blades. There are some ways that can decrease the number of bird deaths, such as siting wind power facilities in the most advantageous locations, employing radian, or painting turbine blades. As a result, after viewing the colours from a distance, the birds are going to avoid the wind turbine blades. Many birds' and bats' lives have been spared as an outcome of this.

Fig 1.15: Challenges in wind generation

**4. Literature Survey**

1. In their analysis of the development of wind energy in India, Kara et al. [1] highlighted the country's potential to boost its contribution to fulfilling the nation's ever-rising energy demands. The document clearly outlines India's development towards ranking among the top five global producers of wind energy. This essay also covers wind power installation incentives, initiatives, policies, and manufacturing or accomplishments in India. Opportunities, difficulties, and solutions for removing obstacles to further growth have all been looked into.

2. Investigated the assessed wind energy production potential at several sites in Jharkhand, India, including Ranchi, Jamshedpur, Devghar, Lohardaga, and Chaibasa. There is a requirement for a change in renewable energy sources in Jharkhand because of the region's demand for electricity and its restricted supply of fossil fuels. The places under study have been determined to be unsuitable for large-scale wind-to-electricity generation at a height of 10 m above the ground. However, low-speed wind may be harnessed with the help of small-scale wind turbines, ideally situated above 10 m from the ground.

3.The government should develop conventional energy sources to fulfil society's growing energy demands at an acceptable cost, based to a conversation. The necessity for new sustainable energy supply solutions has been highlighted by the scarcity of fossil fuels and the resulting environmental issues. India relies largely on coal and oil to supply its energy needs, which increases the production of greenhouse gases, acid rain, and pollution. In India, the last 25 years have seen a flurry of activity in the fields of energy research, development, production, and distribution. India has certainly made an impact on the globe by producing wind energy.

4.focused on Weather research and weather data’s, generation of wind will and its power.

5.presented the status and development of wind energy in India. discusses the challenges and opportunities in the development of wind energy in the country and also different approaches to increase and expand the utilization of wind resources.

The energy of the wind to obtain some useful work like grinding grains, pumping water, and sailing boats have been there for a very long time. In modern times, wind energy is being used to generate electricity. Wind energy is one of the clean sources of energy and India has a huge potential for wind energy resources (102 GW at 80m height and 302 GW at 100m height). This vast potential has remained unexplored which can be achieved through well-framed policies. This paper presents a detailed study of the fiscal incentives and development schemes offered by the Indian government in expanding wind energy business. Wind energy policies of India have been keenly studied and obstacles to the success of these policie programes have also been discussed in this paper. The outcomes of this paper reiterate the work that has been conducted by Indian government (Central and State) in wind energy sector indicating lower renewable energy prices, improved financial incentives, opportunities in offshore wind energy and a steady market growth.

7.presented the application of multi-criteria decision making to sustainable energy planning also Review on renewable and sustainable energy *whether it is suitable or not.*

8.Offered the hierarchical Communication network architecture for offshore wind power farms. Wind provides a clean and renewable source of energy, and is relatively simple: the wind spins blades attached to a turbine that turns and generates power. It uses the best technique to communicate and also the transmission, distribution.

