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Wind Resource for Electrical Energy of Tourism and Micro Small and Medium Enterprises (MSMEs) in Coastal Areas After the COVID-19 Pandemic

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ABSTRACT

Purpose – This paper seeks to examine the The strategy to growth economical in coastal area that's one of the areas more lovely designed to be a tourist destination in which is quite attractive to tourists, especially domestic tourists. **Methodology/approach –**To obtain wind potential data, data is collected using equipment that is adapted to the final destination in the form of place and time. Anemometer equipment is used to obtain wind speed data so that the condition of the wind speed in a place can be known.
Findings – It was found that The potential wind generated will be the basis for the design that will be used to design a wind turbine suitable for power generation. At that hour the wind has a speed of 2 m/s - 5 m/s. Effective hour that can operating turbine while wind speed flow continue in 10.00 AM until 04.00 AM day tomorrow. The existing wind speed will be adjusted according to the design of the turbine that will be used.
Novelty/value – Electrical energy from wind resources in coastal areas can save the cost of electricity needs for growing SMEs. Savings in electricity needs are obtained from wind turbines that can rotate at low speeds.

Keywords: electricity, wind, coast, power, turbine

INTRODUCTION

Utilization of the potential that exists in tourist attractions aims to increase the savings in expenses that must be borne by the community to manage tourism. The world of tourism that is currently developing will certainly increase the need for energy for the purposes of running tourism activities. This energy need must be answered with the community's foresight to look for potential energy producers that are free from dependence on energy provided by state companies such as PLN, which is currently still experiencing an energy deficit, especially in North Sumatra. Therefore, the energy-producing potentials that exist in the community around tourism sites must continue to be explored and utilized. The most abundant energy potential in nature after the solar is wind, therefore the potential for wind energy needs to be explored in order to obtain new and renewable energy results that are beneficial to the community, especially in tourism areas.

The beach is a place that is rich and abundant in wind potential that can be used to drive wind turbines. The wind in the coastal area will always be there and can be used for free. This potential also supports the new renewable energy mix that must be achieved by the government by 2025. The existing wind potential is in the form of wind speeds greater than 2 m/s which can be used to drive suitable wind turbines.

The Kota Pari Village area is a very large coastal area and still has a sparsely populated area, so that free electrical energy becomes a genuine power that can support the economy and lift the community's economy. Currently the existing beaches are managed by private parties to become tourist attractions visited by people from various regions in North Sumatra.

To support the Indonesian government's program on the use of new and renewable energy that is environmentally friendly and support regional income in the tourism sector because by utilizing wind and solar energy to meet electricity needs in the tourism area of Kota Pari Village will reduce electricity costs and provide solutions for additional electrical energy for development tourism attraction. And then make a study of wind potential for wind energy power plants around Kota Pari Village. In addition, people's knowledge, initiative and intuition regarding new renewable energy sources will be able to be awakened or awakened from their sleep by educating energy knowledge through intelligent energy, namely the potential of wind energy.

Based on the observed background, it is necessary to know the wind speed profile on the coast of Kota Pari Village and which part of the coast of Kota Pari Village has the largest and relatively constant wind speed. After obtaining this answer, theoretically, it is necessary to know the ability of the wind speed on the coast of Kota Pari Village to rotate wind turbines to produce electrical energy.

Open landscapes such as lakes that are wide enough to become passageways or wind channels that move from one place with high air pressure to another with low air pressure. The air to flow has a certain speed depending on the difference in air pressure and the distance between the two air spaces with different pressures. Natural events like this make the wind flow in open and wide areas such as

LITERATURE REVIEW

Wind is caused by the uneven heating of sunlight over the earth's surface. Hotter air will expand to become lighter and move upwards, while cooler air will be heavier and move to occupy the area. (Sharma, Sellami, Tahir, & Mallick, 2021) The difference in atmospheric pressure in an area caused by a temperature difference will produce a force. The difference in pressure expressed in terms of the pressure gradient is the rate of change of pressure due to the difference in distance. Gradient force is a force that acts in the direction of higher pressure to lower pressure. The direction of the pressure gradient force in the atmosphere is perpendicular to the surface of the isobars.

