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Factors influencing the adoption of rice paddy threshing machine "Powered-Thresher": A case study of Serang District, Banten Province

Faktor-faktor yang mempengaruhi adopsi mesin perontok padi "power-threser": Studi kasus di kabupaten serang, provinsi banten

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Abstrak. *Mulyaqin T, Keichi I. 2017. Faktor-faktor yang mempengaruhi adopsi mesin perontok padi "Power Threser": Studi kasus di Kabupaten Serang, Provinsi Banten. Pros Sem Nas Masy Biodiv Indon 3: 420-425.* Fokus utama kebijakan pemerintah Indonesia tidak hanya meningkatkan produksi padi, tetapi juga mengurangi kehilangan hasil pada proses panen dan pasca panen untuk menyelamatkan produksi padi dan memastikan tercapainya ketahanan pangan nasional. Pengenalan dan diseminasi mesin perontok padi seperti power thresher kepada petani padi merupakan salah satu upaya pemerintah untuk mengurangi kehilangan hasil dan upah tenaga kerja, terutama pada tahap perontokan. Makalah ini menganalisis faktor-faktor yang mempengaruhi adopsi penggunaan power thresher di wilayah produksi padi di Kabupaten Serang, Provinsi Banten, Indonesia. Data yang digunakan dalam kajian ini dikumpulkan melalui wawancara menggunakan kuesioner terstruktur kepada 103 responden, meliputi 61 responden sebagai adopter dan 42 responden sebagai non-adopter mesin perontok padi. Kajian ini dilaksanakan di 4 kecamatan (Kecamatan Ciruas, Kecamatan Lebak Wangi, Kecamatan Pontang, Kecamatan Tirtayasa) di Kabupaten Serang pada musim tanam pertama tahun 2014/2015. Data dianalisis secara deskriptif dan menggunkan model regresi logistic probit. Hasil kajian menunjukkan bahwa faktor yang signifikan mempengaruhi adopsi petani terhadap power thresher secara positif yaitu luas garapan dan sumber keuangan dan faktor yang secara negatif mempengaruhi petani secara signifikan yaitu jumlah rumah tangga tani yang bekerja di sawah dan pekerjaan sampingan sebagai buruh tani. Betul adanya, di wilayah yang tingkat keberadaan buruh taninya masih tinggi enggan untuk menggunakan mesin perontok padi dikarenakan kemungkinan terjadinya konflik akibat buruh yang tergantikan oleh mesin tersebut. Akan tetapi, diseminasi informasi tentang mesin melalui kegiatan penyuluhan oleh stake holder (pemerintah, penyuluh, petani) kepada petani sebagai pengguna merupakan faktor penting untuk meningkatkan adopsi teknologi pertanian seperti mesin perontok ini.

Kata kunci: power threser, padi, kehilangan hasil

Abstract. *Mulyaqin T, Keichi I. 2017. Factors influencing the adoption of rice paddy threshing machine "Powered-Thresher": A case study of Serang District, Banten Province. Pros Sem Nas Masy Biodiv Indon 3: 420-425.* For ensuring national food security, main focus policy of Indonesia government is not only to increase rice production, but also to reduce harvest and post-harvest losses in order to safe rice production. Introducing and disseminating threshing machine such as powered-thresher to rice farmer is one of the government efforts to reduce yield losses and labor cost, especially on threshing stage. This paper examined the factors influencing the adoption of powered-thresher in rice production area in Serang District, Banten Province, Indonesia. The data used in this study were collected mainly through an interview survey using structured questioner to 103 respondents, including 61 respondents as adopters and 42 respondents as non-adopters of paddy's threshing machine. It was conducted in 4 (four) sub-district (Ciruas, Lebak Wangi, Pontang, Tirtayasa) in Serang district area for the first season of 2014/2015 cropping season with descriptive statistics and probit logistic regression model as a tool for data analysis. Empirical study shows that the significant factors influencing the adoption of power threshers positively are farm size and financial source, and the significant factors that influencing the adoption of power thresher negatively are the labor availability including the number of the household member who working in farm and side job as a labor and threshing cost. This is true in the case of a non-adopter area where high labor availability prevents the use of power thresher because of the possibility of conflict due to labor displacement. However, dissemination information about the machine through agriculture extension activity by stakeholder (government, extension officer, farmers) to the farmer as a user is the important factor to increase adoption of agriculture technology, especially this kind of threshing machine.

