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Design and Development of Wind Energy The Simple HAWT Multiblade Type for Agricultural Irrigation Rainfed and Fishpond in Coastal Village of Situbondo District, Indonesia.

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Abstract —*Issues that are getting a lot of attention of Indonesia at this time and the future of which is the problem of food security and energy conservation. Many rainfed agriculture land in coastal area is one of coastal village of Situbondo which do not have technical irrigation so management is not optimal, during the dry season many farmers make wells and raise the water with motor fuel pump, since the increase of fuel many farmers began to complain as operational and maintenance costs are more expensive so that many rainfed fields are not managed during the dry season. Though this area has a lot of wind energy potential during the dry season with an average wind speed of 2.5 - 4 m / s and blowing all day from 08.00 am to 16.00 pm.*

The purpose of this research is to create and develop Multiblade HAWT Simple, Affordable Windmills and easily made from local materials to raise irrigation water in rainfed agriculture during dry season especially in coastal area of Situbondo. This windmill prototype can be used to raise seawater to fish ponds, thus supporting the food security and energy conservation programs as they depend not only on the increasingly scarce and costly fossil fuels.

The design approach to design the windmill is done through several stages, among others; Literature review and field, basic data collection and analysis, Design and testing. design method using the methods compiled by Gerhardt Pahl and Wolfgang Beitz presented in Engineering Design book. The tests include structural and functional testing at the Laboratory. After doing the field test; adaptation, functional, and verification tests. Then for the improvement made the modifications and re-testing.

Keywords-*Windmills, Energy, Multiblade, Irrigation, Agriculture*

I. INTRODUCTION

Situbondo is a coastal area located in eastern Java Island Indonesia. This area has a lot of rain-fed agricultural land in the coastal areas that do not have technical irrigation, farmers generally cultivate land once a year in the rainy season with seasonal crops. In addition, in the dry season most of the land is not cultivated due to lack of water. During the dry season many farmers make wells and raise the water with motor fuel pumps, since fuel price increases have begun to complain that their operational and maintenance costs are more expensive so that much of the rainfed is not managed during the dry season. This area has a lot of wind energy potential during the dry season with an average wind speed of 2.5 - 4 m/s and blowing all day from 08.00 am to 04.00 pm.

In the dry season, non-irrigated rice crops are no more than 2 tons/ha. By providing irrigation water as supplementation at certain phases of sensitive plant growth the productivity of the plant can reach 4 ton / ha, where the farmer must operate the water pump for about 16.5 hours for every ton of crop production.

This research aims specifically to develop wind turbine type multiblade HAWT in order to produce power and water discharge of optimal irrigation, easy to manufacture and operational, and the price reached by farmer community, so this research able to empower farmer community in rainfed area to support food security and developing energy conservation technologies that are environmentally friendly and not just dependent on fossil energy.

Figure 1. Study area

II. LITERATUR VIEW

Soepriono[5] menjelaskan bahwa penggunaan kincir angin untuk memompa air tanah tersebut sangat nyata dalam meningkatkan intensitas pertanaman dari 100% (1 kali/tahun) menjadi 300% (tiga kali/tahun). Indonesia adalah negara yang memiliki sumber daya energi yang sangat melimpah, salah satunya adalah sumber energi angin. Indonesia yang merupakan negara kepulauan dan salah satu Negara yang terletak di garis khatulistiwa merupakan faktor, bahwa Indonesia memiliki potensi energi angin yang melimpah.

Meel [2] menjelaskan bahwa setiap jenis turbin angin memiliki ukuran dan efisiensi yang berbeda. Untuk memilih jenis turbin angin yang tepat untuk suatu kegunaan diperlukan tidak hanya sekedar pengetahuan tetapi juga pengalaman. Pada umumnya turbin angin yang mempunyai jumlah sudu banyak (soliditas tinggi) akan mempunyai torsi yang besar. Turbin angin jenis ini banyak digunakan untuk keperluan mekanikal seperti pemompaan air, pengolahan hasil pertanian dan aerasi tambak. Sedangkan turbin angin dengan jumlah sudu sedikit, misalnya dua atau tiga, digunakan untuk keperluan pembangkitan listrik. Turbin angin jenis ini mempunyai torsi rendah tetapi putaran rotor yang tinggi.