9.presented the monthly Chart v/s Yearly Chart of Average Wind Speed for

 Twenty-Four Districts of Jharkhand.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S/No** | **Districts** | **Population** | **Density** | **Area** **(Km^2)** | **Longitude** **(E)** | **Latitude** **(N)** | **Elevation** **(M)** |
| 1 | DHANBAD | 2,684,487 | 1,284 | 2,075 | 86.43 | 23.79 | 246.2 |
| 2 | RANCHI | 2,914,253 | 557 | 7,974 | 85.33 | 23.35 | 651 |
| 3 | BOKARO | 2,062,330 | 716 | 2,861 | 86.15 | 23.67 | 210 |
| 4 | DEOGHAR | 1,492,073 | 602 | 2,479 | 86.69 | 24.48 | 254 |
| 5 | GIRIDHI | 2,445,474 | 497 | 4,887 | 86.30 | 24.18 | 289 |
| 6 | HAZARIBAGH | 1,734,495 | 403 | 4,302 | 8.79 | 47.83 | 610 |
| 7 | RAMGARH | 949,443 | 684 | 1,212 | 85.52 | 23.63 | 1518 |
| 8 | DUMKA | 1,321,442 | 300 | 4,404 | 87.25 | 24.27 | 137 |
| 9 | KHUNTI | 531,885 | 215 | 2,467 | 85.27 | 23.07 | 611 |
| 10 | GUMLA | 1,025,213 | 193 | 5,327 | 84.54 | 23.04 | 652 |
| 11 | LOHARDAGA | 461,790 | 310 | 1,494 | 84.68 | 23.43 | 647 |
| 12 | PALAMU | 1,939,869 | 381 | 5,082 | 85.95 | 23.83 | 377 |
| 13 | JAMTARA | 791,042 | 439 | 1,802 | 86.80 | 23.95 | 155 |
| 14 | PAKUR | 900,422 | 498 | 1,805 | 24.63 | 87.85 | 75 |
| 15 | SIMDEGA | 599,578 | 160 | 3,750 | 84.52 | 22.62 | 418 |
| 16 | GARHWA | 1,322,784 | 497 | 4,064 | 58.41 | 17.63 | 203 |
| 17 | GODDA | 1,313,551 | 622 | 2,110 | 87.22 | 24.83 | 77 |
| 18 | CHATRA | 1,042,886 | 275 | 3,700 | 84.85 | 24.15 | 463 |
| 19 | SAHIBGANJ | 1,150,567 | 719 | 1,599 | 87.64 | 25.23 | 39.74 |
| 20 | KODERMA | 716,259 | 427 | 1,312 | 85.59 | 24.46 | 390 |
| 21 | LATEHAR | 726,978 | 310 | 3,630 | 84.50 | 23.75 | 387 |
| 22 | SERAIKELAKHARSAWAN | 1,065,056 | 390 | 3,750 | 85.92 | 22.70 | 182.3 |
| 23 | EAST SINGHBHUM | 2,293,919 | 648 | 3,533 | 86.49 | 22.48 | 94 |
| 24 | WEST SINGHBHU | 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**

The Monthly average wind speed velocity of (Kth) districts in the (nth)

Month Daily Avg wind speed velocity of (Kth) districts in the (Nth) month

 Number of days of (Nth) months

Where

K= District for which average wind speed is being calculated N= Month for which wind speed is being calculated

Sample Calculation

Evaluation of average wind velocity for khunti district in January 2017

11.2+11.2+7.6+3.6+5.4+3.6+9.4+7.6+11.2+9.4+11.2+11.2+9.4+5.4+9.4+11.2+3.6+9.4+11.2+

14.8+13+7.6+11.2+9.4+7.6+3.6+7.6+11.2+11.2+13+11.2

31

= 283.6/31

= 9.14

Table 6.1: Average wind speed date throughout the years 2017 for twenty-four districts of Jharkhand.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 6.84 | 15.3 | 8.50 | 1.81 | 1.74 | 1.80 | 1.74 | 1.74 | 1.81 | 1.74 | 1.8 | 1.74 |
| Ranchi | 9.33 | 12.5 | 11.8 | 12.1 | 13.9 | 16.1 | 22.5 | 17.1 | 18.1 | 13.1 | 11.9 | 13.9 |
| Bokaro | 8.92 | 12.9 | 11.2 | 11.7 | 12.8 | 14.7 | 22.1 | 14.6 | 17.4 | 13.7 | 11.9 | 13.8 |
| Deoghar | 5.60 | 17.9 | 9.0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Giridhi | 6.41 | 18.4 | 9.47 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Hazaribagh | 8.78 | 12.6 | 11.6 | 12 | 13.9 | 15.5 | 22.5 | 16.9 | 18.3 | 13.7 | 11.9 | 13.9 |
| Ramgarh | 9.14 | 12.6 | 11.8 | 12.1 | 13.9 | 16.1 | 22.5 | 17.1 | 18.1 | 13.7 | 11.9 | 17.5 |
| Dumka | 5.26 | 18.4 | 7.80 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Khunti | 9.14 | 11.9 | 11.8 | 11.9 | 13.9 | 14.1 | 22.5 | 17.1 | 18.2 | 13.7 | 12.5 | 13.1 |
| Gumla | 4.77 | 16.2 | 7.94 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Lohardaga | 9.14 | 12.4 | 11.8 | 12.7 | 13.9 | 16.1 | 22.5 | 17.1 | 18.1 | 13.7 | 11.9 | 13.9 |
| Palamu | 6.51 | 21.9 | 11.4 | 4.01 | 4.28 | 3.52 | 3.18 | 3.68 | 2.91 | 2.85 | 0.36 | 0.94 |
| Jamtara | 4.20 | 3.26 | 3.87 | 2.15 | 2.87 | 3.85 | 3.06 | 2.93 | 3.13 | 2.43 | 1.48 | 2.18 |
| Pakur | 6.96 | 14.3 | 10.8 | 5.07 | 4.80 | 4.27 | 3.87 | 3.75 | 4.46 | 4.21 | 2.71 | 3.44 |
| Simdega | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Garhwa | 7.76 | 14.5 | 13.1 | 8.41 | 9.14 | 7.81 | 26.1 | 23.1 | 21.6 | 20.2 | 19.6 | 18.3 |
| Godda | 4.26 | 3.89 | 5.33 | 2.89 | 3.62 | 4.51 | 5.22 | 4.32 | 5.31 | 3.47 | 2.17 | 3.66 |
| Chatra | 13.2 | 16.2 | 17.4 | 19.6 | 18.8 | 17.9 | 14.2 | 17.1 | 16.1 | 13.8 | 12.2 | 9.21 |
| Sahibganj | 11.1 | 12.7 | 18.8 | 17.2 | 20.1 | 17.5 | 16.9 | 15.9 | 22.2 | 13.2 | 13.4 | 20.1 |
| Koderma | 13.5 | 16.3 | 17.9 | 18.7 | 19.3 | 18.6 | 15.4 | 16.6 | 16.1 | 13.8 | 12.2 | 9.21 |
| Latehar | 4.74 | 16.5 | 10.3 | 4.19 | 4.09 | 3.52 | 3.19 | 3.69 | 3.05 | 2.87 | 0.36 | 1.04 |
| Seraikela Kharsawn | 6.20 | 8.19 | 10.2 | 13.7 | 11.5 | 9.28 | 10.6 | 11.7 | 10.2 | 7.22 | 6.35 | 6.12 |
| EastSinghbm | 5.43 | 8.41 | 11.42 | 12.89 | 10.47 | 8.36 | 8.90 | 9.72 | 9.92 | 7.80 | 5.40 | 5.44 |
| WestSinghbm | 6.01 | 7.22 | 11.01 | 13.6 | 12.5 | 7.32 | 8.32 | 8.73 | 9.87 | 8.36 | 7.17 | 6.15 |

