Factors Affecting Paddy Farmers' Perception of Utilizing Agricultural Machines in Indonesia

Pullaila, Ani
Rastiyanto, Eka Amrullah
Astuti, Yati
Ishida, Akira

(Citation)
Journal of Agricultural Extension and Rural Development,10(8):150-157

(Issue Date)
2018-08

(Resource Type)
journal article

(Version)
Version of Record

(URL)
https://hdl.handle.net/20.500.14094/90006859

Vol.10(8), pp. 150-157, August 2018
DOI: 10.5897/JAERD2018.0963
Articles Number: 23E929557916
ISSN: 2141-2170

http://www.academicjournals.org/JAERD

ACADEMIC JOURNALS

Journal of Agricultural Extension and Rural Development

Full Length Research Paper

Factors affecting paddy farmers' perception of utilizing agricultural machines in Indonesia

Ani Pullaila[1,2], Eka Rastiyanto Amrullah[1,2], Yati Astuti[2] and Akira Ishida[1*]

[1]Graduate School of Agricultural Science, Kobe University, Kobe, Japan.
[2]Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture, Indonesia.

Received 12 May, 2018; Accepted 25 June, 2018

This paper aims to identify factors affecting farmers' negative perception on utilizing rice transplanters and combine harvesters. To this end, data obtained from interview survey in the westernmost part of Java Island, Banten Province was analyzed, where agricultural labor wages increase at a faster pace as compared to other regions and a rapid diffusion of agricultural mechanization is anticipated. The estimation results of multiple regression models clearly show that majority of coefficients of three independent variables: farm size extension, and farming experience, are statistically significant and take negative values. Therefore, it can be concluded that the larger the farm size, the more training provided by the government extension office, and the longer farming experience, the lesser the negative perception on the use of transplanters and combine harvesters. Educational background (formal human capital formation), the number of family members (within-household labor endowment), and yield per hectare are not found to significantly affect farmers' negative perception. Considering the above estimation results, it seems that the government agricultural extension service plays a significant role in lessening farmers' negative perceptions on transplanters and combine harvesters and thereby facilitates agricultural mechanization to cope with the rapid rise in agricultural labor wages.

Key words: Paddy farmer, perception, agricultural mechanization, Indonesia.

INTRODUCTION

It is well documented, in both developed and rapidly developing countries, that the adoption of labor saving technologies in the agricultural sector, in particular, the use of machines such as tractors, transplanters and harvesters, is inevitable for maintaining agricultural production (Otsuka et al., 2013). This is especially true in cases of massive labor outflow from the rural to urban sectors. This phenomenon frequently leads to tightening of the rural labor market and an increase in the agricultural wage rates, and thereby inducing the substitution of labor for capital (agricultural machineries) (Liu et al., 2016; Wang et al., 2016; Yamauchi, 2016). Indonesia is no exception in this regard. Yamauchi (2016) who analyzed two times data of 98 villages in Indonesia,

*Corresponding author. E-mail: akira_ishida@people.kobe-u.ac.jp.

pointed out that an increase in real agricultural wages induces the utilization of hired-in agricultural machines, and this behavior is more predominant among relatively large-scale farmers when compared with small-scale farmers. In an effort to cope with the rapid increase in hired-in agricultural labor cost[1], improve labor productivity, increase crop intensity, and thereby partly regain self-sufficiency in rice production, the Indonesian government has been providing agricultural machinery, such as rice transplanters and combine harvesters, to the association of farmers' groups (called *gapoktan* in Indonesian language) since 2014. According to the Ministry of Agriculture, the use of agricultural machinery resulted in reduction in production costs by approximately 50%, and rice farmers were able to plant two to three times a year (*Tempo*, January 1, 2017).[2] However, the extent to which the participant farmers positively (or negatively) perceive the government-led introduction of mechanization in transplanting and harvesting operations through rice farmers' groups has not been clearly assessed so far.