Wind energy is one of the fastest-growing electrical energy sources in the world. The United States installed over 5,200 MW in 2007, and experts are forecasting for as much to be installed in 2008. The United States cumulative installed capacity as of Dec. 31, 2007, was 16,596 MW.(Thresher & Robinson, 2008) National average wholesale market value of wind in 2019 was 39% less than that of a generalized flat block of power-driven down by wind’s location (transmission congestion) and temporal output profile, with curtailment generally being a comparatively minor influence.(Wiser et al., 2020) when compared to the condition of the use of wind energy in America, Indonesia is still the opposite or not as big as that carried out in America. In Indonesia, the potential for wind is spread in almost all regions; this is because Indonesia has many coastal and coastal areas. The current condition of the wind potential has not been widely used as a source of electrical energy, so there are still many areas that are possible to develop wind energy potential.

The use of renewables to provide power to remote villages has had a mixed record in the past because maintenance was costly and replacement parts difficult to obtain. However, due to research on very low-maintenance designs, small wind turbines are once again gaining popularity as an economical way to bring the benefits of power production to homes, villages, and industries that may be remote from an established grid or wish to operate without burning fossil fuels. (Energy & Association, 2001)

Geostrophic Wind
The gradient force results from the difference in air pressure and the point is always towards the lower pressure region. If due to the difference in pressure, the air mass moves, i.e., northward along the Meridian, it is deflected by the Coriolis force to the right. If moving from north to south, turn left. So the balance between the two forces is only found if the geostrophic wind moves along the line of constant pressure, i.e. isobars. Therefore, in the Northern Hemisphere areas of low pressure are found always to the left of the geostrophic wind and high pressure to the right. In the southern hemisphere it works the other way around.(Robert Gasch Jochen Twele, 2012)

Atmospheric boundary layer
The lowest layer of the atmosphere is a turbulent layer called the boundary layer of the atmosphere. Air flow in this layer is influenced by friction on the soil, orography, and topography and also by the vertical distribution of temperature and pressure. Geostrophic winds above the boundary layer are not affected by friction in the soil.(Dunne & Simley, 2011) Thus, between these undisturbed geostrophic winds and the ground there is a layer in which wind speed varies greatly with elevation above the ground. Friction on the surface roughness takes energy from the air flow which causes a vertical gradient of wind speed. This causes a turbulent exchange of momentum and air mass with air flowing in higher layers above the ground.

To be able to take advantage of wind energy we must be able to take into account where the wind can be utilized. In certain areas the wind may be difficult to obtain but in other places the wind is quite strong. The wind turbine will be able to rotate if there is enough wind speed to make it spin. Wind turbines must operate within this atmospheric boundary layer. The nature and intensity of this airflow determines the amount of energy that can be extracted as well as the load on the wind turbine. The height of the atmospheric boundary layer varies depending on soil roughness, vertical temperature profile and wind speed. On a clear night it might just extend approx. 100 m above the ground. On a warm summer day with low wind speeds, it may reach 2,000 m. The assumed average height of the atmospheric boundary layer is about 1,000 m.(Irena International renewable Energy Agency, 2018)

Wind speed measurement
Measurement of wind speed is the most important part to see if the wind has the potential to produce electrical energy. In addition, the measurement of wind speed makes it easier to get a wind benefit profile for various purposes. Measurement of wind speed can be done in many ways, one of which is for areas with complex topography, namely by means of unmanned drones. An unmanned aerial vehicle is equipped with a standard ultrasonic anemometer. Uncertainty in how the wind is obtained corrects for the stationary anemometer data at different altitudes and shows very good data similarity, especially in the mean wind speed (< 0.12 m/s) and the mean direction (< 2,4◦).(Ingenhorst, Jacobs, Stößel, Schelenz, & Juretzki, 2021) This measurement method is more accurate because it can work on different altitude data and in uncertain directions.

