Solar power Pump Renewable Energy Supporting Green Farmers Ploso Geneng Village Jombang Indonesia

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Abstract (12 fonts)

Solar water pumps are more effective, efficient, and economical, because in their management they do not depend on electricity or other fuels, require less operation and maintenance (OP) costs, and do not even burden farmers and their groups. in carrying out their farming activities (Widodo, Dedy 2016). For this reason, the manufacture of solar energy pumps that do not need electricity, is extra energy efficient, and is environmentally friendly so that the income of farmers in the village of Plsogeneng, Jombang District, has increased. The method used to determine the relationship and influence between production land area, agricultural production, costs incurred on income or profits obtained by farmers for current conditions (costs if using an electric pump) is to use the linear regression method with theequation model **$Y. = -0.361+0.207. X_1+0.469.X_2+0.362.X_3$,** where this equation model has R^2 0.857 which means the model is close to a value of 1 indicating the accuracy of the model that has been compiled.

Keywords
Agriculture, Water Pumps, Economy, Village, Cost

1. Introduction

Jombang Regency is located between $7^0$20'48.60" – $7^0$46'41.26" South latitude between $112^0$03'46.57 – $112^0$27'21.26" East longitude, occupies about 2.5% of the area of East Java Province. Jombang Regency is also located on the primary arterial route, the connecting road between the city of Surabaya and the cities of Madiun and Yogyakarta, and is on the provincial road connecting the cities of Malang, Jombang and Babat. The city of Jombang is also crossed by the Surabaya-Mojokerto-Kertosono toll road section.

The land designation in Jombang Regency is dominated by agricultural land by 81% of the entire Jombang Regency area with details on the use of agricultural land for rice fields and non-rice fields or in the form of plantations, dry fields and also community forests.

The Jombang Regency Spatial Plan (RTRW) for 2009-2029 explains that the direction of Jombang Regency development is as a center for agribusiness and industrial development.

In supporting the marketing of agricultural products, the government has provided access in the form of transportation facilities and infrastructure to facilitate the mobility of rural communities for the distribution of agricultural products, but this is still considered inadequate if it is not supported by agricultural equipment to produce higher quality agricultural products. Modern equipment, energy efficient, cheaper and easier to operate and

environmentally friendly is needed to meet the demands of urban communities for agricultural products, one of the most needed equipment is a water pump.

Solar water pumps are one of the solutions and developments in the agricultural sector in Indonesia, this system not only dominates the industrial sector, but also in the agricultural and agro-industry sectors. This solar water pump can solve the problems that often occur in many rice fields in Indonesia that rely on a rain-fed system, especially for areas far from irrigation. The use of this electric water pump is used with the hope that agricultural activities can carry out planting and harvesting activities without depending on the season, so that the economic condition of the villagers will improve.

The potential for solar radiation in Indonesia is quite large with an average radiation intensity of 4.8 kWh (m2)-1 hr-1 (BMKG) throughout the year, but its utilization has only reached 5 mWp, so it can be optimized to provide electricity for irrigation which is expected to provide certainty of fulfillment. irrigation water needs, for that a solar water pump has been developed (Rahardjo, Ira 2006).

Solar water pumps are more effective, efficient, and economical, because in their management they do not depend on electricity or other fuels, require less operation and maintenance (OP) costs, and do not even burden farmers and their groups in carrying out their farming activities. .
For this purpose, a solar energy pump will be developed. The use of solar energy does not need electricity, it is extra energy efficient, and environmentally friendly. In addition, it is easy to use, high efficiency, stable performance and can be used for a long time (Widodo, Dedy 2016).

In addition, the use of SI-PTS can save fuel consumption from 162.5 liters to 58 liters and the cost of purchasing fuel from Rp. 1.202.000,- to Rp. 425,500 per hectare per season, resulting in a savings of 183%. Furthermore, the use of SI-PTS can reduce GHG emissions from the use of hydrocarbon materials from 0.409 tons of CO2 to 0.146 tons of CO2 so that they are more environmentally friendly.

Therefore, in this paper, we will discuss the effect of using solar water pumps on improving the economy of farmers in Ploso Geneng village, Jombang district, Jombang district.

2. Literature Review

Some of the advantages of utilizing solar energy are that it can be obtained free of charge from nature, the payback period can be very short when compared to other energy sources, solar energy systems and other renewable energies can stand alone without the need for additional connecting equipment in the power installation unit, The sun provides an almost unlimited supply of solar energy and if it is used for agriculture, it has a market opportunity that has not been overlooked by many agricultural tools and machinery entrepreneurs. While the main disadvantage of using solar energy in general is a large initial investment. Most types of solar cells require a large surface area to achieve average efficiency. (Agung Prabowo)