Keywords: powered-thresher, rice, yield loss

INTRODUCTION

Rice is a strategic and important cereal crop commodity in Indonesia. Rice is a staple food for more than 95% of the population, with a per capita consumption of rice of approximately 97.40 kg/year. In addition, rice is a source of income for more than 21 million people in Indonesia. In order to ensure national food security, the policy focus of

the Ministry of Agriculture (2010–2014) is to increase rice production and to reduce harvest and post-harvest losses (Ministry of Agriculture of Indonesia 2014).

High yield losses during harvesting and post-harvest activities still constrain national rice production. Each harvest and post-harvest activity, including cutting, threshing, winnowing, drying, milling, transporting, and marketing, can cause a yield loss that reduces rice farming profits. Losses from improper harvest and post-harvest activities reached 20.51%, broken up as follows: 9.52% on harvesting, 4.78% on threshing, 2.13% on drying, 2.19% on milling, 0.19% on transporting, and 1.61% on storage (Purwanto 2011). Vulnerable points that result in yield losses occur in the cutting stage (2–9%) and the threshing stage (2–4%) (see Table 1). In addition, harvesting is critical to rice farming because it is labor intensive, with more than 50% of total labor costs being harvest and post-harvest activities (Mayunar 2012).

Implementing different technologies would result in different yield losses. Introducing and disseminating threshing machines, such as power threshers, to rice farmers, is one of the government's efforts and policy to reduce yield loss and labor costs, especially in the threshing stage. Threshing using power thresher is the current ultimate technology for Indonesia. Pingali (2007) stated that the agricultural machinery adoption in the densely populated countries such as in Asia, it could increase the agricultural productivity and decreased the unit cost of crop production.

According to our observations, the use of power threshers is increasing, but some farmers still refuse to use these threshers, because of labor issues. Their labor is hired using the traditional hiring system for rice harvesting. Thus, laborers believe that if farmers use power threshers, they will lose their jobs. The purpose of this study is to assess the factors influencing the adoption of power threser.

MATERIALS AND METHODS

Data sources

The data used in this study were collected mainly through an interview survey using structured questioner, conducted in 4 (four) Subdistrict (Ciruas, Lebak Wangi, Pontang, Tirtayasa) in Serang District area for the first season of 2014/2015 cropping season. The number of sample farmers covered in the survey was 103 respondents, including 61 respondents as a powered-thresher adopter and 42 respondents as powered-thresher non-adopter of paddy's threshing Machines. Also, additional information was collected from thresher rental owner, extension officers and agricultural service officer, and secondary data was obtained from official documents, notes, reports and records relating to this research.

Model specification

This study tries to assess the factors causing the farmer to adopt power threshers based on a probit model analysis. The probit model examines several variables, which are assumed because the factors will influence the adoption of power threshers. The explanatory variables included in this analysis are the characteristics of respondents (age and education), farm size, information or knowledge about power thresher, farmer perception about conflict with labor, availability of labor for harvesting (side job of respondent as labor and member of family who works in rice farming), financial resources for rice farming, and threshing costs. These are defined in Table 2, along with the expected signs of their coefficients.