Figure 1. Measurement system WindLocator (Ingenhorst et al., 2021)

Another way of better wind measurement is the Light Detection and Ranging System (LIDAR) which is able to measure the incoming wind speed before interacting with the wind turbine rotor. This advance wind measurement can be used in a feed forward control system designed to reduce the turbine load, so that it will better suit the turbine rotation requirements..(Dunne & Simley, 2011)

Another measurement is to adopt video technology, namely the innovation of using video observations of flow structure interactions to make wind speed predictions without using classical meteorological measurements as input. This allows prediction of wind speed over a much wider range of physical environments, particularly where meteorological sensors would be expensive or impractical to install.(Haider, Alam, Yousuf, & Salim, 2012) In addition, the Coupled Convolutional and Recurrent Neural Network method will better predict which direction the wind will pass through the turbine then.(Yamaguchi, 2021)(Giebel, Schlipf, & Kaifel, 2019)

The practice of predicting wind speed some time before and recently has become important for forecasting the production of wind power plants made. One of the methods such as neural networks, supporting vector machines, genetic algorithms and comparing with traditional techniques in terms of accuracy.(Lawan, Abidin, Chai, Baharun, & Masri, 2014) The accuracy of the data will have an impact on the wind profile of a place.(Tripp, Optis, & King, 2020)

Some of these methods perform well on short-term predictions while others perform better on predictions of different timescales.(Myklebust, 2014)(Sheng, Wan, Cheng, & Wang, 2020) But various wind forecasting methods are available in the power system, which will help wind farm owners to identify wind forecasting methods according to their needs.(Mauger, 2016)

METHOD

This research is related to the problem of analyzing the existence of air flow in the Kota Pari Village area which is horizontal into continuous wind traffic at a fairly large speed. The wind speed in the Kota Pari Village area theoretically provides the potential for designing wind power plants. To determine the capacity of wind turbines and generators, it is necessary to analyze wind speed. This raises the desire to make an analysis of the potential for wind speed in the Kota Pari Village area.

The research procedure will be carried out through several stages as follows:

1. Determine the wind speed measurement point in the Kota Pari Village area
2. At the measuring point that has been determined based on the direction of the wind, a high pole is installed to get a bigger wind.
3. The pole whose pole has been determined will be installed with a wind speed measuring device.

4. This measurement is carried out repeatedly with a scaled time to get accurate data about wind speed in different wind directions / the results listed in the tool will be recorded comprehensively
5. The results of the wind speed will be analyzed.

Observed Parameters

The parameters observed in this study are:

1. Wind direction
2. Wind speed
3. Time

Data collection technique

The data collection technique was carried out by installing a wind speed measuring device and then recording wind speed data on a wind speed measuring device based on experiments (experiments) in the field according to the experimental stages carried out.

Data Analysis Method

The analysis method is carried out by carrying out activities or activities through the following stages:

Stage I: Conduct a survey in the field, which is to see the condition of the wind speed in Kota Pari Village and see the natural conditions as well as take the data needed to support this research. There are several parameters observed in this stage, namely: the potential of air space in Kota Pari Village, wind direction, wind speed and weather at the research location.

Stage II: Installing the tool at the measuring point that has been set according to the wind direction at the research location.

Stage III: Recording wind speed data at the research location to see wind speed data variables recorded in wind speed measuring devices that have been installed in the research area according to the measuring point that has been set, according to a time scale.

Stage IV: Grouping the wind speed data that has been recorded and collected comprehensively according to the time scale that has been set in the measurement process at the research site. In this stage the calculations are carried out based on data obtained from conditions in the field.

Stage V: Perform data analysis according to the grouping of wind speed data that has been structured accurately and correctly according to the data obtained in the field using the WRPLOT view program.

Stage VI: Compile and collect data from the analysis of wind speed that has been carried out. Furthermore, the data that has been collected and arranged will be described in a complete research report.