Riso [3] menjelaskan bahwa jika dikaitkan dengan sumber daya angin, turbin angin dengan jumlah sudu banyak lebih cocok digunakan pada daerah dengan potensi energi angin yang rendah karena *rated wind speed*-nya tercapai pada putaran rotor dan kecepatan angin yang tidak terlalu tinggi. Sedangkan turbin angin dengan sudu sedikit (untuk pembangkitan listrik) tidak akan beroperasi secara effisien pada daerah dengan kecepatan angin rata-rata kurang dari 4 m/s. Dengan demikian daerah-daerah dengan potensi energi angin rendah, yaitu kecepatan angin rata-rata kurang dari 4 m/s, lebih cocok untuk dikembangkan turbin angin keperluan mekanikal. Jenis turbin angin yang cocok untuk keperluan ini antara lain *american tipe multi blade*, *cretan sail* dan *multiblade HAWT*.

The result ofresearch Soegiyanto[6], showed that on the laboratory scale with the help of blower as wind energy source is at 30.8 rpm turbine rotation and output spindle output 55 rpm of debit generated 2.6 liter/min. At 39 rpm turbine rotation and output spindle output 68 rpm of debit generated 3.4 liters/min. While at 39.5 rpm turbine rotation and output spindle output 71.7 rpm of debit generated 4.2 liters/min.

III. METHODOLOGY

The design approach for designing this wind energy is done through several stages, among others; Literature review and field, basic data collection and analysis, Design and testing. Stages of making this machine design refers to the methods compiled by Gerhardt Pahl and Wolfgang Beitz [1] which is described in the book Engineering Design,which includes problem identification, formulation and completion of ideas, selection of draft concepts, analysis and drawing of work drawings. The tests include structural and functional testing at the Laboratory. After doing the field test; adaptation test, functional, and verification. Then for the improvement made the modifications and re-testing.

IV. MODEL THE WIND TURBINE

This research makes multiblade HAWT windmill units which have components, among others 1. Blade. 2. Buffer. 3. Axle Bearings. 4. Transmission the successor of the wind blade shaft to the water pump. 5. Piston pump.
Sitompul [4] explains that the calculation of the wide sweeping blade uses the equation:

$$P = Cp \tfrac{1}{2} \rho A v^3$$

where P: mechanical power (W), v: wind speed (m/s), ρ: air density (ρ average: 1.2 kg/m^3), Cp: power factor

The calculation for the irrigation pump is the potential energy per unit of time (Joule/s = W) or the power to raise the water by the head height H is

$$Ph = \rho a\, g\, H\, q$$

with the density of water ρa = 1000 kg/m^3, g = acceleration of gravity = 9.8 m/s^2; H total head in m; and q = flow discharge (m^3/s).
The size or capacity of the water storage system (tank) is important in the pumping system, to obtain the optimal size, the approach taken is to take into account when the wind is low or less (lull condition).

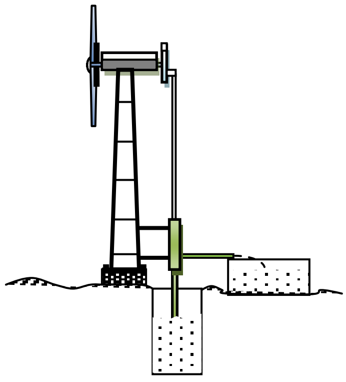

Figure 2. Installing a windmill

V. RESULT

The results of this researchshowed that:

Table 1. Windmill test results

No	Parameters	Measurement	Measurement
1.	Wind velocity	2-4 m/s	2-4 m/s
2.	Blade diameter	3 m	3 m
3.	Number of blades	6 pieces	12 pieces
4.	Rpm blade	20 - 60	20 - 60
5.	Different pumping heads	7 m	7 m
6.	Diameter of piston pump	2 dim	4 dim
12.	Long step	12 cm	12 cm
13.	Water discharge	V = 2,5 m/s, 22 rpm, Q = 2 liters/min	V = 2,5 m/s, 22 rpm, Q = 6 liters/min
		V = 4 m/s, 40 rpm, Q = 4 liters/min	V = 4 m/s, 40 rpm, Q = 10 liters/min

Figure 3. Research documentation

REFERENCES

[1] Gerhard P and B Wolfgang. 1984. Engineering Design. The Design Consul London, First Edition
[2] Meel VJ and P Smulders (1989), Wind Pumping , A Handbook, The World Bank, Washington, DC.
[3] Riso. 2002. Guidelines for Design of Wind Turbines 2nd Edition. Jydsk Centraltrykkeri, Denmark
[4] Sitompul R. (2011). Renewable Energy Training Module. PNPM Mandiri. Jakarta.
[5] Soepriono. (2011). Potential and Development of Wind Energy in Indonesia. LAPAN. Jakarta.
[6] Sugiyanto, et el. 2014. Design of Wind Water Pump For Rice Watering Using Vertical Wind Turbine Type Savonius. Journal of Mechanical Engineering. Vol 9. State Polytechnic of Semarang