Many previous studies have pointed out that perception about modern technology has a highly significant effect on adoption of such technology (Adesina and Baidu-Forson, 1995; Negatu and Parikh, 1999; Romadi and Lusianto, 2014). In relation to agricultural mechanization in Indonesia, it is reported that a farmer with negative perception on the adoption of agricultural machinery is more likely to be reluctant to use it (Romadi and Lusianto, 2014). Therefore, in order to promote agricultural mechanization in rice farming in a situation where hired-in agricultural wages tend to rise along with rapid economic growth, eliminating the detrimental factors that affect perception regarding the use of transplanters and combine harvesters is an urgent policy matter in the field of agricultural extension in Indonesia. However, few detailed studies have been conducted to identify factors determining rice farmers' perception on the adoption of agricultural machinery, with the exception of Romadi and Lusianto (2014) pointing out that governments' agricultural extension activities positively influence the farmers' perception to some extent. Therefore, this paper aims to identify factors affecting the participant farmers' negative perception on utilizing rice transplanters and combine harvesters. To this end, data obtained from interview survey in the westernmost part of Java Island, Banten Province was analyzed, where agricultural labor wages increase at a faster pace as compared to other regions and a rapid diffusion of agricultural mechanization is anticipated.

Overview of the Government Agricultural Machinery Grant Program

In 1998, the Ministry of Agriculture launched the agricultural machinery (tractors and water pumps) grant program (*Usaha Pelayanan Jasa Alat dan Mesin Pertanian*) to cope with the rapid increase in the cost of hired-in agricultural labor and to improve labor productivity (Departement Pertanian, 2008). However, both rice transplanters and combine harvesters were not included in the program, suggesting that, under the program, a rice farmer could only plough paddy fields using a hired tractor. In 2014, a pilot project in line with the concept of *Upaya Khusus Peningkatan Padi, Jagung dan Kedelai*[3] known as UPSUS (roughly translated as "the Special Efforts to Increase Paddy, Corn, and Soybean Production"), which promotes self-sufficiency in staple and major food stuffs, was introduced in eight selected provinces (including Banten province where this survey was undertaken). The initiative aims to further accelerate agricultural mechanization (Winarno, 2017). A transplanter, combine harvester, hand tractor and water pump were granted to the association of farmers' groups (*gapoktan*), established in each rural district (*desa*) and comprising several farmers' groups (*kelompok tani*). In 2016, the Ministry of Agriculture spent about 4.6 billion Indonesian rupia (IDR) on the procurement of 100,000 units of agricultural machineries for the grant program (USD 1 is approximately equivalent to IDR 14,000) to extend the program nationwide.[4] Between 2014 and 2015, 10,000, two-wheel tractors, 1,000 four-wheel tractors, 3,425 water pumps and 5,000 rice transplanters were granted.[5]

Since government-subsidized fertilizers and seeds are distributed to rice farmers through farmers' groups, and non-members of such farmers' groups are not eligible to receive the government subsidized fertilizers and seeds, most rice farmers willingly affiliate with the farmers' group of their village. For example, in Banten province, which was selected as our case study, there are 1,136 associations of farmers' group (*gapoktan*) and 5,010 farmers' groups (*kelompok tani*) with 143,444 member farmers in 1,551 districts. This means one *gapoktan*, on an average, consists of 4.41 *kelompok tani* and has 126 member farmers.[6] Every member farmer is eligible to rent a transplanter and a combine harvester at IDR 400,000–600,000 and IDR 1,500,000–2,500,000 per hectare, respectively. The total labor costs for employing

[1]For example, according to the Badan Pusat Statistik (BPS), the real wage index of production workers in animal husbandry and fishery below supervisory level increased by 40 percentage point from 2007 to 2014.

[2]In Malaysia, which is a neighboring country of Indonesia, a rapid diffusion of labor saving technologies such as direct seeding and mechanization in ploughing and harvesting operations in rice sector have suppressed the rise in hired-in labor cost to some extent (Ishida and Asmuni, 1998).

[3] This concept was first advocated by President Joko Widodo who was elected as the seventh president of Indonesia in July 2014.

[4]The Ministry of Agriculture's home page (Pemerintah Tegaskan Bantuan Alisintan Gratis, http://psp.pertanian.go.id/index.php/page/publikasi/309, last accessed on 26 April 2018).

[5]See the above.

[6]Of 1,551 rural districts, *gapoktan* is not established in 415 districts where there are mountainous terrain areas not popular with rice farming.