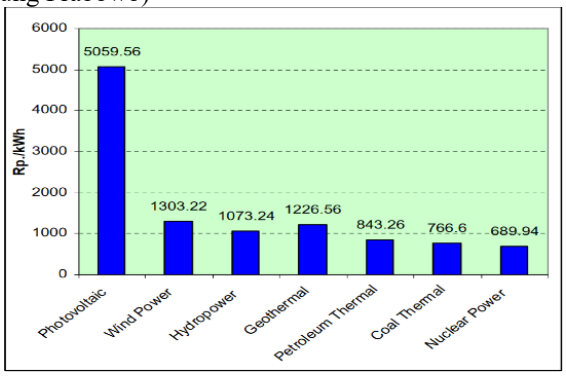

Figure 1. Operational Costs of Various Energy Sources Source: AOTS, EBARA, AIT, 2003

Based on data from the central statistical agency contained in Jombang sub-district in figures for 2020, information was obtained regarding harvested area, production and average rice production rice fields and fields for the village of Ploso Geneng with a net harvested area of 197.52 Ha are able to produce 1,422.14 tons with an average production of 72 (Kw/Ha). As for the harvested area, production and average maize production for the village of Plosogeneng with an area of 61.68 Ha, it is able to produce 413.26 Tons with an average production of 67 (Kw/Ha). For more details, see the following table

Table 1. Harvested Area, Production and Average Production of Rice Fields and Fields

Desa / Kelurahan	Luas Panen Bersih (Ha)	Produksi (Ton)	Rata - rata Produksi (Kw/Ha)
(1)	(2)	(3)	(4)
001. Tunggorono	128,00	806,40	63,00
002. J a b o n	177,60	88,800	5,00
003. Sengon	76,00	433,20	57,00
004. Jombatan	48,00	273,60	57,00
005. Plandi	120,00	684,00	57,00
006. Kaliwungu	18,00	102,60	57,00
007. Jelakombo	26,00	148,20	57,00
008. Kepanjen	-	-	-
009. Kepatihan	-	-	-
010. Pulo Lor	70,00	399,00	57,00
011. Denanyar	324,00	2.235,60	69,00
012. Jombang	28,20	189,22	67,10
013. Candi Mulyo	28,00	159,60	57,00
014. Mojongapit	52,00	296,40	57,00
015. Dapur Kejambon	-	-	-
016. Sambong Dukuh	-	-	-
017. Tambakrejo	126,40	834,24	66,00
018. Plosogeneng	197,52	1.422,14	72,00
019. Banjardowo	453,00	2.853,90	63,00
020. Sumberjo	126,00	718,20	57,00
Jumlah	1.998,7	11.645,1	58,3

Source: Jombang District in Figures, BPS 2020

Table 2. Harvested Area, Production and Average Production

Desa / Kelurahan	Luas Panen Bersih (Ha)	Produksi (Ton)	Rata - rata Produksi (Kw/Ha)
(1)	(2)	(3)	(4)
001. Tunggorono	27,00	194,40	72,00
002. J a b o n	177,60	88,800	5,00
003. Sengon	28,00	154,00	55,00
004. Jombatan	24,00	132,00	55,00
005. Plandi	60,00	330,00	55,00
006. Kaliwungu	9,00	49,50	55,00
007. Jelakombo	13,00	71,50	55,00
008. Kepanjen	-	-	-
009. Kepatihan	-	-	-
010. Pulo Lor	35,00	192,50	55,00
011. Denanyar	98,00	803,60	82,00
012. Jombang	23,25	141,10	60,69
013. Candi Mulyo	14,00	77,00	55,00
014. Mojongapit	26,00	143,00	55,00
015. Dapur Kejambon	-	-	-
016. Sambong Dukuh	-	-	-
017. Tambakrejo	87,40	532,18	60,89
018. Plosogeneng	61,68	413,26	67,00
019. Banjardowo	45,00	283,50	63,00
020. Sumberjo	60,00	330,00	55,00
Jumlah	788,93	3.936,34	49,89

Source: Jombang District in Figures, BPS 2020

3. Methods

The method used in this paper uses the multiple linear regression method where the dependent variable is Farmer Income and the independent variable is net harvested area, production yield and farm capital costs. This method is

expected to be able to prove the hypothesis of this research, that the use of solar water pumps can increase farmers' income.
The water pump operational costs include all costs calculated for the initial investment and operating/maintenance costs. Investment costs include equipment procurement costs, land acquisition, construction and supervision costs. Operational costs consist of operating costs, maintenance costs and initial investment interest.

4. Data Collection

The data used in this study are primary and secondary data obtained from agencies, questionnaires and also interviews with farmers. This interview was conducted to obtain information about the costs incurred before and after using a solar water pump and agricultural products obtained before and after using a solar water pump.

5. Results and Discussion

Some secondary data obtained from agencies and preliminary surveys for rice production in Jombang sub-district obtained an average net harvest area of 99.936 Ha with an average production of 582.26 tons/year with an average cost of Rp. 594,119.520/year and the average income is IDR 3,144,204,000/year. If taken on average per hectare capable of producing rice of 5.8 tons/year at a cost of Rp 5,945,000/ha and a net income of Rp 23,305,000/ha.