Table 6.2: Average wind speed date throughout the years 2018 for twenty-four districts of Jharkhand

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 6.56 | 15.1 | 8.50 | 1.82 | 1.73 | 1.83 | 1.72 | 1.74 | 1.81 | 1.74 | 1.85 | 1.73 |
| Ranchi | 8.77 | 12.4 | 10.9 | 12.4 | 13.2 | 16.3 | 21.5 | 16.9 | 18.4 | 13.2 | 12.1 | 14.0 |
| Bokaro | 8.43 | 12.4 | 11.1 | 11.6 | 12.9 | 14.2 | 21.4 | 15.1 | 16.4 | 13.7 | 11.8 | 13.6 |
| Deoghar | 6.50 | 17.6 | 10.0 | 8.02 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Giridhi | 6.21 | 18.2 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Hazaribagh | 8.71 | 11.7 | 11.5 | 12.1 | 14.3 | 15.6 | 22.1 | 16.4 | 18.4 | 13.6 | 12.1 | 14.2 |
| Ramgarh | 9.12 | 12.7 | 12.1 | 12.1 | 13.8 | 16.0 | 22.5 | 17.2 | 18.2 | 14.2 | 11.7 | 17.7 |
| Dumka | 5.23 | 18.5 | 8.01 | 4.55 | 1.21 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Khunti | 9.22 | 12.1 | 11.5 | 11.8 | 13.5 | 14.2 | 21.7 | 17.2 | 18.6 | 13.4 | 11.7 | 12.3 |
| Gumla | 5.12 | 16.1 | 7.54 | 3.77 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Lohardaga | 9.11 | 12.2 | 12.1 | 12.5 | 13.7 | 16.4 | 22.1 | 16.5 | 19.1 | 14.1 | 11.8 | 13.7 |
| Palamu | 6.52 | 21.2 | 11.2 | 4.02 | 4.58 | 3.55 | 3.22 | 3.76 | 2.81 | 2.82 | 0.37 | 0.93 |
| Jamtara | 4.20 | 3.26 | 3.87 | 2.15 | 2.87 | 3.85 | 3.06 | 2.93 | 3.13 | 2.43 | 1.48 | 2.18 |
| Pakur | 6.82 | 13.2 | 10.1 | 5.17 | 4.28 | 4.28 | 3.83 | 3.77 | 4.25 | 4.22 | 2.65 | 3.21 |
| Simdega | 0.81 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Garhwa | 7.71 | 13.9 | 13.3 | 8.43 | 9.18 | 7.85 | 25.4 | 22.9 | 21.8 | 20.1 | 19.2 | 18.4 |
| Godda | 4.22 | 3.77 | 5.57 | 2.74 | 3.66 | 4.52 | 5.42 | 4.31 | 5.32 | 3.43 | 2.12 | 3.56 |
| Chatra | 12.9 | 16.1 | 17.2 | 19.1 | 17.9 | 17.6 | 14.7 | 17.3 | 16.5 | 14.1 | 13.2 | 9.22 |
| Sahibganj | 11.2 | 12.5 | 18.1 | 17.1 | 21.1 | 17.1 | 16.5 | 14.8 | 21.6 | 13.4 | 14.5 | 21.2 |
| Koderma | 12.5 | 15.5 | 17.5 | 18.2 | 19.1 | 18.1 | 15.2 | 15.5 | 15.9 | 13.6 | 12.3 | 9.22 |
| Latehar | 3.58 | 12.2 | 10.1 | 4.11 | 4.11 | 3.77 | 3.11 | 3.45 | 3.01 | 3.82 | 0.37 | 1.01 |
| SeraikelKharsawan | 5.89 | 8.23 | 10.6 | 13.4 | 11.2 | 9.21 | 10.2 | 12.1 | 10.1 | 8.21 | 6.11 | 6.11 |
| East Singhbhm | 5.54 | 9.45 | 11.7 | 12.22 | 10.74 | 8.77 | 8.87 | 9.77 | 9.81 | 7.51 | 5.41 | 5.42 |
| West Singhbhum | 6.21 | 6.75 | 10.9 | 13.1 | 12.3 | 7.31 | 8.27 | 8.77 | 9.91 | 8.31 | 7.18 | 6.14 |