Table 1. Distribution of rice transplanters and combine harvesters in Banten Province in 2014.

District/City	Rice Transplanters	Combine Harvesters
Pandeglang	3	2
Lebak	2	3
Serang	5	4
Tangerang	2	1
Tangerang City	0	0
Cilegon City	0	0
Serang City	0	0
Tangerang Selatan City	0	0
Total	12	10

Source: Banten Assessment Institute for Agricultural Technology.

agricultural workers to manually transplant paddy nurseries and harvest paddy seeds are expected to be approximately IDR 750,000–1,000,000 (15–20 workers multiplied by IDR 50,000 per worker) and IDR 3,000,000–3,600,000 (60 workers multiplied by IDR 50,000–60,000 per worker) per hectare, respectively. Therefore, utilizing rent-in transplanters and combine harvesters has a considerable labor cost reduction effect.

MATERIALS AND METHODS

Data collection

For this study, a face-to-face interview survey was carried out in three districts of Pandeglang, Lebak and Serang of Banten Province, which is in the westernmost part of Java Island. It lies next to DKI Jakarta State, which is the national capital. Banten has four regencies: Pandeglang, Lebak, Tangerang and Serang, and four autonomous cities: Tangerang City, Cilegon City, Serang City and Tangerang Selatan City. The population of Bantan is 11,955,243 (cited from homepage of Badan Pusat Statistik (BPS)) and occupies a land area of about 9,663 sq km. The reasons for the selection of Banten Province as the research site are (1) the major agricultural commodity is rice, (2) domestic rural labor migration from Banten Province to the capital city of Jakarta[7] is occurring at a fast rate, causing a rapid increase in hired-in agricultural labor costs, and (3) rice farming mechanization is one of the utmost important measures emphasized by the provincial office of the Ministry of Agriculture.

In 2014, when the government initially launched the rice farming mechanization program in Banten Province under the UPSUS, 12 rice transplanters and 10 combine harvesters were granted to 22 associations of farmers' groups (*gapoktan*) in four districts (Table 1). In this study, 116 members from three farmers' groups to which a rice transplanter had been granted and 119 members from another three farmers' group to which a combine harvester had been granted were chosen. Therefore, a total of 235 farmers were randomly selected and were interviewed regarding their perceptions on utilizing government-granted agricultural machinery. The interview survey, which was carried out from April to September 2015, used the semi-structured questionnaire.

[7] The northern part of Banten Province is directly connected to the capital city by the Jakarta-Merak toll road.

Measuring rice farmers' perception on transplanters and combine harvesters

According to the diffusion of innovation theory presented by the very well-cited Rogers (2003), the adoption rate of an innovation depends largely on the adopter's perceptions on the technological innovation characteristics. Specifically, the adopter's perceptions on an innovation are categorized into the following five classes (Rogers, 2003): (1) relative advantage (the degree to which an innovation is perceived as being better than the idea it supersedes); (2) compatibility (the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters); (3) complexity (the degree to which an innovation is perceived as relatively difficult to understand and use); (4) trialability (the degree to which an innovation may be experimented with on a limited basis); and (5) observability (the degree to which the results of an innovation are visible to others).

To measure the degree of the aforementioned five perceptions on utilizing the rice transplanters and combine harvesters, five negative statements related to each perception, or a total of 25 statements for five perceptions, were provided to respondents to assess their degree of negative perceptions (Table 2). Responses were provided on a Likert-type scale with scores ranging from 1 to 5 (1: strongly disagree, 2: disagree, 3: neutral, 4: agree and 5: strongly agree). The total score of five statements for each perception was calculated, meaning that the higher the score, the greater the negative perception on the use of the transplanters and combine harvesters.

