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Wind Energy Potential In Indonesia (Case Study in Thousand Islands)

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Abstract

We know that this country of Indonesia consists of thousands of islands and has a very wide sea, which means it has several sources of energy that we can use, such as waves of sea water and wind that can help us get energy sources. So it is regrettable if this energy source is not used correctly. One of the most potent energies is wind energy. Moreover, the wind is in mountainous areas, valleys, and areas around the coast of Indonesia. This energy source is free from the pollution often associated with fossil fuel and nuclear power plants. This energy can be utilized by converting mechanical energy produced by windmills into electrical energy. The wind is used as an energy source using windmills. To obtain stable energy, the placement of the wind turbine is carried out in an area with a relatively constant wind speed, with a wind direction that does not change. The offshore area is one of the suitable places for the placement of the wind turbine because the offshore wind speed is better than on land, and offshore wind power's contribution to providing electricity is much higher. From the problems above, what is desired from the use of wind energy found in the offshore area can help the community get electricity and avoid electricity consumption with expensive subsidies. Calculation of potential energy using a simple energy formula. The turbines are installed at a height of 5, 10, 15 and 20 meters to determine the potential speed of each altitude. The energy generated per day from each height is above 500 Joules for each 1 pole installed and the energy that can be converted into electricity is around 150 Watts with each height having a diameter of 4 m.

Key words : Pollution Reduction, Wind Energy, Renewable Energy, Wind Energy

1. Introduction

Today's energy needs are increasing in both developed and developing countries such as Indonesia. The need for alternative energy sources is already a global issue as an effort to anticipate the increase in energy use and the depletion of conventional energy sources or fossil energy sources throughout the world (Sheptiawan et al., 2001). At present it is very prone to a global electrical energy crisis due to an increase in population that cannot be avoided anymore. The need to produce electricity has led to a search for alternative renewable energy sources. It is known that more than 82% of commercial energy consumption comes from petroleum, so one day Indonesia will experience an energy crisis. The world really needs energy every second, especially in Indonesia today, which continues to increase day by day. This is due to population growth, economic growth and the pattern of energy consumption itself is increasing. And the availability of energy found on earth will decrease (Novrita et al., 2021).

Energy resources that have been widely used so far are non-renewable types of energy, these energy sources will run out and humans must switch to other energy sources that can still be used. This condition encourages the world community and Indonesia to use energy from renewable energy sources (Rachman, 2012). Several new renewable energy

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sources have been developed in various parts of the world. Starting from this, it is necessary to look for other alternatives so that we do not only depend on oil energy but utilize other sources such as wood, coal, various waste residues such as straw, bagasse, sawdust, petroleum, natural gas, solar energy, wave energy, water energy, geothermal energy, wind energy, and so on. Wind energy includes renewable energy which is defined as energy that can be quickly reproduced through natural processes. Some of the advantages of renewable energy include: the source is relatively easy to obtain, can be obtained free of charge, minimal waste, does not affect the global temperature of the earth, and is not affected by rising fuel prices. Indonesia is a country that has abundant energy resources, one of which is wind energy. Indonesia which is an archipelagic country and one of the countries located on the equator is a factor, that Indonesia has abundant wind energy potential. The potential for wind energy in Indonesia is quite adequate, because the average wind speed is around 3.5 - 7 m/s (Sheptiawan et al., 2001).

The territory of Indonesia which is located around the equator is a meeting area for the Hadley, Walker and local circulations. This condition is suspected to have a large wind potential (Utami et al., 2018). These conditions cause Indonesia to have high wind potential and can be used to develop renewable energy as an alternative to electricity generation (Novrita et al., 2021). The current use of electrical energy continues to increase resulting in an increasing electricity crisis in Indonesia. Currently, most of the energy used by the Indonesian people comes from fossil fuels (Simamora et al., 2020). According to research results from the National Institute of Aeronautics and Space (LAPAN), out of 166 locations where research has been carried out, there are 35 locations that have wind potential with wind speeds above 5 meters per second at an altitude of 50 meters. These locations include West Nusa Tenggara (NTB), East Nusa Tenggara (NTT), the south coast of Java and the south coast of Sulawesi. In line with the high potential of wind energy, the President of the Republic of Indonesia through Presidential Decree No. 22 of 2017 issued a regulation regarding the National Energy General Plan (RUEN) which contains references for carrying out wind energy development plans per Province or Regional Energy General Plans (RUED (Rahman, 2015). In addition, in the process of achieving the targets of the National Energy General Plan (RUEN) and Regional Energy General Plan (RUED), there are several regulations that require the Regional Government to build and manage PLTB (Wind Power Plants) through BUMD (Regional Owned Enterprises), improve quality and quantity of surveys and mapping of wind/wind power potential, conducting pre-feasibility studies for areas that already have wind potential measurements and continuing with feasibility studies for PLTB construction and building PLTB generating units in remote areas and outer islands. Information about wind energy is fundamental and very important in efforts to maximize its utilization (Utami et al., 2018).