Table 6.3: Average wind speed date throughout the years 2019 for twenty-four districts of Jharkhand.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 4..57 | 12.7 | 7.82 | 1.99 | 1.89 | 1.82 | 1.57 | 1.85 | 1.77 | 1.72 | 1.91 | 1.83 |
| Ranchi | 9.22 | 12.5 | 10.77 | 12.3 | 13.2 | 16.2 | 23..7 | 18.7 | 18.4 | 13.2 | 11.9 | 12.9 |
| Bokaro | 7.82 | 12.7 | 10.9 | 12.1 | 12.3 | 14.8 | 23.1 | 14.1 | 18.2 | 18.1 | 12.1 | 13.2 |
| Deoghar | 4.69 | 15.2 | 8.66 | 00 | 00 | 1.22 | 0.89 | 00 | 00 | 00 | 00 | 00 |
| Giridhi | 8.22 | 17.7 | 9.22 | 00 | 0.77 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Hazaribagh | 9.22 | 11.5 | 11.8 | 12.8 | 13.7 | 13.7 | 20.5 | 17.0 | 17.7 | 13.2 | 10.9 | 14.2 |
| Ramgarh | 8.91 | 11.8 | 11.8 | 11.3 | 14.1 | 15.4 | 23.2 | 18.1 | 18.3 | 12.9 | 12.8 | 18.2 |
| Dumka | 6.20 | 13.7 | 8.22 | 7.01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Khunti | 10.1 | 10.2 | 11.6 | 11.7 | 14.2 | 14.0 | 18.2 | 17.7 | 18.5 | 12.7 | 12.8 | 12.6 |
| Gumla | 5.22 | 15.1 | 8.22 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 0.89 |
| Lohardaga | 8.42 | 12.3 | 11.7 | 11.9 | 12.7 | 16.8 | 19.2 | 18.2 | 17.8 | 14.1 | 12.1 | 12.5 |
| Palamu | 6.29 | 20.4 | 13.4 | 3.01 | 3.22 | 3.42 | 3.27 | 3.55 | 2.07 | 2.45 | 0.23 | 0.21 |
| Jamtara | 4.26 | 4.12 | 3.17 | 2.12 | 2.42 | 3.77 | 3.55 | 3.01 | 3.12 | 1.99 | 1.86 | 1.99 |
| Pakur | 7.01 | 13.5 | 11.2 | 5.09 | 4.76 | 4.21 | 3.24 | 4.21 | 4.29 | 4.56 | 3.17 | 3.16 |
| Simdega | 0.36 | 0.22 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Garhwa | 7.77 | 12.5 | 13.2 | 9.22 | 9.17 | 8.01 | 25.1 | 23.4 | 22.1 | 20.3 | 20.1 | 19.3 |
| Godda | 4.72 | 3.92 | 5.77 | 3.22 | 3.29 | 5.61 | 5.15 | 5.41 | 5.23 | 3.24 | 2.47 | 2.99 |
| Chatra | 14.2 | 15.9 | 18.2 | 19.2 | 18.6 | 17.2 | 15.4 | 19.1 | 16.2 | 12.9 | 13.5 | 13.1 |
| Sahibganj | 11.5 | 11.7 | 18.2 | 18.1 | 21.4 | 17.5 | 16.5 | 17.1 | 22.2 | 12.9 | 13.4 | 19.9 |
| Koderma | 14.0 | 15.6 | 16.6 | 18.7 | 18.5 | 18.4 | 15.7 | 16.7 | 12.3 | 15.6 | 12.3 | 10.5 |
| Latehar | 5.01 | 15.4 | 10.1 | 10.1 | 3.88 | 3.24 | 2.77 | 3.45 | 2.56 | 2.27 | 0.86 | 0.89 |
| Seraikela KharsawaN | 5.22 | 8.24 | 10.5 | 13.5 | 11.7 | 9.45 | 11.2 | 11.5 | 11.3 | 8.02 | 6.62 | 5.89 |
| East Singhbhu m | 5.55 | 8.42 | 10.4 | 13.0 | 10.2 | 8.23 | 8.59 | 9.56 | 9.48 | 7.56 | 4.53 | 5.21 |
| West Singhbhum | 5.96 | 7.83 | 10.2 | 13.5 | 13.2 | 8.41 | 8.45 | 8.52 | 8.76 | 8.51 | 6.59 | 6.43 |