Model specification

To identify factors determining the level of the aforementioned perceptions on utilizing transplanters and combine harvesters, multiple regression models with the perceptions as dependent variables are applied. Although, few detailed studies have been conducted to identify the factors determining rice farmers' perception on the adoption of agricultural machinery, Romadi and Lusianto (2014) pointed out that government agricultural extension activities improved the farmers' perception on rice farming mechanization in Indonesia. Rasouli et al. (2009) found that factors such as farm size and farm income affect the decision-making on farmers' adoption of agricultural mechanization on sunflower seed farms in Iran. Therefore, in addition to basic attributes of respondents such as age (year), educational level (primary level=1, secondary level=2, tertiary level=3), number of family members (person), farm size (ha), farm experience (year), farm income (IDR), and government extension dummy (yes=1, no=0) are used as

Table 2. Scores of negative perceptions on utilizing transplanters and combine harvesters.

	Transplanters		Combine harvesters	
	Mean	**s.d.**	**Mean**	**s.d.**
Relative advantage	13.828	2.061	12.882	2.949
Renting rice transplanters or combine harvesters is less profitable than the traditional way.	2.526	0.597	2.529	0.779
Using transplanters or combine harvesters seems to increase yield when compared with the traditional way.	2.733	0.517	2.588	0.718
Renting transplanters or combine harvesters does not increase income when compared with the traditional method.	2.776	0.529	2.454	0.661
Rental fee of transplanters or combine harvesters is high, which negatively affects profit from rice farming.	2.862	0.603	2.580	0.670
Since maintenance and its cost are required, using transplanters or combine harvesters is not more beneficial than the traditional way.	2.931	0.586	2.731	0.647
Compatibility	15.957	3.368	14.294	3.954
Using transplanters or combine harvesters is less suitable for the current environment than the traditional way.	3.241	0.742	2.782	0.967
Recommendation to use transplanters or combine harvesters is not in accordance with the existing customs.	3.267	0.762	2.849	0.870
Renting transplanters or combine harvesters makes me change the existing customary practice in rice farming.	3.422	0.712	2.882	0.845
Renting transplanters or combine harvesters does not match community's or farmers' need.	3.086	0.890	2.899	0.896
I hesitate to rent transplanters or combine harvesters since I am afraid that the result is not as expected.	2.940	0.907	2.882	0.761
Complexity	16.440	3.113	16.092	3.059
Operating transplanters or combine harvesters is more difficult than the traditional manual way.	3.431	0.805	3.269	0.733
Renting transplanters or combine harvesters is not practical since it requires additional costs.	3.207	0.704	3.185	0.747
Renting and operating transplanters or combine harvesters is difficult because of unavailability of skilled drivers.	3.353	0.725	3.261	0.786
I do not rent transplanters or combine harvesters because Gapoktan does not have enough equipment and spare parts.	3.414	0.735	3.277	0.663
Operating transplanters or combine harvesters is technically difficult.	3.034	0.658	3.101	0.643
Trialability	15.940	2.739	14.723	2.728
Limited opportunity of trying test run affects your decision to rent transplanters or combine harvesters.	3.060	0.805	3.042	0.681
Possible risk of loss arising from renting transplanters or combine harvesters affects decision/choice.	3.078	0.621	3.025	0.657
Limited availability of rental transplanters or combine harvesters makes it difficult to rent when required.	3.336	0.685	2.882	0.640
Group's occupation of transplanters or combine harvesters leads to limiting opportunities of renting.	3.241	0.538	2.857	0.628
High rental fee makes me hesitate to rent transplanters or combine harvesters.	3.224	0.661	2.916	0.591

Table 2. Contd.

Observability	14.552	2.548	13.849	2.875
Renting transplanters or combine harvesters is not immediately apparent in increasing value added from rice farming.	2.871	0.612	2.790	0.712
Although using transplanters or combine harvesters increases gross profit, it does not seem to increase net profit.	3.129	0.626	2.824	0.633
Quality of using transplanters or combine harvesters is not superior to the traditional manual ways.	2.802	0.701	2.782	0.653
Cost of renting transplanters or combine harvesters is more expensive than the traditional manual way.	2.741	0.724	2.655	0.775
Maintenance cost of transplanters or combine harvester is so expensive that its utilization is not more beneficial than the traditional manual way.	3.009	0.519	2.798	0.619

All scores are calculated from authors' survey data.

independent variables shown in Table 3 (age is dropped and farm income is replaced with land productivity (kg per ha) due to high correlation with farm experience and farm size, respectively).