Indonesia is a country whose area of 62% is sea and waters and Indonesia has thousands of islands, around 17,500 islands and has a coastline length of 81,000 km. This data was confirmed by the KKP, the land area is 1.91 million km2 while the water area reaches 6.32 km2. From this we can take advantage of resources from sea breezes that are located offshore because in that area the wind tends to be bigger and it is very helpful for charging energy using wind power which can produce mechanical or electrical power by installing wind turbines around offshore Indonesia.

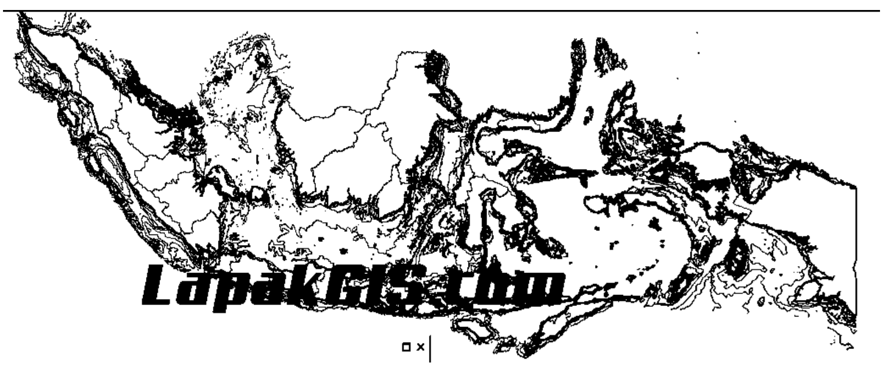

Fig. 1 Indonesian coastline.

Wind energy is an alternative energy that has good prospects, because it has a clean and renewable source and has a fairly good energy density and ease of energy change/transfer, but not all regions in Indonesia have an even wind speed. According to the report of the Minister of Energy and Mineral Resources (ESDM) (2005) the potential for wind energy in Indonesia is still very likely to be studied, because there are certain areas that have speeds above the average (5 – 6 m/s) (Utami et al., 2018). Wind energy can be used to drive sailing ships, generate electricity, use it in irrigation, dry clothes and hair, cool machines and others (Ihwan and Sota, 2010). Some of the advantages of renewable energy include: the source is relatively easy to obtain, can be obtained free of charge, minimal waste, does not affect global temperatures, and is not affected by rising fuel prices (Daryanto, 2007). Knowledge of the exact location of wind energy sources to be utilized is very crucial (Rizkiani, 2012). Determining the location for a wind power plant is not easy. Determining this location is very complex and requires research on choosing the right location. This is due to the lack of availability of data on the potential of local wind energy resources (Utami et al., 2018). Indonesia's wind energy potential is identified as around 978 MW. In several locations in Indonesia, research and measurement of wind energy potential has been carried out several times by government agencies such as (LAPAN, BMKG). The potential for wind power on land is limited, with average wind speeds between 3 m/s and 7 m/s. Large-scale wind turbine technology can work well at speeds between 5 – 20 m/s. Less than 5 m/s is more suitable for conversion into mechanical energy or small-scale wind power generation, so for areas that have wind speeds below 5 m/s it is more suitable to use a vertical shaft wind turbine to produce good electricity (Notosudjono, 2017).

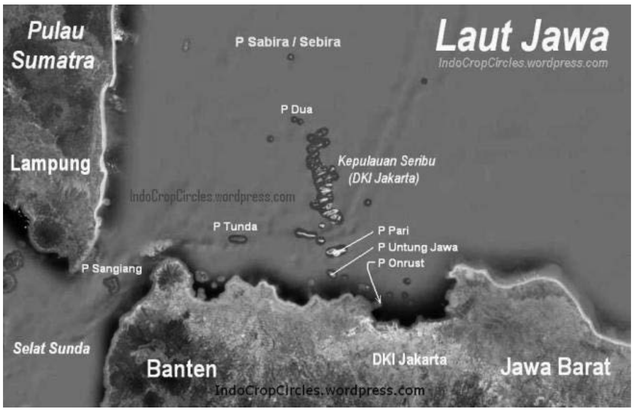

Fig. 2 Research location.