The probit model is often used in situations where an individual chooses between two alternatives. In this case, the decision is whether to adopt (or not adopt) a threshing machine (power thresher). Many of previously researched using this probit model (e.g., Gould et al. 1989; Traore et al. 1998; Neil and Lee. 1999; Egyir 2007; Zhou et al. 2010; Barungi et al. 2013; Boniphace et al. 2015). From an economic perspective, an individual *i* decides to adopt if the utility associated with the adoption choice (V_{1j}) is higher than the utility associated with the decision not to adopt (alternative choice), (V_{0j}). Following Koop (2003), the difference in utilities of the two choices is stated as $y^*_j = V_{1j} - V_{0j}$ and the econometric specification of the model is given as:

$$y^*_j = X_j B + e_j,$$

Where y^*_j is an unobserved (latent) random variable that defines a farmer's binary (adoption) choices, X_j is sets of explanatory variables associated with individual *j*. B is a vector of coefficients associated with the explanatory variable, while e_j represents the random error terms, defined as $e \sim N(0,1)$. The relationship between the unobserved variable y^*_j and the observed outcome (Yj) can be specified as:

$$y_j = 1 \quad \text{if } y^*_j \geq 0$$
$$y_j = 0 \quad \text{if } y^*_j < 0$$

The dependent and independent variables in this research described in Table 2.

Table 1. Rice yield loss influenced by different harvesting technology

Harvest Activity	Harvest Technology	Yield Loss (%)
Cutting	Sickle	9.52*
	Serrated Sickle	7.80**
	Reaper	6.00**
	Paddy Mower	2.00**
Threshing	Beating	4.79*
	Pedal Thresher	4.75**
	Power Thresher	1.90**
Cutting and Threshing	Combine Harvester	2.50***

Note: *) Nugraha et al. (2007); **) Tjahjohutomo (2008); ***) Purwadaria et al. (1994)

Table 2. Dependent and independent variable

Variable	Unit	Variable Description	Exp. Impact
Y Adoption	Dummy	D = 1 if farmer already uses a power thresher; 0 otherwise	+
X_1 Age	Years	Age of respondent	+
X_2 Education level	Years	Level of education of respondent	+
X_3 Farm size	Hectare	Total farm size of respondent	+
X_4 Information	Dummy	D = 1 if farmer already knows about power thresher; 0 otherwise	+
X_5 Conflict	Dummy	D = 1 if farmer perceives if they use the power thresher conflict will happen; 0 otherwise	-
X_6 Work in farm	Persons	Number of household members who work on the farm	-
X_7 Side job labor	Dummy	D = 1 if the farmer has side business as labor in farm, 0 otherwise	-
X_8 Financial sources	Dummy	D = 1 if the farmer can only raise finance by self-financed, and 0 otherwise	+
X_9 Threshing cost	Indonesian Rupiah	Amount of cost for threshing activity	-/+

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

A total of 103 respondents, 61 as a power thresher adopter and 42 non-adopter were interviewed. The selected socioeconomic characteristics of the respondent include age, formal education, farming experience, farm size, land status, financial source for rice farming, and primary and secondary business.

Age, formal education, and farming experience

As shown in Table 3, most respondents were within the age range of 41 to 60 years (52.46% for adopters and 52.38% for non-adopters). Then, 42.62% of adopters and 35.71% of non-adopters were within the age range of 20 to 40 years, and less than 5% of adopters and 11.90% of non-adopters were more than 60 years old. These results show that the ages of respondents in the research site are in good proportion and their peak age of productivity. A significant proportion of the farmers were between 41 and 50 years, indicating that they were mainly middle-aged and in their economically active stage and, as such, can withstand the stress and be productive.

The formal education of respondents falls primarily within the formal education range of 6 and 9 years (77.05% for adopters and 85.71% for non-adopters). Thus, most farmers have a formal education until the elementary school or junior high school. Thus, the level of education among respondents is not low, with only 3.28% of adopters and 7.14% of non-adopters not having a formal education or not finishing elementary school. This may have a positive influence on their farming practices because they have access to information on improved methods of production, which help to improve productivity.

Rice farming experience in the research site shows that the most respondents are within the range of 5 to 15 years (65.57% for adopters and 54.76% for non-adopters). In addition, 24.59% of adopters and 33.33% of non-adopters have rice farming experience of between 16 and 30 years, 6.56% of adopters and 7.14% of non-adopters have rice farming experience of fewer than 5 years, and 3.28% of adopters and 4.76% of non-adopters have rice farming experience of more than 30 years. Thus, most respondents have sufficient experience in rice farming; In addition to education, rice farming experience may also have a positive influence on rice farming practices.