RESULTS AND DISCUSSION

Rice farmers' perception on transplanters and combine harvesters

Results on rice farmers' negative perceptions of relative advantage, compatibility, complexity, trialability and observability are shown in Table 2. The Cronbach's alpha values of reliability for the transplanters range from 0.710 to 0.909, while those for the combine harvester range from 0.830 to 0.947. All the Cronbach's alpha values are more than the threshold limit of 0.70, indicating acceptable reliability levels. Therefore, the total score of the five statements for each perception is used as a dependent variable for regression analysis.

The highest score of negative perception on transplanters is 'Complexity' (16.440), followed by 'Compatibility' (15.957), while the lowest score was in 'Relative advantage' (13.828). The highest score of negative perception on combine harvester is also 'Complexity' (16.092), followed by 'Trialability' (14.723), while the lowest score was in 'Relative advantage' (12.882). Therefore, rice farmers tend to perceive transplanters and combine harvesters as relatively difficult to understand and use.

Factors affecting rice farmers' negative perception

Adjusted R-squared values range from 0.127 to 0.462 and the hypothesis that all coefficients are equal to zero can be rejected at the 1% significance level in all estimated equations, except the hypothesis about the 'Observability' of combine harvesters, which can be rejected at the 5 percent significance level (Table 3). In addition, the average variance inflation factor is 1.41 for transplanters and 1.39 for combine harvesters. Considering all indicators together, the estimation results are largely acceptable for further discussion and justify the need for further examination.

The estimation results clearly show that all coefficients of the two independent variables, farm size and extension, are statistically significant and take negative values, with an exemption of 'Observability' of combine harvester, where none of coefficients are significant. Following farm size and extension, farming experience with its coefficients being significant for seven of ten values seems to lessen farmer's negative perceptions. Educational background (formal human capital formation), the number of family members (within-household labor endowment), and yield per hectare are not found to significantly affect farmers' negative perception.

With regard to farm size, it can be highlighted that the larger the farm, the lesser the negative perception of the use of transplanters and combine harvesters. This finding may be consistent with Yamauchi (2016) who pointed out that, in Indonesia, an increase in labor cost induced relatively large farmers to substitute labor

Table 3. Estimation results on farmers negative perception

Transplanter	Relative advantage			Compatibility			Complexity			Trialability			Observability			Mean	SD
Education																	
Secondary	-0.003	-0.009	-	-0.762	-1.170	-	-0.557	-0.922	-	-0.061	-0.105	-	-0.650	-1.091	-	0.345	-
Tertiary	-0.474	-1.104	-	-1.055	-1.428	-	-1.395	-2.036	*	-0.669	-1.012	-	0.086	0.127	-	0.267	-
Family member	-0.334	-2.341	*	0.252	1.024	-	-0.003	-0.012		0.210	0.958	-	-0.098	-0.437	-	4.362	1.099
Farming experience	-0.060	-2.888	**	-0.052	-1.443		-0.066	-1.989	*	-0.084	-2.645	*	-0.009	-0.273	-	17.276	8.629
Farm size	-1.670	-4.792	**	-4.490	-7.479	**	-3.650	-6.558	**	-2.372	-4.419	**	-1.797	-3.275	**	0.446	0.446
Yield	0.000	1.748		0.000	0.706		0.000	0.880		0.001	1.909		0.001	2.420	*	5536.724	642.697
Extension	-2.519	-5.969	**	-1.678	-2.308	*	-2.546	-3.778	**	-2.051	-3.156	**	-1.316	-1.980	*	0.853	-
Area																	
Pandeglang	0.020	0.056	-	-0.476	-0.761	-	0.330	0.569	-	-0.100	-0.179	-	0.175	0.307	-	0.345	-
Serang	0.642	1.784	-	-0.101	-0.164	-	0.691	1.202	-	0.979	1.766	-	0.686	1.211	-	0.319	-
Constant	16.925	11.011	**	18.392	6.945	**	19.848	8.086	**	15.503	6.548	**	12.176	5.031	**	-	-
Adjusted R-squared	0.462	-		0.402	-		0.399	-	-	0.277	-	-	0.127	-	-	-	-
Combine harvester	**Relative advantage**			**Compatibility**			**Complexity**			**Trialability**			**Observability**			**Mean**	**SD**
Education																	
Secondary	0.738	1.487		1.641	2.285	*	0.705	1.180		-0.125	-0.230		-0.160	-0.279		0.387	
Tertiary	0.363	0.565		0.488	0.525		0.862	1.115		-0.343	-0.490		-1.240	-1.671		0.176	
Family member	0.039	0.171		0.699	2.117	*	0.334	1.215		0.390	1.567		0.121	0.458		4.387	1.106
Farming experience	-0.057	-2.006	*	-0.051	-1.240		-0.069	-2.025	*	-0.129	-4.164	**	-0.124	-3.788	**	17.899	9.098
Farm size	-1.513	-4.369	**	-2.788	-5.568	**	-1.856	-4.457	**	-1.005	-2.661	**	-0.775	-1.938		0.545	0.638
Yield	-0.001	-2.239	*	0.000	0.174		0.000	0.045		0.000	0.213		0.000	-0.843		5884.454	572.006
Extension	-3.089	-4.798	**	-3.407	-3.660	**	-1.626	-2.100	*	-1.579	-2.250	*	-0.920	-1.238		0.866	
Area																	
Pandeglang	-0.835	-1.572	-	0.704	0.918	-	-0.916	-1.435	-	0.420	0.725	-	-1.340	-2.186	*	0.353	-
Serang	0.309	0.575	-	0.146	0.188	-	-0.018	-0.028	-	-0.368	-0.627	-	-1.176	-1.893	-	0.303	-
Constant	22.284	8.971	**	15.006	4.178	**	18.060	6.046	**	16.758	6.188	**	20.126	7.017	**	-	-
Adjusted R-squared	0.430	-		0.337	-	-	0.234	-	-	0.208	-	-	0.200	-	-	-	-