Indonesia has a wind energy potential of 978 MW. The largest wind energy potential is in the Sidrap and Jeneponto regions in South Sulawesi, which has the potential to generate more than 200 MW of electricity from the wind. In Sidrap it has a capacity of 75 MW and in Jeneponto it has a capacity of 72 MW. Apart from Sidrap and Jeneponto, other regions also have quite large potential sources of wind energi (Prasetyo et al., 2018). The potential for wind energy is very possible to be developed in Indonesia, namely the potential of 73 GW, the optimum installed capacity is 25 MW, while the current capacity is only 0.6 MW, so that the potential for wind energy economically has investment opportunities that have prospects in the future (Ihwan & Sota, 2010).

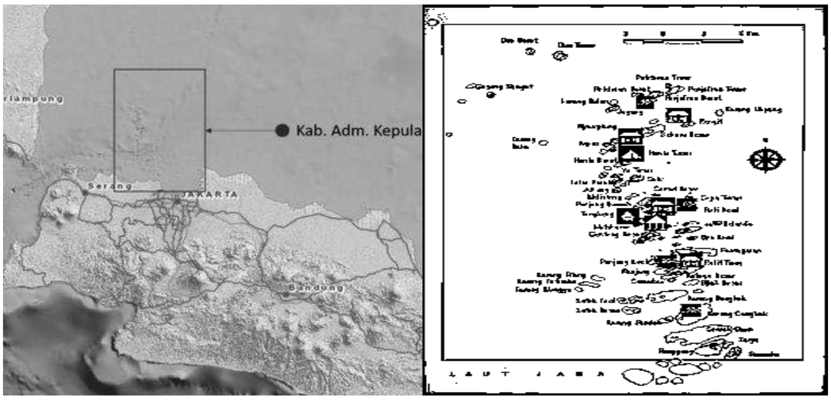

Fig. 3 Thousand Islands

Energy needs in Indonesia continue to increase, especially in coastal areas due to uneven sources of electricity, therefore to solve this problem a source of electricity is needed that can be utilized and wind can be a source of electric power that can be utilized besides being able to produce wind energy sources as well as energy source that is safe from the environment because it does not harm the surrounding environment. With data on local wind energy potential, it is possible to plan the creation of wind energy generators that can be utilized to meet long-term energy needs on an ongoing basis without the need for interconnection of energy from other regions or even being able to supply energy to other regions (Utami et al., 2018). Therefore, it is very appropriate to study the potential use of wind energy to identify areas that have the potential to produce wind energy as a source of unlimited electrical energy in the Thousand Islands.

2. Methodology

Wind is air moving from higher air pressure to lower air pressure. The difference in air pressure is caused by differences in air temperature due to the uneven heating of the atmosphere by sunlight. Because of that movement, the wind has kinetic energi. Wind energy can be converted or transferred into other forms of energy such as electricity or mechanics by using a windmill or wind turbine. Therefore, windmills or turbines are often referred to as Wind Energy Conversion Systems (walks) (Ihwan & Sota, 2010). Utilizing wind energy to drive windmills which are then converted to other forms of energy, wind speed and wind direction data are needed over a long period of time. Wind energy is a kinetic energy or energy due to wind speed and then this kinetic energy can be used to rotate the windmill blades. This energy can be calculated by the formula:

$E = 1/2\ mv\hat{}2$ ... Joule (1)

Power is energy per unit time. Wind power is directly proportional to the air density, and the cubic wind speed. The power caused by the kinetic energy of the wind flow with speed v, density ρ, through a cross section A = $\frac{\pi}{4}\ d^2$.

If an air block has a cross section A with a velocity V (m/s), then the total mass of air flowing each seconds is:

$m = AV\rho$ ... Kg/s (2)

Furthermore, the energy produced per unit time is obtained:

$P = \frac{1}{2}AV^3\rho$ ... Watt (3)

However, not all of the wind power can be utilized by the turbine because in fact there is a loss of friction on the turbine blades. According to Brown, C.K. and Warne (1975) the effective power of the wind that may be generated by a windmill can be calculated by the formula:

$P = \frac{1}{2}CpV^3\rho D^2$ ...Watt (4)

Where Cp and D are a coefficient of the power and diameter of the wind turbine. The value on Cp is 0.4.