Table 6.4: Average wind speed date throughout the years 2020 for twenty-four districts of Jharkhand

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 5.89 | 12.7 | 8.50 | 1.86 | 1.54 | 1.56 | 1.49 | 1.89 | 1.81 | 1.48 | 1.68 | 1.88 |
| Ranchi | 9.21 | 10.5 | 12.3 | 12.5 | 15.7 | 19.4 | 17.2 | 19.1 | 13.1 | 11.0 | 11.2 | 12.9 |
| Bokaro | 8.52 | 12.8 | 11.7 | 10.9 | 12.7 | 13.5 | 21.3 | 14.9 | 14.5 | 13.2 | 11.7 | 13.5 |
| Deoghar | 6.03 | 16.4 | 8.77 | 2.30 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Giridhi | 9.82 | 11.2 | 9.47 | 2.36 | 2.01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Hazaribagh | 9.06 | 12.3 | 12.0 | 12.1 | 12.7 | 15.2 | 21.6 | 16.4 | 18.2 | 13.4 | 10.9 | 12.5 |
| Ramgarh | 9.15 | 12.5 | 11.8 | 12.3 | 13.1 | 16.3 | 18.4 | 17.4 | 18.9 | 13.7 | 12.4 | 16.5 |
| Dumka | 4.96 | 15.6 | 7.43 | 0.22 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Khunti | 8.77 | 12.7 | 11.9 | 11.5 | 12.6 | 15.4 | 19.9 | 14.8 | 18.4 | 13.5 | 12.2 | 12.4 |
| Gumla | 3.83 | 10.5 | 12.7 | 1.20 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Lohardaga | 8.57 | 12.3 | 11.5 | 12.6 | 12.4 | 15.9 | 23.4 | 17.2 | 17.9 | 13.5 | 16.4 | 13.2 |
| Palamu | 5.91 | 20.4 | 11.2 | 5.01 | 4.42 | 3.52 | 3.42 | 3.12 | 2.16 | 2.41 | 0.82 | 0.76 |
| Jamtara | 4.20 | 3.46 | 3.21 | 2.04 | 2.18 | 3.14 | 3.19 | 3.56 | 2.18 | 1.77 | 1.22 | 2.01 |
| Pakur | 7.02 | 14.2 | 10.1 | 5.06 | 4.80 | 4.54 | 3.24 | 3.58 | 4.42 | 3.89 | 3.01 | 2.17 |
| Simdega | 0.12 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Garhwa | 6.96 | 13.9 | 13.2 | 8.13 | 9.13 | 8.15 | 25.1 | 22.2 | 21.3 | 21.4 | 19.4 | 17.1 |
| Godda | 5.02 | 3.46 | 5.32 | 2.76 | 3.24 | 4.51 | 5.47 | 4.23 | 5.12 | 3.13 | 2.19 | 3.47 |
| Chatra | 14.0 | 16.5 | 16.4 | 18.7 | 19.5 | 16.7 | 15.2 | 13.2 | 15.7 | 13.7 | 13.1 | 8.69 |
| Sahibganj | 10.9 | 11.5 | 11.8 | 16.9 | 21.1 | 17.5 | 17.0 | 19.9 | 13.8 | 13.7 | 21.0 | 17.4 |
| Koderma | 13.4 | 16.8 | 17.5 | 19.4 | 16.4 | 16.3 | 17.4 | 16.3 | 18.4 | 12.7 | 9.22 | 9.76 |
| Latehar | 3.56 | 13.5 | 12.4 | 4.12 | 4.58 | 3.12 | 3.14 | 3.24 | 2.95 | 2.48 | 1.21 | 0.89 |
| Seraikela Kharsawan | 6.32 | 7.15 | 11.3 | 12.7 | 12.5 | 9.56 | 10.5 | 10.8 | 9.56 | 6.15 | 6.13 | 6.14 |
| East Singhbhum | 5.12 | 7.13 | 11.2 | 12.7 | 10.2 | 7.89 | 9.48 | 9.64 | 7.14 | 5.40 | 5.34 | 4.52 |
| WestSinghbhum | 7.02 | 7.54 | 10.6 | 13.1 | 12.4 | 7.58 | 7.65 | 8.93 | 8.59 | 7.21 | 6.91 | 5.49 |