** And * represent 1 and 5% significant levels, respectively.

with rented or hired machines.[8] Farmers with large

[8]As pointed out by Yamauchi (2016), it should be noted that majority of small-scale farmers on Java, where land is scarce, can be trapped in high-cost farming in terms of land market rigidities. Therefore, it is suggested that agricultural mechanization in situations of rising labor costs seems to be in more favor of large farmers (Foster and Rozenweig, 2010; Otsuka et al., 2016).

rice fields tend to have a strong entrepreneurial mind-sets and are more dependent on hired labor for transplanting nursery and harvesting paddy. It is well documented that a new agricultural technology is more likely to be diffused to large-scale farmers on the basis that they are more resilient to crop failure or unexpected profit loss and will be more accepting of technology, as profit-seeking risk takers. For small-scale farmers who heavily rely on their own family's labor, replacing family labor with rent-in transplanters or combine harvesters increases expenditures. The effects of adopting agricultural mechanization for shortening the required time for transplanting or harvesting paddy is in favor of large-scale farmers. For example, harvesting time per hectare is approximately 60 man-days with the traditional manual way and one man-day with a combine harvester. This suggests that a farmer with a one-hectare paddy field can save 59 man-days in harvesting operations through agricultural mechanization. However, a small-scale rice farmer with 0.2 hectares of rice field can save only 11.8 man-days, which is roughly equivalent to four days' work by three family laborers.

As for the government extension service, a farmer who gets training provided by agricultural extension workers is less likely to have negative perceptions on transplanters or combine harvesters. This finding is consistent with Romadi and Lusianto (2014). Before 2014, when the government initially launched the rice farming mechanization program in Banten Province, a majority of rice farmers in Banten were not familiar with agricultural mechanization. In such a situation, it should be noted that the government extension service lessens rice farmers' negative perceptions on utilizing transplanters and combine harvesters, to some extent. Therefore, the government agricultural extension service plays a significant role in lessening farmers' negative perceptions on transplanters and combine harvesters and thereby facilitates agricultural mechanization to cope with a rapid rise in agricultural labor wages.[9]

As for farming experience, although coefficients of 'Compatibility' for both transplanters and combine harvesters and 'Observability' for transplanters are notsignificant, all others are significant at one or five percent level and take negative values. Thus, it seems that the longer the farming experience, the lesser the negative perception on the use of transplanters and combine harvesters. This is probably because more experienced farmers tend to have more knowledge on rice farming through their own farm experiences and have a wider social network that aids access to information on various agricultural technologies.