Table 3. Operational Costs and Income of Rice Production without a Solar Pump

No	Luas panen bersih (Ha)	Produksi (ton)	Biaya	Pendapatan
1	128	806.5	Rp 760,960,000	Rp 3,226,000,000
2	177.6	88.8	Rp 1,055,832,000	Rp 355,200,000
3	76	433.2	Rp 451,820,000	Rp 1,732,800,000
4	48	273.6	Rp 285,360,000	Rp 1,094,400,000
5	120	684	Rp 713,400,000	Rp 2,736,000,000
6	18	102.6	Rp 107,010,000	Rp 410,400,000
7	26	148.2	Rp 154,570,000	Rp 592,800,000
8	0	0	Rp -	Rp -
9	0	0	Rp -	Rp -
10	70	399	Rp 416,150,000	Rp 1,596,000,000
11	324	2235.6	Rp 1,926,180,000	Rp 8,942,400,000
12	28.2	189.22	Rp 167,649,000	Rp 756,880,000
13	28	159.6	Rp 166,460,000	Rp 638,400,000
14	52	296.4	Rp 309,140,000	Rp 1,185,600,000
15	0	0	Rp -	Rp -
16	0	0	Rp -	Rp -
17	126.4	834.24	Rp 751,448,000	Rp 3,336,960,000
18	197.52	1422.14	Rp 1,174,256,400	Rp 5,688,560,000
19	453	2853.9	Rp 2,693,085,000	Rp 11,415,600,000
20	126	718.2	Rp 749,070,000	Rp 2,872,800,000
Rata-rata	99.936	582.26	Rp 594,119,520	Rp 2,329,040,000

Source: Analysis results

For corn production in Jombang sub-district, the average net harvest area is 39.446 Ha with an average production of 196.817 tons/year with an average cost of Rp. 591.697.500/ year and the average income is IDR 1,082,493,500/year. If taken on average per hectare capable of producing corn of 4.98 tons/year at a cost of Rp 15,000,000/ha and a net income of Rp 27,442,000/ha.

Table 4. Operational Costs and Income of Corn Production Without Solar Pumps

No	Luas panen bersih (Ha)	Produksi (ton)	Biaya	Pendapatan
1	27	194.4	Rp 405,000,000	Rp 1,069,200,000
2	177.6	88.8	Rp 2,664,000,000	Rp 488,400,000
3	28	154	Rp 420,000,000	Rp 847,000,000
4	24	132	Rp 360,000,000	Rp 726,000,000
5	60	330	Rp 900,000,000	Rp 1,815,000,000
6	9	49.5	Rp 135,000,000	Rp 272,250,000
7	13	71.5	Rp 195,000,000	Rp 393,250,000
8	0	0	Rp -	Rp -
9	0	0	Rp -	Rp -
10	35	192.5	Rp 525,000,000	Rp 1,058,750,000
11	98	803.6	Rp 1,470,000,000	Rp 4,419,800,000
12	23.25	141.1	Rp 348,750,000	Rp 776,050,000
13	14	77	Rp 210,000,000	Rp 423,500,000
14	26	143	Rp 390,000,000	Rp 786,500,000
15	0	0	Rp -	Rp -
16	0	0	Rp -	Rp -
17	87.4	532.18	Rp 1,311,000,000	Rp 2,926,990,000
18	61.68	413.26	Rp 925,200,000	Rp 2,272,930,000
19	45	283.5	Rp 675,000,000	Rp 1,559,250,000
20	60	330	Rp 900,000,000	Rp 1,815,000,000
Rata-rata	39.4465	196.817	Rp 591,697,500	Rp 1,082,493,500

Source: AnalysisThe

Resultsresults of regression analysis of farmers' income (Y) with harvested area (X_1), Production (X_2) and Cost (X_3) get an R value of 0.926 which of these figures shows that there is a strong relationship between the variables Y with the variable X, while for the coefficient of determination ($R^{2)}$obtained a value of 0.857 this means that the independent variable in this case is the harvested area ($X_{1),}$Production ($X_{2)}$and Cost (X_3) explains the variable farmers' income of 0.92% and 0.17% is explained by other variables not examined in the study. The greater the value of R^2 or close to the value of 1 indicates the accuracy of the model that has been compiled.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.926[A]	.830 .610		.857

a. Predictors: (Constant), Cost, Production, Area

The equation for the regression model that is generated using the current condition variable cost (without using a solar cell pump) is as follows.

$$Y = -0.361+0.207.\ X_1+0.469.X_2+0.362.X_3$$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-.361	.301		-1200	.247	-.999	.277
	Size	.306 .197 .675 .509				.207	-.442	.856
	Productio n	.546. 000	.107		4,362	.469	.697	.241
	Cost	.347. 312		.288	1,043	.362	-.373	1,097

a. Dependent Variable: Income

By using the same method and variables, the analysis will be carried out again to obtain a model of equations and relationships between variables if one of the independent variables (costs) is changed using the value of costs incurred by using a solarcell pump. it is expected that there is a strong relationship between the dependent variable and the independent variable even though the cost value changes significantly.

6. Conclusion

a. Initial investment for solarcell water pump is higher than electric water pump
b. By using the variable current cost (electric water pump) the resulting model equation is
$Y = -0.361+0.207.\ X_1+0.469.X_2+0.362.X_3$

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Biographies

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