Farm size and land status

The land is the primary and significant input for rice production. The average farm size in the research site is between 0.1 and 1.9 hectares (see Table 4), so these could be categorized as a small-hold farmer (less than 2 hectares). As shown in Table 4, most adopters and non-adopters have farm sizes between 0.5 and 1 hectare (73.77% and 66.67%, respectively). Then, 18.03% of adopters and 19.05% of non-adopters have farm sizes greater than 1 hectare, while 8.20% of adopters and 14.29% of non-adopters have farm sizes less than 0.5 hectares. However, most non-adopters own their land for rice farming (57.14%), while for adopters, this figure is only 26.23%. Most adopters share or rent their land (62.30% and 11.48%, respectively), while 42.86% of non-adopters share their land.

Financial source for rice farming

The availability of financial resources is important for buying or hiring inputs for rice farming. Table 5 describes the sources of finance for rice farming. Most respondents use their own money and loans (73.77% of adopters and 47.62% of non-adopters), while 18.03% of adopters and 45.24% of non-adopters are self-financed, and 8.20% of adopters and 7.14% of non-adopters use loans. Usually, farmers receive loans from input sellers, output buyers, landowners, farmers' groups, or other farmers, because the procedure is easy. The farmer will usually pay back the loan after harvesting.

Primary and secondary business

Farmers whose primary business is farming make up 88.52% of adopters and 90.48% of non-adopters (Table 6.). Most respondents have a secondary business as farm labor (24.59% of adopters and 45.24% of non-adopters), which means they also work as a laborer on another farm and

receive an income from that farm. In the Serang District, there is a traditional system called *sambatan*, or mutual help, according to which farmers help each other with rice farming in the rotation or by exchanging labor.

Other secondary businesses of farmers are those business related to agriculture, such as input and output sellers and agriculture machine rental (16.39% of adopters and 2.38% of non-adopters). Then, 9.84% of adopters and 9.52% of non-adopters have a secondary business not related to agriculture, and 4.92% of adopters are private company officers.

Table 3. Age, formal education, and farming experience of respondents

	Adopter		Non-Adopter	
	Freq	**Percent**	**Freq**	**Percent**
Age (Year)				
< 20	0	0.00	0	0.00
20–40	26	42.62	15	35.71
41–60	32	52.46	22	52.38
> 60	3	4.92	5	11.90
Total	61	100.00	42	100.00
Formal education (Year)				
< 6	2	3.28	3	7.14
6–9	47	77.05	36	85.71
10–12	10	16.39	2	4.76
> 12	2	3.28	1	2.38
Total	61	100.00	42	100.00
Rice farming experience (Year)				
< 5	4	6.56	3	7.14
5–15	40	65.57	23	54.76
16–30	15	24.59	14	33.33
> 30	2	3.28	2	4.76
Total	61	100.00	42	100.00

Table 4. Farm size and land status

Farm size and land status	**Adopter**		**Non-adopter**	
	Freq.	**Percent.**	**Freq.**	**Percent.**
Farm size (hectare)				
<0.5	5	8.20	6	14.29
0.5-1	45	73.77	28	66.67
>1	11	18.03	8	19.05
Total	61	100.00	42	100.00
Land status				
Own	16	26.23	24	57.14
Tenant	7	11.48	0	0.00
Share	38	62.30	18	42.86
Total	61	100.00	42	100.00

Table 5. Financial source for rice farming, primary and secondary business

Financial source for rice farming	**Adopter**		**Non-Adopter**	
	Freq.	**Percent.**	**Freq.**	**Percent.**
Self-finance	11	18,03	19	45,24
Loan	5	8,20	3	7,14
Self-finance + loan	45	73,77	20	47,62
Total	61	100,00	42	100,00