Furthermore, the wind energy conversion system for generating electricity is calculated by the formula:

$\left(\frac{Psyst}{A}\right)Wp = \frac{1}{2}V^3\rho Cp\eta tr\eta b\eta g$ ...Watt/m^2 (5)

By successively known are the efficiency of the transmission, generator and battery. The values of the efficiency are respectively 0.95, 0.85 and 0.75.

3. Data

The Thousand Islands Administrative District Government is one of the administrative areas under the Provincial Government of DKI Jakarta. Geographically the location of the Thousand Islands Administrative District is between 106º19'30" - 106º44'50" East Longitude and 5º10'00" - 5º57'00" South Latitude. The total area of the Thousand Islands Administrative District is 4,745.62 km2 consisting of 8.76 km2 of land, 4,690.85 km^2 and 46 km^2, consisting of more than 110 islands. The administration of the Thousand Islands Administrative District is divided into 2 Districts, namely the North Thousand Islands District and the South Thousand Islands District. The number of sub-districts in the Thousand Islands Administrative District is 6 Sub-districts, namely Kelapa Island Sub-district, Harapan Island Sub-district, Panggang Island Sub-district, Tidung Island Sub-district, Pari Island Sub-district and Untung Jawa Island Sub-district. The Thousand Islands Administrative District has a northern border with the Java Sea / Sunda Strait, east with the Java Sea, south with North Jakarta Administrative City and west with the Java Sea / Sunda Strait.

As a study material for the potential of wind energy. The author takes wind energy speed data obtained based on valid data. To facilitate data collection using secondary data assistance from the web http://indonesia.windprospecting.com/ and https://globalwindatlas.info/en/area/Indonesia.

This mesoscale wind resource map is available for public use. The map was developed in 2014-2017 by EMD International A/S, Denmark, financed by the Environmental Support Programme 3 (ESP3) / Danida. The project was implemented for The Ministry of Energy and Mineral Resources, Indonesia, and ESP3. The applied mesoscale model is WRF (Weather and Research Forecast Model) with a spatial resolution of 0.029° (ca. 3 km) and driven by Era-Interim global data from the period 2004-2015. The Global Wind Atlas is a free, web-based application developed to help policymakers, planners, and investors identify high-wind areas for wind power generation virtually anywhere in the world, and then perform preliminary calculations. The Global Wind Atlas facilitates online queries and provides freely downloadable datasets based on the latest input data and modeling methodologies. Users can additionally download high-resolution maps of the wind resource potential, for use in GIS tools, at the global, country, and first-administrative unit (State/Province/Etc.) level in the Download section. Information on the datasets and methodology used to create the Global Wind Atlas can be found in the Methodology and Datasets sections.

From the author's observations, the potential for wind conditions in the Thousand Islands region is strong enough to turn the wheel. This research begins with the selection of coastal areas that are limited by the outermost areas of residential areas. As for wind speed data taken at a height of 5, 10, 15, and 20 meters for 1 month, namely October.

Table 1 Wind Speed

Date	High 5 (m)	High 10 (m)	High 15 (m)	High 20 (m)
	Speed (m/s)	Speed (m/s)	Speed (m/s)	Speed (m/s)
1	4.4	4.41	4.42	4.43
2	4.42	4.43	4.43	4.44
3	4.42	4.43	4.44	4.45
4	4.45	4.46	4.47	4.48
5	4.48	4.49	4.5	4.51
6	4.52	4.53	4.54	4.55
7	4.54	4.55	4.55	4.56
8	4.43	4.44	4.44	4.45
9	4.37	4.38	4.39	4.4
10	4.05	4.09	4.13	4.17
11	4.32	4.33	4.33	4.34
12	4.26	4.27	4.27	4.28
13	4.26	4.27	4.27	4.28
14	4.37	4.38	4.39	4.4
15	4.48	4.49	4.5	4.51
16	4.6	4.62	4.63	4.64
17	4.7	4.71	4.72	4.73
18	4.6	4.63	4.63	4.65
19	4.58	4.59	4.6	4.61
20	4.46	4.47	4.47	4.48
21	4.42	4.43	4.43	4.44
22	4.4	4.41	4.42	4.43
23	4.39	4.4	4.41	4.42
24	4.39	4.4	4.41	4.42
25	4.26	4.27	4.27	4.28
26	4.4	4.4	4.42	4.44