The stages of the research above can be seen in the flow chart below:

Figure 2. Figure 2. Research work procedures

RESULT AND DISCUSSION

The results of wind speed measurements were obtained by placing the measuring instrument on a pole as high as 8 m.

5.1 Numerical Results

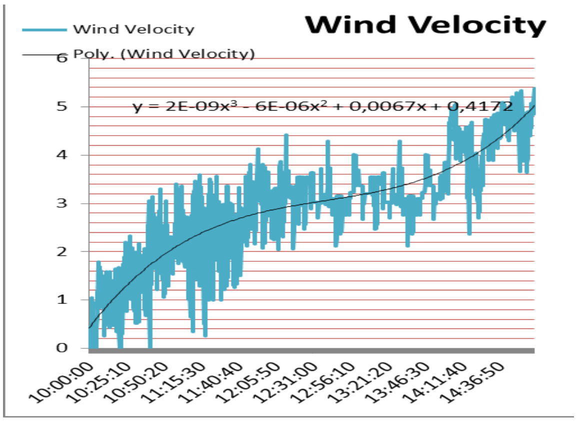

Figure 6. Wind speed potential

The wind speed profile during the day is not evenly distributed continuously, but fluctuates according to the place where we install the measuring instrument. Mathematically it can be formulated as a function of time (x) against wind speed (y) as follow,

$$y = 2E\text{-}09x^3 - 6E\text{-}06x^2 + 0{,}0067x + 0{,}4172$$

5.2 Graphical Results

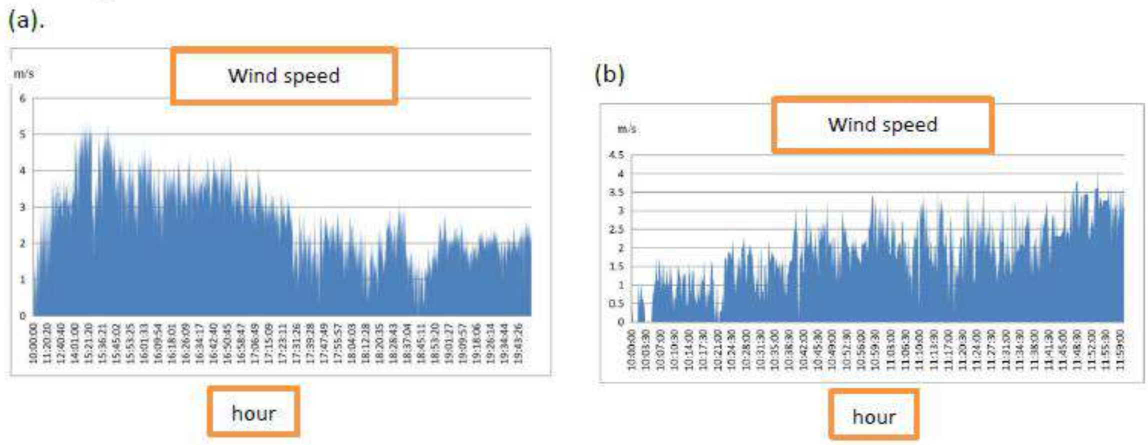

Figure 7. Graph of wind speed at any time during the day (a). first periode, (b). second periode

5.3 Proposed Improvements

Wind speed data measured in the coastal area shows wind speeds that have the potential to be used as a source of wind turbine propulsion. The installed wind turbine must meet the criteria proportional to the rotor and wind speed. The wind speed obtained during the day to night is a maximum of 5 m/s. This speed can only be used to load light turbines and rotors that have low rpm. Based on literature research, it is found that the appropriate type of turbine is the Savonius wind turbine. With this turbine, the wind can drive the turbine and rotor to produce small-scale electricity. By installing more turbines, more energy will be obtained for electricity sources in people's homes and businesses. After calculating wind energy, the next step is to calculate electrical energy. Calculate the electrical energy that may be generated by a windmill with a predicted blade radius of 0.8 m. Then it can be calculated using equation (2). Where P is the wind power with units of W, C_p is the efficiency of the blades, and electric is the efficiency of the generator, transmission and controller efficiency which refers to the following table.