Table 6.5: Average wind speed date throughout the years 2021 for twenty-four districts of Jharkhand

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 6.24 | 12.3 | 7.50 | 2.01 | 1.21 | 1.71 | 1.62 | 1.74 | 1.81 | 1.54 | 2.0 | 1.72 |
| Ranchi | 8.32 | 13.2 | 10.7 | 12.2 | 13.7 | 15.2 | 21.2 | 17.5 | 18.3 | 12.1 | 9.9 | 12.1 |
| Bokaro | 8.77 | 11.7 | 11.6 | 10.9 | 11.9 | 14.2 | 21.3 | 15.1 | 16.2 | 14.1 | 11.3 | 14.2 |
| Deoghar | 16.7 | 8.91 | 4.22 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 3.21 | 00 |
| Giridhi | 6.03 | 17.7 | 8.9 | 7.62 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Hazaribagh | 7.77 | 12.5 | 11.5 | 11.9 | 12.7 | 16.2 | 21.7 | 16.5 | 17.3 | 14.2 | 11.3 | 14.4 |
| Ramgarh | 8.72 | 12.1 | 11.7 | 12.2 | 12.7 | 15.8 | 23.5 | 16.2 | 19.5 | 12.7 | 11.9 | 17.4 |
| Dumka | 5.28 | 16.5 | 7.05 | 5.6 | 00 | 00 | 00 | 3.21 | 00 | 00 | 00 | 00 |
| Khunti | 9.22 | 12.1 | 12.3 | 11.1 | 12.7 | 13.7 | 21.5 | 18.4 | 18.2 | 13.8 | 13.0 | 13.2 |
| Gumla | 4.22 | 16.7 | 8.12 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Lohardaga | 9.15 | 12.5 | 11.9 | 12.2 | 13.7 | 16.2 | 21.9 | 17.2 | 19.1 | 13.2 | 11.5 | 13.4 |
| Palamu | 5.45 | 22.1 | 11.5 | 4.31 | 4.22 | 3.62 | 3.16 | 3.22 | 3.12 | 2.36 | 0.42 | 0.65 |
| Jamtara | 4.56 | 3.25 | 3.46 | 2.45 | 3.12 | 3.15 | 3.15 | 3.05 | 3.04 | 2.50 | 2.46 | 1.26 |
| Pakur | 6.52 | 14.3 | 10.4 | 5.02 | 4.25 | 4.56 | 3.22 | 2.44 | 5.40 | 2.20 | 2.31 | 2.89 |
| Simdega | 0.11 | 0.12 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Garhwa | 7.23 | 13.9 | 13.2 | 9.56 | 9.15 | 7.83 | 24.9 | 23.8 | 22.1 | 20.4 | 18.9 | 17.2 |
| Godda | 3.79 | 3.59 | 5.21 | 3.22 | 3.59 | 4.52 | 5.84 | 4.56 | 5.21 | 2.98 | 2.41 | 2.88 |
| Chatra | 12.5 | 17.9 | 17.3 | 17.5 | 17.9 | 13.5 | 14.3 | 16.5 | 18.6 | 9.77 | 9.12 | 9.01 |
| Sahibganj | 12.3 | 12.7 | 17.9 | 17.6 | 21.0 | 19.5 | 16.2 | 17.2 | 13.2 | 15.4 | 14.2 | 18.9 |
| Koderma | 12.5 | 15.6 | 17.8 | 18.3 | 19.2 | 18.4 | 14.3 | 16.4 | 16.2 | 13.4 | 12.4 | 8.89 |
| Latehar | 10.8 | 14.6 | 9.56 | 4.22 | 4.56 | 4.01 | 4.09 | 3.49 | 3.17 | 2.19 | 2.17 | 2.06 |
| Seraikela Kharsawan | 5.89 | 7.77 | 9.22 | 13.1 | 11.6 | 9.50 | 10.4 | 10.8 | 10.1 | 6.59 | 6.89 | 6.01 |
| East Singhbhum | 5.41 | 8.44 | 8.89 | 12.7 | 11.6 | 8.23 | 8.04 | 10.1 | 10.3 | 7.72 | 5.30 | 5.13 |
| WestSinghbhum | 6.22 | 7.02 | 11.0 | 12.9 | 12.5 | 6.25 | 6.89 | 9.24 | 9.48 | 8.15 | 8.14 | 7.96 |