27	4.21	4.32	4.23	4.24
28	4.16	4.18	4.21	4.22
29	4.44	4.44	4.44	4.44
30	4.35	4.37	4.38	4.4
31	4.35	4.37	4.38	4.4

4. Results and Discussion

This experiment was carried out in the Seribu Islands area. In this experiment wind speed measurements were measured using the help of the web which is explained in the Data Chapter. By using web, you can measure speed in real time. From the observation of secondary data wind speed measured for 1 month shows that there is a fluctuating wind speed pattern. The results of the calculation of the relative frequency distribution of wind speed during one month that blows in the Thousand Islands range from 4.04 - 4.7 m/s. The most dominant wind speed distribution is at 4.4 – 4.6 m/s. Based on the measurement results in Table 1, it shows that the highest wind speed occurred on October 17, reaching 4.7 m/s, the lowest wind speed occurred on October 10, which was 4.05 m/s for a height of 5 meters. Wind speed The highest wind speed occurred on October 17, reaching 4.71 m/s, the lowest wind speed occurred on October 10, namely 4.09 m/s for a height of 10 meters. Wind speed The highest wind speed occurred on October 17, reaching 4.72 m/s, the lowest wind speed occurred on October 10, namely 4.13 m/s for a height of 15 meters. Wind speed The highest wind speed occurred on October 17, reaching 4.73 m/s, the lowest wind speed occurred on October 10, namely 4.17 m/s for a height of 20 meters. It is said to be a location with an average wind speed of 2.5 – 4 m/s, the power generated is 200 – 1000 kWh/year. This condition is quite good as a driving force for small-scale electrical energy conversion systems and for pumping purposes [4]. The amount of wind energy which is kinetic energy is calculated based on the average wind speed parameter.

Table 2 Wind energy potential at a height of 5 meters

Date	High 5 (m)				
	Mass	Kinetic Energy	Power	Effective Power	Energi Conversion
1	66,317	641,947	641,947	327,107	155,512
2	66,618	650,740	650,740	331,587	157,642
3	66,618	650,740	650,740	331,587	157,642
4	67,070	664,081	664,081	338,385	160,874
5	67,523	677,602	677,602	345,275	164,149
6	68,125	695,915	695,915	354,606	168,585
7	68,427	705,194	705,194	359,334	170,833
8	66,769	655,167	655,167	333,843	158,714
9	65,865	628,905	628,905	320,461	152,352
10	61,042	500,617	500,617	255,092	121,275
11	65,111	607,564	607,564	309,587	147,182
12	64,207	582,599	582,599	296,866	141,135
13	64,207	582,599	582,599	296,866	141,135
14	65,865	628,905	628,905	320,461	152,352
15	67,523	677,602	677,602	345,275	164,149
16	69,331	733,524	733,524	373,770	177,696
17	70,838	782,410	782,410	398,680	189,539
18	69,331	733,524	733,524	373,770	177,696
19	69,030	723,998	723,998	368,916	175,388
20	67,221	668,568	668,568	340,671	161,961
21	66,618	650,740	650,740	331,587	157,642

22	66,317	641,947	641,947	327,107	155,512
23	66,166	637,580	637,580	324,881	154,454
24	66,166	637,580	637,580	324,881	154,454
25	64,207	582,599	582,599	296,866	141,135
26	66,317	641,947	641,947	327,107	155,512
27	63,453	562,325	562,325	286,535	136,223
28	62,700	542,526	542,526	276,447	131,427
29	66,920	659,614	659,614	336,109	159,791
30	65,563	620,310	620,310	316,081	150,270
31	65,563	620,310	620,310	316,081	150,270

To determine the wind energy in the Thousand Island area, it is necessary to know the wind mass in the area. Wind mass can be calculated if data regarding the cross-sectional area of the air sweep, air density and air speed are known in the area. The density of air is in accordance with existing standards, namely 1.2 kg/m2, the cross-sectional area adjusts to the wind turbine blade that will be used later, which is 4 meters in diameter and the wind speed is used based on data obtained from table 1. Calculations use eq (1) to calculate wind mass and equation (2) to calculate wind energy. The amount of wind energy which is kinetic energy is calculated based on the wind speed parameter and shows that the greatest wind energy for a height of 5 meters is 782 joules and the lowest is 500 joules. In 1 day, on average, you will get about 644 joules of energy. If converted into potential power potential that can be generated into electrical energy in 1 day is around 156 Watt/day for a height of 5 meters per 1 windmill.