Table 1. Measuring Performance of Hemi-Savonius Windmill Model(Nurdin and Purwanto 2019)

Nr	Wind Speeds (m/s)	Rotor speed (rpm)	Force (N)	Power	
				$[P_{act}/P_{theo}]$	Watt
1	1,6	10	1,2	0,023	0,0264
2	2,5	27,1	1,3	0,094	0,1101
3	3,2	35,2	1,48	0,194	0,2114
4	4	42,7	1,55	0,353	0,4128
5	4,7	50	1,65	0,463	0,6696
Average	3,2	33	1,44	0,547	1,024

Notes: R_b = 11,0 cm ;L_b = 90, 0 cm ; r_P= 1,0 cm *) Result of Analysis

From the table above we find trend line that meet with the formula of rotor speed as the function of wind speed as

$y = 36{,}407.ln(x) - 6{,}9259$,

y = rotor speed and x = wind speed.

Through the results of the performance tests in the field and the analysis carried out obtained information on the characteristics of savonius turbine applied shows an average rotor power of speed 50 rpm will produce 0,669 watts while 4,7 m/s wind speed. At an average daylight wind speed of V = 2.69 m / sec with an average shaft speed of 29,1 rpm and an average voltage of 15.2 volts. The result of the design of the Savonius prototype was able to convert mechanical energy into generator power by an average of 2.43 Watts. The low efficiency and electricity produced are influenced by low generator efficiency. In this research we obtain the maximum wind speed is 5 m/s, will meet the power produce about 0,6696 watts with the physical size of model scale construction with diameter/radius 0,11 m.

Influence on the economy

To revive this condition, mitigation and recovery solutions are needed. Short -term priority mitigation steps are to create stimulus on the demand side and encourage digital platforms (online) to expand partnerships. Other efforts, namely through cooperation in the use of innovation and technology that can support the improvement of the quality and competitiveness of the product, the product processing, packaging and marketing system and others.

Electric energy needs are one of the important things in a business. The need for electrical energy for a Micro Small and Medium Enterprises (MSMEs) becomes a routine expenditure that must be done. Due to the impact of the COVID-19 pandemic, it is increasingly difficult for MSMEs to maintain their existence. To help the economy recover after the COVID-19 pandemic, all routine expenses that burden MSMEs must be reduced. The best strategy is to innovate energy needs into the smallest possible expenditure. To cover these routine expenses, MSMEs must utilize the potential that can replace these expenses. The most appropriate way is to produce its own electrical energy from free available sources. The source is managed with technology so that it can be utilized. With the existence of wind sources on the coast, MSMEs will be able to use it to replace PLN electricity which has been a routine expenditure.

With reduced spending on electricity payments to MSMEs, the profits will be greater than before. Increased income will encourage people to be more active in developing businesses, especially in the tourism sector. Electricity needs in tourist areas can be met with wind potential, besides that wind turbine fields will also be able to become a special attraction in the tourism sector after Covid-19.

5.4 Validation

With the measurement results of coastal wind speed, it is obtained how much electricity can be generated and at which position the wind can be utilized by the community and how much wind is useful and converted into electricity generation. After obtaining the turbine model, the experimental results can be made a power generation model that is easy for the community to use.

CONCLUSION

From the research on wind potential in the coastal area of Kota Pari Village, it was concluded that wind speed is an important factor that must be owned by the wind in the coastal area to be used as a source of electricity. The potential for wind speed to be used as a source of electricity does not occur all the time but at 10.00 PM-04 PM tomorrow, outside of that time the potential for wind speeds is very low. The wind speed in the coastal area of Kota Pari Village is at least 0 m/s and a maximum of 5 m/s. potentially fixed wind direction from sea to land. The use of wind energy to generate electricity for MSMEs and the tourism sector will increase income so that they can develop and growth back after the COVID-19 pandemic.

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