According to the survey of Data on average velocity for the last five years from 2017- 2018, 2018- 2019,2019-2020 and 2020-2021. The average velocity of the last five years of table is given below.

Overall average wind speed of kth districts

 yearly average wind velocity of (Kth) districts in the (Nth) years

 =

 Total number of years

Where

K= District for which average wind speed is being calculated N= year for which wind speed is being calculated

Sample Calculation

Evaluation of average wind velocity for khunti district in January 2017-2018, 2018-2019, 2019-2020, 2020-2021. Data were taken from tables 3.2, 3.4, 3.6, 3.8, and 3.10 respectively.

= 9.14+9.22+10.1+8.77+9.22/ 5

= 46.45/5

= 9.29

Table 6.6: Data of average velocity of last five years from 2017-to 2021

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Districts | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Dhanbad | 4.98 | 13.6 | 8.16 | 1.89 | 1.61 | 1.74 | 1.61 | 1.79 | 1.80 | 1.64 | 1.84 | 1.78 |
| Ranchi | 8.49 | 12.2 | 11.2 | 12.3 | 13.9 | 16.6 | 16.4 | 17.8 | 17.2 | 12.5 | 11.4 | 13.1 |
| Bokaro | 8.49 | 12.5 | 11.3 | 11.4 | 12.5 | 14.2 | 21.8 | 14.7 | 16.54 | 14.5 | 11.7 | 13.6 |
| Deoghar | 7.90 | 15.2 | 8.13 | 2.06 | 0.00 | 0.24 | 0.17 | 0.00 | 0.00 | 0.00 | 0.64 | 0.00 |
| Giridhi | 7.33 | 16.6 | 7.41 | 1.99 | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hazaribagh | 8.70 | 12.1 | 11.6 | 12.1 | 13.4 | 15.2 | 21.6 | 16.6 | 17.9 | 13.6 | 11.4 | 13.8 |
| Ramgarh | 9.00 | 12.3 | 11.8 | 12.0 | 13.5 | 15.9 | 22.0 | 17.2 | 18.6 | 13.4 | 12.1 | 17.4 |
| Dumka | 5.38 | 16.5 | 7.70 | 3.47 | 0.24 | 0.00 | 0.00 | 0.64 | 0.00 | 0.00 | 0.00 | 0.00 |
| Khunti | 9.28 | 11.8 | 11.8 | 11.6 | 13.3 | 14.2 | 20.7 | 17.0 | 18.3 | 13.4 | 12.4 | 12.7 |
| Gumla | 4.63 | 14.9 | 8.90 | 0.99 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 |
| Lohardaga | 8.87 | 12.3 | 11.8 | 12.3 | 13.2 | 16.2 | 21.8 | 17.2 | 18.4 | 13.7 | 12.7 | 13.3 |
| Palamu | 6.13 | 21.2 | 11.7 | 4.07 | 4.14 | 3.52 | 3.25 | 3.46 | 2.61 | 2.57 | 0.44 | 0.69 |
| Jamtara | 4.28 | 3.47 | 3.51 | 2.18 | 2.69 | 3.55 | 3.20 | 3.09 | 2.92 | 2.22 | 1.71 | 1.92 |
| Pakur | 6.86 | 13.9 | 10.5 | 5.08 | 4.57 | 4.37 | 3.48 | 3.55 | 4.56 | 3.81 | 2.77 | 2.97 |
| Simdega | 0.28 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Garhwa | 7.48 | 13.7 | 13.2 | 8.75 | 9.15 | 7.93 | 25.3 | 23.0 | 21.7 | 20.4 | 19.4 | 18.0 |
| Godda | 4.40 | 3.72 | 5.44 | 2.96 | 3.48 | 4.73 | 5.42 | 4.56 | 5.23 | 3.25 | 2.27 | 3.31 |
| Chatra | 13.3 | 16.5 | 17.3 | 18.8 | 18.5 | 16.5 | 1.7 | 16.6 | 16.6 | 12.8 | 12.2 | 9.84 |
| Sahibganj | 11.4 | 12.2 | 16.9 | 17.3 | 20.9 | 17.8 | 16.6 | 16.9 | 18.6 | 13.7 | 15.3 | 19.5 |
| Koderma | 13.1 | 15.9 | 17.4 | 18.6 | 18.5 | 17.9 | 15.6 | 16.3 | 15.7 | 13.8 | 11.6 | 9.51 |
| Latehar | 5.53 | 14.4 | 10.4 | 5.34 | 4.24 | 3.53 | 3.26 | 3.46 | 2.94 | 2.72 | 0.99 | 1.17 |
| SeraikelaKharsawan | 5.90 | 7.91 | 10.3 | 13.2 | 11.7 | 9.41 | 10.5 | 11.3 | 10.2 | 7.23 | 6.42 | 6.05 |
| East Singhbhum | 5.41 | 8.37 | 10.7 | 12.7 | 10.6 | 8.29 | 8.77 | 9.75 | 9.33 | 7.19 | 5.19 | 5.14 |
| WestSinghbhum | 6.28 | 7.27 | 10.7 | 13.2 | 12.5 | 7.37 | 7.91 | 8.83 | 9.32 | 8.10 | 7.19 | 6.43 |

