Analysis of Horizontal Sumbu Wind Tines Using Three Blades and Diameters of 12 Meter Kinds on Wind Speed in Barat-Maluku Seram Region

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Abstract

Kinetic wind energy can be utilized as a source of electrical energy, Indonesia has a source of wind energy that is large enough, wind energy occurs because of differences in air pressure between hot air and cold air with the impact of earth rotation. Windmills are one form of utilization of wind energy that is converted to environmentally friendly electrical energy, horizontal axis windmills are wind turbines with horizontal main shafts that are parallel to the ground surface, a parameter that must be considered in horizontal axis windmills is the use of the number of blades and the type of blade used. This study is to analyze the calculation of windmills using three blades with a type of blade, namely NACA Airfoil 63-212 with a lift coefficient of 1.36 and a drag coefficient of 0.48 at an angle of attack 200, to determine the use of a windmill blade against the output power. In this study, the time needed by researchers was one month, and from the results of this study, the highest power was 4540.75 watts at 7 months with a tip speed ratio value of 4.18, at a wheel rotation of 46.16 RPM with the torque of the wheel. 939.71 Nm was produced while the lowest was 1043.16 watts in 11 months with a tip speed ratio of 4.18, at 28.27 RPM of the wheel with the torque of the wheel produced of 352.48 Nm. The coefficient of power (Cp) of the windmill analyzed by the researcher is 0.21 or equal to the efficiency of the windmill is 21%.

Keywords: Windmills, Horizontal Axis, Three Blades Wind Speeds

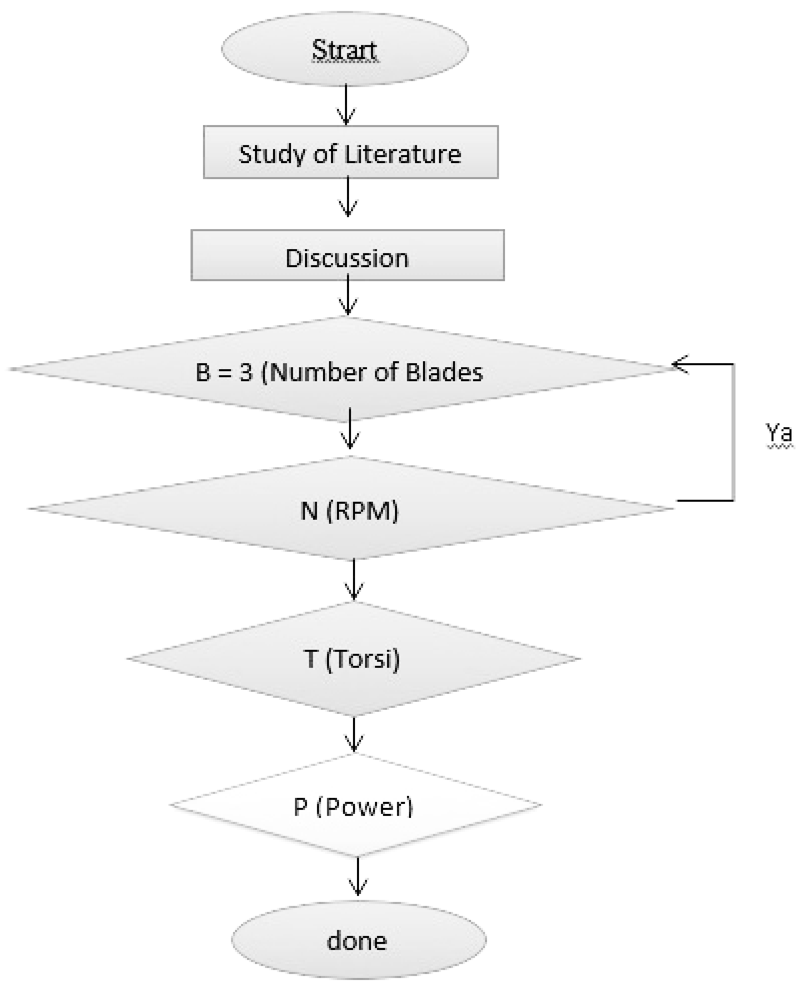
1. Introduction

A wind turbine is a form of renewable alternative energy utilization by utilizing wind kinetic energy that is converted to environmentally friendly electrical energy (Galloway, Myers, and Bahaj 2010). The wind turbine is divided into two, namely horizontal axis windmill and vertical axis windmill. Horizontal axis windmill is a windmill with shaft main horizontal parallel to the ground surface, the position of the shaft parallel to the direction of the arrival of the wind and the power generator is located on the top of the tower (Saputra, Weking, and Jasa 2017). Analyze the effect of flowrate on the power and efficiency of the windmill (Rahman and Kimin 2018).