Table 3 Wind energy potential at a height of 10 meters

Date	High 10 (m)				
	Mass	Kinetic Energy	Power	Effective Power	Energi Conversion
1	66,468	646,333	646,333	329,342	156,574
2	66,769	655,167	655,167	333,843	158,714
3	66,769	655,167	655,167	333,843	158,714
4	67,221	668,568	668,568	340,671	161,961
5	67,673	682,150	682,150	347,592	165,251
6	68,276	700,544	700,544	356,965	169,707
7	68,578	709,864	709,864	361,714	171,965
8	66,920	659,614	659,614	336,109	159,791
9	66,015	633,233	633,233	322,666	153,401
10	61,644	515,598	515,598	262,725	124,903
11	65,262	611,793	611,793	311,742	148,207
12	64,357	586,711	586,711	298,961	142,131
13	64,357	586,711	586,711	298,961	142,131
14	66,015	633,233	633,233	322,666	153,401
15	67,673	682,150	682,150	347,592	165,251
16	69,633	743,133	743,133	378,667	180,024
17	70,989	787,415	787,415	401,231	190,751
18	69,783	747,969	747,969	381,131	181,196
19	69,180	728,751	728,751	371,338	176,540
20	67,372	673,075	673,075	342,968	163,052
21	66,769	655,167	655,167	333,843	158,714
22	66,468	646,333	646,333	329,342	156,574
23	66,317	641,947	641,947	327,107	155,512

24	66,317	641,947	641,947	327,107	155,512
25	64,357	586,711	586,711	298,961	142,131
26	66,317	641,947	641,947	327,107	155,512
27	65,111	607,564	607,564	309,587	147,182
28	63,001	550,389	550,389	280,453	133,332
29	66,920	659,614	659,614	336,109	159,791
30	65,865	628,905	628,905	320,461	152,352
31	65,865	628,905	628,905	320,461	152,352

The amount of wind energy which is kinetic energy is calculated based on based on data obtained from table 1. Calculations use eq (1) to calculate wind mass and equation (2) to calculate wind energy. The wind speed parameter and shows that the greatest wind energy for a height of 10 meters is 787 joules and the lowest is 518 joules. In 1 day, on average, you will get about 651 joules of energy. If converted into potential power potential that can be generated into electrical energy in 1 day is around 157 Watt/day for a height of 10 meters per 1 windmill.

Table 4 Wind energy potential at a height of 15 meters

Date	High 15 (m)				
	Mass	Kinetic Energy	Power	Effective Power	Energi Conversion
1	66,618	650,740	650,740	331,587	157,642
2	66,769	655,167	655,167	333,843	158,714
3	66,920	659,614	659,614	336,109	159,791
4	67,372	673,075	673,075	342,968	163,052
5	67,824	686,718	686,718	349,920	166,357
6	68,427	705,194	705,194	359,334	170,833
7	68,578	709,864	709,864	361,714	171,965
8	66,920	659,614	659,614	336,109	159,791
9	66,166	637,580	637,580	324,881	154,454
10	62,247	530,873	530,873	270,509	128,604
11	65,262	611,793	611,793	311,742	148,207
12	64,357	586,711	586,711	298,961	142,131
13	64,357	586,711	586,711	298,961	142,131
14	66,166	637,580	637,580	324,881	154,454
15	67,824	686,718	686,718	349,920	166,357
16	69,783	747,969	747,969	381,131	181,196
17	71,140	792,441	792,441	403,792	191,969
18	69,783	747,969	747,969	381,131	181,196
19	69,331	733,524	733,524	373,770	177,696
20	67,372	673,075	673,075	342,968	163,052
21	66,769	655,167	655,167	333,843	158,714
22	66,618	650,740	650,740	331,587	157,642
23	66,468	646,333	646,333	329,342	156,574
24	66,468	646,333	646,333	329,342	156,574
25	64,357	586,711	586,711	298,961	142,131
26	66,618	650,740	650,740	331,587	157,642
27	63,755	570,377	570,377	290,638	138,174
28	63,453	562,325	562,325	286,535	136,223
29	66,920	659,614	659,614	336,109	159,791
30	66,015	633,233	633,233	322,666	153,401
31	66,015	633,233	633,233	322,666	153,401

From the results of the calculations shown in table 3, like the 2 previous tables the calculation of mass and energy using eq (10 and (2). Obtained that the greatest wind energy for a height of 10 meters is 792 joules and the lowest is 530 joules. In 1 day, on average, you will get about 653 joules of energy. If converted into potential power potential that can be generated into electrical energy in 1 day is around 158 Watt/day for a height of 15 meters per 1 windmill.