Before concluding, the shortcoming of farmer-managed agricultural mechanization in Indonesia should be highlighted. It is widely accepted that tractor hire services in the public sector tend to be a particular cause of operational inefficiency and poor longevity in many developing countries (Pingali, 2007). In the case of irrigation water management, many previous studies pointed out that famers' own management is more efficient than government-led management. For example, Bhatta et al. (2006) who compared the performance of farmer-managed and agency-managed irrigation systems in Nepal, pointed out that equity in distribution of irrigation water and leakage had significantly improved after the water users' group took over management responsibilities from the government department. Kosanlawit et al. (2017) also pointed out rice farmers' active participation in local irrigation operations is likely to be more effective in facilitating irrigation operations in Thailand. However, in the case of farmer-managed agricultural mechanization in Indonesia, we were told by several informants that some of the government-provided agricultural machineries were broken and abandoned in warehouses without being repaired, mainly due to severe budget constraints and poor management of the farmers' groups associations (*gapoktan*) and difficulty in the procurement of necessary parts. Although, the farmer managed mechanization program seems to contribute to lessening the negative effect of rising wages in the agriculture sector to some extent, such operational inefficiencies may jeopardize its longevity and be a waste of government funds in some farmers' associations. Therefore, there should be proper intervention, assistance, and monitoring by the district extension office, a nonprofit organization, and/or an international donor agency to ensure that transplanters and combine harvesters are not lying unused.[10]

Concluding remarks and policy implications

This paper aims to identify factors affecting farmers' negative perception on utilizing rice transplanters and combine harvesters. To this end, an interview survey is conducted in the westernmost part of Java Island, Banten Province, where agricultural labor wage increases at a faster pace as compared to other regions and a rapid diffusion of agricultural mechanization is expected. The estimation results of multiple regression models clearly show that majority of coefficients of three independent variables- farm size, extension and farming experience, are statistically significant and take negative values. Therefore, it can be concluded that the larger the farm size, the more training provided by the government

[9]Many previous studies also reveal that the government extension service positively affects productivity, technical efficiency, and technological adoption (Elias et al., 2013, 2014; He et al., 2007). However, a few studies have tried to identify factors determining farmers' satisfaction with agricultural extension service with a few exemptions by Elias et al. (2015) pointing out that regular extension contact is one of the driving factors for farmers' satisfaction.

[10]Although, it may be controversial whether the farmer managed mechanization program inhibits the growth of the machinery rental or hire market led by the private sector, detail regarding this cannot be given because reliable data has not been collected yet and it is beyond the scope of the paper.

extension office, and the longer farming experience, the lesser the negative perception on the use of transplanters and combine harvesters. Educational background (formal human capital formation), the number of family members (within-household labor endowment) and yield per hectare are not found to significantly affect farmers' negative perception. Considering the above estimation results, it seems that the government agricultural extension service plays a significant role in lessening farmers' negative perceptions on transplanters and combine harvesters and thereby facilitates agricultural mechanization to cope with the rapid rise in agricultural labor wages. However, it should be noted that some of the government-provided agricultural machineries are damaged and disposed in warehouses without being repaired, mainly due to severe budget constraints of associations of farmers' groups (*gapoktan*) and the difficulty in procuring the necessary parts. Therefore, the government should ensure appropriate intervention and assistance, to prevent transplanters and/or combine harvesters from being left unused.

Finally, it should be noted that our study uses a small sample of 235 rice farmers who live in the westernmost part of Java Island, Banten Province, thus making it difficult to generalize the findings to the whole of Indonesia. In addition, several important factors that are likely to affect farmers' perception of utilizing transplanters and combine harvesters, such as management and maintenance of agricultural machineries by farmers' groups, leaders' abilities and interpersonal relationships among group members were not examined. These limitations suggest the need for further research. A more representative picture of farmers' perception on the use of agricultural machineries in Indonesia is required to promote rice farming mechanization more effectively and efficiently.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Adesina AA, Baidu-Forson J (1995). Farmers' perceptions and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics 13(1):1-9.