Parameters that must be considered in horizontal axis windmills are the number of blades, increasing or decreasing the number of blades is one way to increase windmill efficiency (Singh and Ahmed 2013). And the results of the optimal windmill output on wind speed, this study was made to calculate the windmill output using three windmill blades which were carried out in the West Seram Sliding Village.

2. Research Methods

The type of research used by the author is the study of literature wherein the process of collecting data the author observes data taken from the literature on windmills (Griffin and Ashwill 2003). The time needed by the author is conducting research activities is for three months (Mathew et al. 2016; Reibold et al. 2009), The location used by the author as a place for research activities is at the Center for Meteorology, Climatology and Geophysics Slide, East Seram.



Picture 1.
Research Flow Chart

3. Results and Discussion

Table 1.
Specifications Analyzed

Blade Type	Airfoil Naca 63-212
Pinwheel Diameter (D)	12 m
Pinwheel Fingers (r)	6 m

Number of Blades (N)	3 blade
Corner α	20^0
Coeffisien drag (Cd)	0,48
Coeffisien lift (Cl)	1,36
Wind Speed	5,75 m/s
Air density (ρ)	1,2 kg/m^3

Table 2
Data Processing

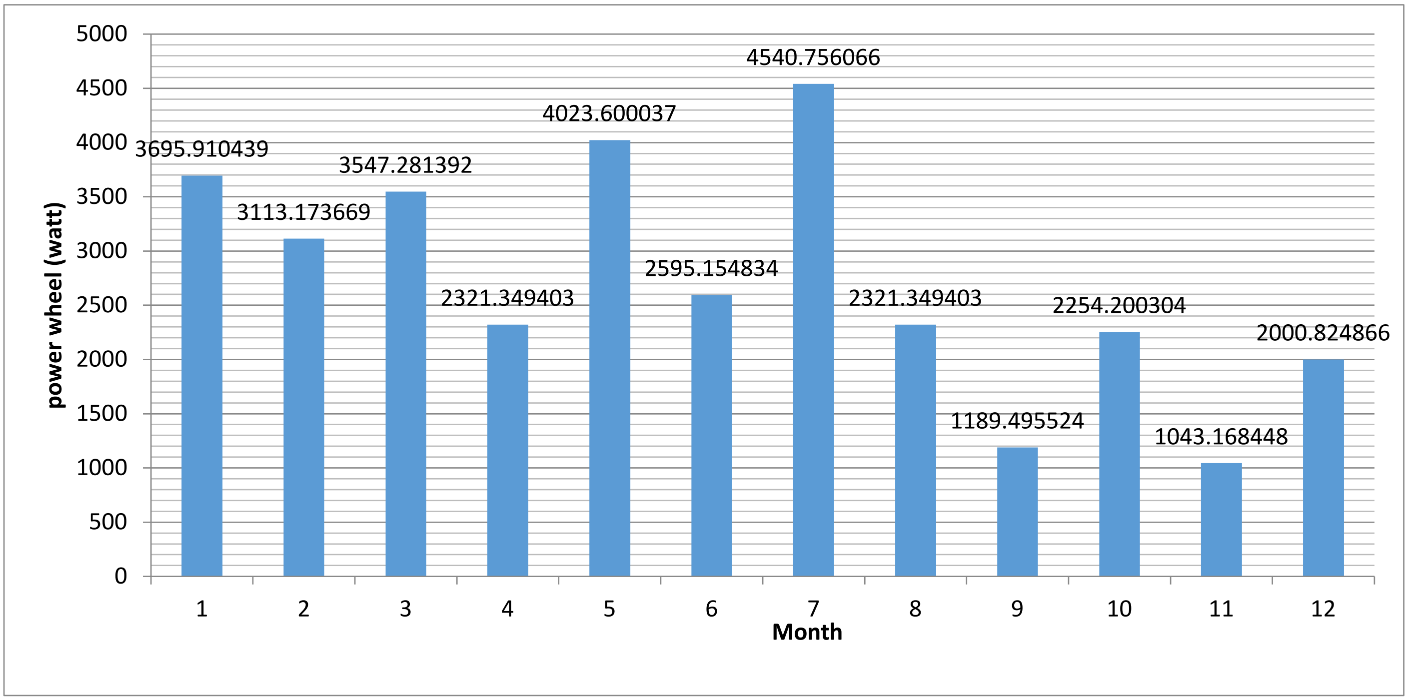
Wind power		**Tip Speed Ratio (λ)**	**Turbine Rotation (n)**	**Drag Energy**	**Lift Energy**	**Tangential Energy (Ft)**	**Windmill Torsi**		**Windmill Energi**	**Coefficient Power (Cp)**
$A = \frac{\pi}{4}D^2$	$P_{wind} = \frac{1}{2}\rho A v^3$	$\lambda = \frac{4\pi}{B}$	$n = \frac{30\lambda v}{\pi r}$	$l = \frac{1}{2}Cl\rho v^2 A$	$l = \frac{1}{2}Cl\rho v^2 A$	Ft = l sinα – d cosα	T_{local} = Ft . r	T_{total} = B . T_{lokal}	$P_{pinwheel}$ = T_{total}.ω $P_{pinwheel}$ = $Ttolal \frac{N\pi}{30}$	$Cp = \frac{Pk}{Pa}$
113,04 m^2	12892,58 watt	λ = 4,18	38,27 RPM	1074,45 N	3049,45 N	37,58 N	225,48 Nm	676,44 Nm	2709 watt	0,21