Table 5 Wind energy potential at a height of 20 meters

Date	High 20 (m)				
	Mass	Kinetic Energy	Power	Effective Power	Energi Conversion
1	66,769	655,167	655,167	333,843	158,714
2	66,920	659,614	659,614	336,109	159,791
3	67,070	664,081	664,081	338,385	160,874
4	67,523	677,602	677,602	345,275	164,149
5	67,975	691,306	691,306	352,258	167,469
6	68,578	709,864	709,864	361,714	171,965
7	68,728	714,555	714,555	364,104	173,101
8	67,070	664,081	664,081	338,385	160,874
9	66,317	641,947	641,947	327,107	155,512
10	62,850	546,448	546,448	278,445	132,377
11	65,412	616,042	616,042	313,907	149,236
12	64,508	590,843	590,843	301,067	143,132
13	64,508	590,843	590,843	301,067	143,132
14	66,317	641,947	641,947	327,107	155,512
15	67,975	691,306	691,306	352,258	167,469
16	69,934	752,826	752,826	383,606	182,372
17	71,291	797,488	797,488	406,363	193,192
18	70,085	757,704	757,704	386,091	183,554
19	69,482	738,318	738,318	376,213	178,858
20	67,523	677,602	677,602	345,275	164,149
21	66,920	659,614	659,614	336,109	159,791
22	66,769	655,167	655,167	333,843	158,714
23	66,618	650,740	650,740	331,587	157,642
24	66,618	650,740	650,740	331,587	157,642
25	64,508	590,843	590,843	301,067	143,132
26	66,920	659,614	659,614	336,109	159,791
27	63,905	574,432	574,432	292,704	139,156
28	63,604	566,341	566,341	288,582	137,196
29	66,920	659,614	659,614	336,109	159,791
30	66,317	641,947	641,947	327,107	155,512
31	66,317	641,947	641,947	327,107	155,512

Table five presents that the greatest wind energy for a height of 10 meters is 797 joules and the lowest is 546 joules. In 1 day, on average, you will get about 659 joules of energy. If converted into potential power potential that can be generated into electrical energy in 1 day is around 159 Watt/day for a height of 20 meters per 1 windmill. The minimum height of the wind turbine is taken 5 meters and the highest is taken 20 meters with an interval of 5 meters. The difference in height is intended to determine the potential of wind energy at each turbine height. Based on the data in table 1. The higher the wind turbine installation height, the greater the wind speed potential and otherwise. This is directly proportional to the energy that can be obtained. The greater the speed, the greater the energy potential and otherwise. The power potential that can be generated also calculates how fast the wind blows. The bigger it will produce a large energy potential that will produce high power.

The height of the turbine can reach more than 20 meters depending on the energy and power requirements to be generated. The higher the placement of the turbine, the larger the turbine diameter will be. This will result in the noise generated by the turbine disturbing the surrounding residents because the location of the turbine is quite close to the settlement. Therefore the height taken is only up to 20 meters. If you want more than 20 meters, the location of the turbine must be far from residential areas to avoid noise. The diameter of the propeller used in this study is uniform in size, namely 4 meters for each height. The diameter of the propeller also affects the potential energy that can be generated and the potential power that can be generated. the larger the diameter, the greater the energy and power potential. The diameter of the propeller depends on the turbine catalog that we will choose and use.

5. Conclusion

The potential of wind energy that can be obtained depends on the diameter of the turbine, wind speed, and the height of the turbine. The larger the diameter, the greater the wind speed, and the higher the turbine height, the greater the potential value of wind energy and the power that can be generated. Electrical data is needed in the area that will be selected for the construction of a wind power plant in order to estimate the number of turbines, the height of the turbines, and the diameter of the turbines used to meet the electricity needs in that area. With the wind power electricity generator, it can increase the electricity capacity in the Thousand Islands area. It is necessary to vary the size of the diameter of the blade to optimize its output.

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