**7. Result and Comparison**

Graph 4.1 shows the data average velocity for the last 5 years from 2017 to 2021. Graph 4.2 shows the wind speed is greater than 9kmp/h then electricity can be produced in Large Scale. Graph 4.3 If the wind speed is less than 5kmp/h then electricity cannot be generated Graph 4.4 If the wind speed is medium 5-8kmp/h then electricity can be produced in a small amount

Fig 7.1: Monthly Chart v/s Yearly Chart of Average Wind Speed for Twenty-Four Districts of Jharkhand

Out of 24 districts in Jharkhand only thirteen districts are capable to produced large amout of electricity reason average wind speed should be minimum 9kmp/h

17.8

8.49

22

9

20.7

9.28

17.9

8.7

21.8

8.49

21.8

8.87

20.9

11.4

18.6

11.6

18.8

1.7

23

7.48

13.2

5.9

10.7

5.14

13.2

6.28

Fig 7.2: Monthly Chart v/s Yearly Chart of Average Wind Speed for Twenty-Four Districts of Jharkhand where large amount of electricity can be generated wind speed Is less than 5kmp/h

These are the five districts of Jharkhand which cannot generate electricity reason average

16.6

15.2

16.5

14.9

G I R I D H I D E O G H A R D U M K A G U M L A S I M D E G A

Fig 7.3: Monthly Chart v/s Yearly Chart of Average Wind Speed for Twenty-Four Districts of

0

0

0

0

0.28

0

Jharkhand Where there is no production of electricity being possible.

These are the five districts of Jharkhand which cannot generate electricity reason average wind speed Is less than 5-8kmp/h

Fig 7.4: Monthly Chart v/s Yearly Chart of Average Wind Speed for Twenty-Four Districts of Jharkhand where small amount of electricity can be generated

**8. Conclusion and Futures Scope**

Jharkhand is a land with enormous promise, but its potential is not being used. In order to successfully meet and improve Jharkhand's energy demands, wind energy Many variables affect Jharkhand's economic growth and future. Among them, Its dependence on energy decides should goods are self. Jharkhand will be released from its dependence on other nations for the generation of nuclear energy.

The proposed survey concluded that wind power energy is feasible in the state of Jharkhand at prime locations such locations are RANCHI, KHUNTI, RAMGHAR, BOKARO, KODERMA, HAZARIBAGH, LOHARDAGA, SARAIKELA KHARSAWAN, EAST SINGHBHUM, and WEST SINGHBHUM, GODDA, LATHEHAR, PAKUR, PALAMU, JAMTARA, and DHANBAD. Or it can also be concluded that wind power may exist and provide an efficient amount of power to supply the state of Jharkhand.

There is a total generation of 7320 MW of electricity in Jharkhand while the total consumption of electricity in Jharkhand is 3200 MW. The rest of the electricity is sent to the outside state for general and household uses. Where there is a big profit deal. If seen, around 800 MW of total electricity is generated in Jharkhand from renewable energy. From this, it can be said that it is not far away. When the entire Jharkhand will be free from non-renewable energy. That day is not far away. With this, the meaning of the job will increase twice as before.

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