Table 6. Primary and secondary business of respondents

Type of business	**Adopter**		**Non-Adopter**	
	Freq	**Percent**	**Freq**	**Percent**
Primary business				
Farmer	54	88,52	38	90,48
Farm labor	1	1,64	0	0,00
Business-related to agriculture	1	1,64	0	0,00
Business not related to agriculture	1	1,64	2	4,76
Government officer	0	0,00	2	4,76
Private company officer	4	6,56	0	0,00
No side business		0,00	0	0,00
Total	61	100,00	42	100,00
Secondary business				
Farmer	4	6,56	6	14,29
Farm labor	15	24,59	19	45,24
Business-related to agriculture	10	16,39	1	2,38
Business not related to agriculture	6	9,84	4	9,52
Government officer	0	0,00	0	0,00
Private company officer	3	4,92	0	0,00
No side business	23	37,70	12	28,57
Total	61	100	42	100

Power thresher adoption in Serang District

The adoption of power threshers in the Serang District shows a slow, but increasing trend. The number of power threshers in the Serang District increased from 11 units in 2003 to 127 unit in 2013 (Ministry of Agriculture 2014). The slow adoption of harvest and post-harvest technology could be caused by several factors: (i) There is no information about the technology available to the farmer and agriculturist; (ii) the price of a machine is not affordable to individual farmers; (iii) the absence of a rental service for machines; and (iv) social conflict with labor, because laborers are worried about losing their jobs (Swastika 2012)

The same reasons are evident in this study (see Figure 1), where non-adopters are not using threshers because they do not know about the machine (19.5%), or do not believe the machine is available in the area (50%). However, the main reasons for these machines not being adopted in this area (Pontang Subdistrict and Tirtayasa Subdistrict) are a conflict if a farmer uses the machine (57.14%), most farmers perceiving that they still have enough hired labor (80.95%), and enough family labor (11.90%). According to the respondents and the agriculture extension officer, the refusal to use power threshers is coming mainly from labor, because they believe that if a farmer already uses a power thresher they will lose their job when harvesting time coming. Other farmers perceived that using a power thresher is too costly (2.38%), or that their farm is too far from the road (78.57%).

The information flow of technology to the farmer is an important factor to increase the adoption of technology. Information about power threshers as paddy threshing machines have reached respondents (Table 7.). All adopters already know about the power thresher (80.95%), but so do most non-adopter farmers, although 19.05% of non-adopters did not know about power thresher. Most respondents who already knew about power threshers

received information from an extension officer (51.76% of adopters and 73.33% of non-adopters), other farmers (42.35% of adopters and 17.78 of non-adopters), and other sources of information such as newspapers, radio, and TV (5.88% of adopters and 8.89% of non-adopters).

Farmers knew about the machines from the year 2004 or 2005, but only began to adopt the technology around 2007. Figure 2 shows some of the reasons for adopting a power thresher for threshing (figure 2.). In the research site, some farmers own their thresher machine. In this case, they use the machines but also rent them to other farmers (3.28% of adopters perceived that the acquisition of power threshers was for additional income). Other reasons for power thresher adoption are the speed of operation (98.36%), cleaner results (95.08%), lower losses (55.74%), lower costs (42.62%), shortage of labor (26.23%), and the speed of the next crop (14.75%).

Factors influencing the adoption of power thresher

The probit model (Table 7) shows that the significant factors influencing a farmer to adopt a power thresher are farm size, the number of household members working on the farm, side job as farm labor, financial source, and threshing costs. Farm size is found to have a significant and positive relationship with the probability of power thresher adoption at the 1% significance level. This finding is consistent with the literature that large-scale farmers are more inclined to adopt new technologies than are small-scale farmers (see Abara and Singh 1993).