Source: Singh et al., (2013)

Table 3
Windmill Calculation Table Using Microsoft Excel

Mon	Spe.wind	Windmill Calculation								
	Average	Energy wind	Speeding. wheel	Energy lift	Energy drag	Energy tangential	torsi local	torsi total	Power wheel	Cp
	m/s	Watt	RPM	N	N	N	Nm	Nm	Watt	
1	6.476	18420.606	43.10458599	3868.441	1365.332	45.51107166	273.06643	819.1993	3695.9104	0.20064
2	6.116	15516.216	40.70840764	3450.303	1217.754	40.59180236	243.55081	730.6524	3113.1737	0.20064
3	6.388	17679.832	42.5188535	3764.022	1328.478	44.28260864	265.69565	797.087	3547.2814	0.20064
4	5.546	11569.724	36.9144586	2837.148	1001.346	33.37821535	200.26929	600.8079	2321.3494	0.20064
5	6.662	20053.828	44.34261146	4093.847	1444.887	48.16290107	288.97741	866.9322	4023.6	0.20064
6	5.756	12934.384	38.3122293	3056.074	1078.614	35.95381276	215.72288	647.1686	2595.1548	0.20064
7	6.936	22631.36	46.16636943	4437.522	1566.184	52.20613605	313.23682	939.7104	4540.7561	0.20064
8	5.546	11569.724	36.9144586	2837.148	1001.346	33.37821535	200.26929	600.8079	2321.3494	0.20064
9	4.438	5928.5064	29.53955414	1816.757	641.2084	21.37361478	128.24169	384.7251	1189.4955	0.20064
10	5.492	11235.049	36.55503185	2782.168	981.9417	32.73138926	196.38834	589.165	2254.2003	0.20064
11	4.248	5199.2048	28.27490446	1664.529	587.4808	19.58269221	117.49615	352.4885	1043.1684	0.20064
12	5.278	9972.2132	35.13063694	2569.574	906.9084	30.23027888	181.38167	544.145	2000.8249	0.20064

Figure 2.



Graph of Energy Production Every Month

From the results of calculations shown in table 3 and graph in figure 2, the windmill obtained the greatest results, namely in July with the highest power of 4540.75 Watt with a spinning wheel 46.16 Rpm, with the torque of the resulting wheel of 939.71 in November, namely November the lowest power is 1043.16 Watt, the wheel rotation is 28.27 Rpm, with the torque of the wheel produced 352.48 Nm. While the power coefficient (Cp) produced from the wheel is 0.21 or equal to 21%.

4. Conclusion.

a) The highest power is 4540.75 watts in the 7th month with a tip speed ratio value of 4.18, at the wheel rotation, 46.16 RPM with the torque of the wheel produced 939.71 Nm while the lowest is 1043.16 watts in the 11th month with a tip speed ratio of 4.18, at the wheel rotation 28.27 RPM with the torque of the wheel produced at 352.48 Nm.

b) The coefficient of power (Cp) of the windmill analyzed by the researcher is 0.21 or equal to the efficiency of the windmill is 21%.

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Biography

Kimin is a Lecturer in the Faculty of Engineering, Darussalam Ambon University in the Mechanical Engineering study program with engineering planning and manufacturing. subjects taught by machine elements, structural statics, machine construction. It is an MT degree in Manufacturing Systems obtained from ITS Surabaya in 2003.

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