Bhatta KP, Ishida A, Taniguchi K, Sharma R (2006). Performance of agency-managed and farmer-managed irrigation systems: A comparative case study at Chitwan, Nepal. Irrigation and Drainage Systems 20(2-3):177-191.

Departemen Pertanian (2008). Peraturan Menteri Pertanian Nomor 25/Permentan/PL.130/5/2008 tentang Pedoman Penumbuhan dan Pengembangan Usaha Pelayanan Jasa Alat dan Mesin Pertan.

Elias A, Nohmi M, Yasunobu K, Ishida A (2013). Effect of agricultural extension program on smallholders' farm productivity: Evidence from three peasant associations in the highlands of Ethiopia. Journal of Agricultural Science 5(8):163-181.

Elias A, Nohmi M, Yasunobu K, Ishida A (2015). Farmers' satisfaction with agricultural extension service and its influencing factors: A case study in North West Ethiopia. Journal of Agricultural Science and Technology 18(1):39-53.

Elias A, Nohmi M, Yasunobu K, Ishida A, Alene AD (2014). The effect of agricultural extension service on the technical efficiency of teff (*Eragrostistef*) producers in Ethiopia. American Journal of Applied Sciences 11(2):223-239.

Foster A, Rosenzweig MR (2010). Barriers to farm profitability in India: mechanization, scale and credit markets. In Conference Agriculture for Development-Revisited, University of California at Berkeley. October 24 Sep pp. 1-2.

He XF, Cao H, Li FM (2007). Econometric analysis of the determinants of adoption of rainwater harvesting and supplementary irrigation technology (RHSIT) in the semiarid Loess Plateau of China. Agricultural Water Management 89:243-250.

Ishida A, Asmuni A (1998). Poverty eradication and income distribution in Malaysia. Journal of Contemporary Asia 28(3):327-345.

Kosanlawit S, Soni P, Shivakoti GP (2017). The relationship between effective and equitable water allocation, local rice farmer participation and economic well-being: Insights from Thailand's Chiang Mai Province. Water 9(5):319.

Liu Y, Violette W, Barrett CB (2016). Structural transformation and intertemporal evolution of real wages, machine use, and farm size-productivity relationships in Vietnam. IFPRI Discussion Paper 01525. Washington, D.C.: International Food Policy Research Institute.

Negatu W, Parikh A (1999). The impact of perception and other factors on the adoption of agricultural technology in the Moret and Jiru Woreda (District) of Ethiopia. Agricultural Economics 21:205-216.

Otsuka K, Liu Y, Yamauchi F (2013). Factors endowments, wage growth, and changing food self-sufficiency: evidence from country-level panel data. American Journal of Agricultural Economics 95(5):1252-1258.

Otsuka K, Liu Y, Yamauchi F (2016). The future of small farms in Asia. Development Policy Review 34(3):441-461.

Pingali P (2007). Agricultural mechanization: Adoption patterns and economic impact. Evenson R, Pingali P (eds). Handbook of Agricultural Economics, Vol. 3, Amsterdam: Elsevier.

Rasouli F, Sadighi H, Minaei S (2009). Factors affecting agricultural mechanization: A case study on sunflower seed farms in Iran. Journal of Agricultural Science and Technology 11:39-48.

Rogers EM (2003). Diffusion of Innovations. Fifth Edition. The Free Press: New York.

Romadi U, Lusianto D (2014). Persepsi petani padi terhadap pemanfaatan rice transplanter di Kecamatan Pohjentrek Kabupaten Pasuruan Provinsi Jawa Timur. Agrica Ekstensia 10(2):61-66.

Wang X, Yamauchi F, Otsuka K, Huang J (2016). Wage growth, landholding, and mechanization in Chinese agriculture. World Development 86:30-45.

Winarno K (2017). Factors shaping the operation of machinery hire services: Case studies on the implementation of the institution for rental service of agricultural machinery (IRSAM) Programme in the Special Region of Yogyakarta, the Republic of Indonesia. Master's Thesis submitted to Massey University.

Yamauchi F (2016). Rising real wages, mechanization and growing advantage of large farms: Evidence from Indonesia. Food Policy 58:62-69.