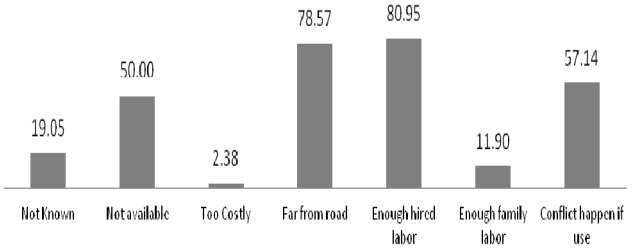

Figure 1. Non-adopter reasons for not using power thresher. Note: Percentage of respondent farmers who said "Yes," allowing more than two answers

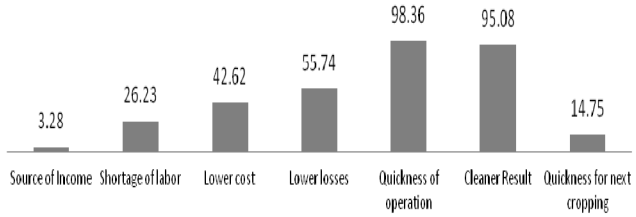

Figure 2. Adopter reasons for hiring/purchasing power thresher. Note: Percentage of respondent farmers who said "Yes," allowing more than two answers

Table 7. Knowledge and information about power threshers

	Adopter		Non-adopter	
	Freq.	**Percent.**	**Freq.**	**Percent.**
Known	61	100	34	80.95
Not Known		0	8	19.05
Total	61	100	42	100.00
Source of Information*)				
Extension officer	44	51,76	33	73,33
Another farmer	36	42,35	8	17,78
Others	5	5,88	4	8,89
Total	85	100,00	45	100,00

Note: *) Percentage of respondent farmers who said, "Yes," allowing more than two answers

Table 8. Probit model empirical analysis result using R application

Coefficients	**Estimate**	**SE**	**z value**	**Pr(>|z|)**	**Sig.**
(Intercept)	-5.49	703.6	-0.008	0.99377	
Age	-0.04566	0.03481	-1.312	0.18959	
Education level	0.1115	0.2267	0.492	0.62271	
Farm size	5.851	2.086	2.805	0.00503	**
Information	9.467	703.6	0.013	0.98926	
Conflict	-9.837	502.3	-0.02	0.98438	
Work in farm	-1.043	0.396	-2.634	0.00845	**
Side Job as labor	-1.941	0.6784	-2.861	0.00422	**
Financial source	1.707	0.7323	2.331	0.01976	*
Threshing cost	-0.000001532	5.839E-07	-2.625	0.00868	**

Note: Signif. level: '**' 1% '*' 5% Null deviance: 139.263 on 102 degrees of freedom, Residual deviance: 29.671 on 93 degrees of freedom AIC: 49.671, Number of Fisher Scoring iterations: 19

In contrast, the number of household members who are working on the farm and farmer who have side jobs as laborers has a significant and negative relationship with the probability of power thresher adoption at the 1% significance level. In this case, farmers prefer to use human labor to thresh their paddy, because there is enough labor and their source of income is farm labor.

From an economic view, minimizing costs is very important to maximizing profit. Threshing costs have a significant and negative relationship with the probability of power thresher adoption at the 1% significance level. Farmers will look for the lowest cost technology for threshing activity. The source of finance for paddy farming has a significant and positive relationship with the probability of power thresher adoption at the 5% significance level. Farmers who depend on their own finance and loans will try to adopt appropriate and low-cost technology to maximize their profit.

The education level of respondents and the information about power threshers have positive relationships with the probability of power thresher adoption but are not significant. In fact, I assumed that education level is an important factor affecting power thresher adoption. The level of education is related to the ability to process more complex information and make decisions (Negassa 2009).

Another assumption is that conflict will have a significant impact on power thresher adoption. The extension officer and the farmers in the research site explain that the main concern about adopting power threshers in the non-adopter area is the possible conflict with labor. Hence, efforts to disseminate power threshers in the non-adopter area would still be possible with an appropriate approach.

As a conclusion, the empirical analysis shows the various factors that significantly influence the adoption of power threshers. Farm size, financial capability, and source of funds are the positive factors. On the other hand, threshing costs (rent/hire/labor) and the high availability of labor are the main negative factors. This is true in the case of non-adopters, where high labor availability prevents the use of power threshers because of possible conflict owing to labor displacement.

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