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TECHNOLOGY ADOPTION OF *JAJAR LEGOWO* RICE PLANTING SYSTEM APPLICATION

Purpose. *This study aims to discover Field Agricultural Counseling (FCA) role in adoption of jajar legowo system for rice farmers, rice farmers income before and after adoption of jajar legowo system, and factors that influences the adoption process which are age, education, and land area.*

Methodology / approach. *This research is using survey method by questionnaire. This research took place in Pakisaji, Malang, started from December 2016 until May 2017. 74 rice farmers were asked to fill the questionnaire according to research objectives.*

Results. *It is found that different class of rice farmers adopting jajar legowo system has different perceptions of FCA role regarding their work in counseling rice farmers to adopt jajar legowo system. It is also determined that by adopting jajar legowo system, rice farmer income has increased. Factors that has significant influence on adoption of jajar legowo system are education and land area, but age has no significant influenced.*

Originality / scientific novelty. *The originality of this research is the idea to discover farmer's opinion and experiences of adopting jajar legowo system. It is because this system is unique and different from others.*

Practical value / implications. *Practical value is determined by the result of this research as it can be used to evaluate better application of jajar legowo system for each class of farmer.*

Key words: *jajar legowo, technology adoption, agriculture economics.*

Introduction and review of literature. The essence of national development is the complete human development and development of the entire society, including rural farmers (Ogunmefun and Achike, 2015). Building a complete farmer man means to establish self-reliance and participation in agricultural development (Suvedi et al., 2017). *Penyuluh Pertanian Lapangan* (Agricultural Counselor on the Field – FCA) is needed to develop the farmer's ability of in mastering, utilizing, and implementing technology that useful and efficient for the development and more profitable farming products by implementing various methods of agricultural extension (Al Qaesi, 2017). Nowadays, central government and local governments of Indonesia have sought various programs to increase rice production. Through the *Sekolah Lapang-Pengelolaan Tanaman Terpadu* (Field School-Integrated Crop Management – FS-ICM) program, FCA plays a role in increasing rice production and which should be followed by increasing rice production, by applying technology adoption of *jajar legowo* system which can increase the number of plant population in wide area of a relatively fixed land. The adoption of *jajar legowo* planting system is one of the technology components of integrated rice resource management which is strategic to increase rice productivity which currently tend to stagnate and even to

decrease (Karmana and Ayesha, 2010).

Overcoming the decrease amount of rice production, the application of technology in agricultural development is absolutely necessary, because it is one of main requirements of agricultural development (Deichman et al., 2016). Without technology, agricultural development will slow down so that people's need for food can't be met because according to Malthus' theory that population growth will increase according to arithmetic (Okosodo, 2016). *Jajar legowo* system is one component of integrated crop management system which is a cultivation technique engineering by arranging spacing between clumps and between rows so that there is compaction of clumps of rice in the line and widen the distance between rows. *Jajar legowo* system also aims to improve knowledge and skills in applying technology in accordance with condition of local resources synergistically and environmentally friendly so that the farming process becomes more efficient and sustainable that will lead to high productivity (Lalla et al., 2012).

Counseling is very important in order to guide and teach the farmers about technology of *jajar legowo* system so that farmers will be able to adopt and apply this technology (Patil, 2017). Social characteristics of farmers can influence farmers in adopting a technology (Darsan et al., 2017). FCA of Pakisaji, especially in this study, plays an important role in realizing the economic condition of decent and prosperous farmers. They have a role in the effort of increase rice production through FS-ICM program. FCA plays a role in increasing rice production by applying technology of *jajar legowo* system.

In order to increase the production of rice farming in Pakisaji, FCA agents are absolutely needed as counselor and coach whose job is to build, give direction and explanation, also to counsel about farming activity to increase rice production (Ikiz and Asici, 2017). FCA is expected to assist farmers in solving problems they faced by farmers applying *jajar legowo* system.

Agricultural Counseling. Counseling is engagement in communication consciously with the purpose of helping client target to provide income, and help to make decisions (Brady-Amoon and Keefe-Cooperman, 2017). This activity is called *Penyuluh Pertanian Lapang* – Field Agricultural Counselor (FCA) (Irwandi and Susilawati, 2016). FCA agents play an important role for agricultural development, because agricultural counseling is one effort to empower farmers and agricultural business actors to improve productivity, income, and farmers' welfare (Sairi, 2015).

Through the role of FCA, farmers are will be expected to be aware of their needs, improve their self-efficacy, and play a better role in the community (Matolo and Makulu, 2016). FCA is a policy tool that can be used by government to encourage agricultural development. On the other hand, farmers have the freedom to accept or reject the advice given by FCA. Thus FCA can only achieve its goals if the desired changes are in accordance to the interests of farmers (Irwandi and Susilawati, 2016).

***Jajar Legowo* System.** *Jajar legowo* system is an engineering planting technique by adjusting the space between the clumps and between rows so that there

will be compaction of rice clumps in the line and widen the distance between rows, so as if the rice clump is in the margin of the crops that benefit as a periphery plant (Fig. 1). The results showed that the rice clumps in the margins were 1.5 to 2 times higher than the production of inner rice clumps (Abdulrachman et al., 2013). *Jajar legowo* system is a rice planting arranged in such a way with a wide hall or open space. *Jajar legowo* system is a technology engineering aimed to improve productivity of rice farming. Legowo is derived from Javanese language which consists of the words *Lego* and *Dowo*. *Lego* means widespread and *dowo* means long, so the rice clumps are brought along a wide hallway and extends along the rows of plants (Abdulrachman et al., 2013).

There are two ways of *jajar legowo*, first by arranging a row of plants in every 2 rows and the third row is emptied along one row. The new planting is done back on the fourth and fifth lines, then the next one is consolidated again, and so on. By setting such a planting line, it will place the whole plant in a marginal position (Abdulrachman et al., 2013). Rows vacated from the plant population and form a wide and elongated space aims to create ideal environmental conditions for plant growth because air circulation becomes smoother. Direct sunlight exposure to the entire surface of plants and soil more open, and facilitate farmers to do maintenance in close proximity to each clump of plants without having to destroy the clumps of plants that must be accessed (Abdulrachman et al., 2013). Basically, the plants that are on the edge of rice fields near the bundle is always better growth, quality and production compared with plants located in the middle of rice fields. This phenomenon is easy to understand because all the plants that sit on the edge get enough air circulation, get sufficient solar radiation, and easier to be treated and supervised (Abdulrachman et al., 2013).

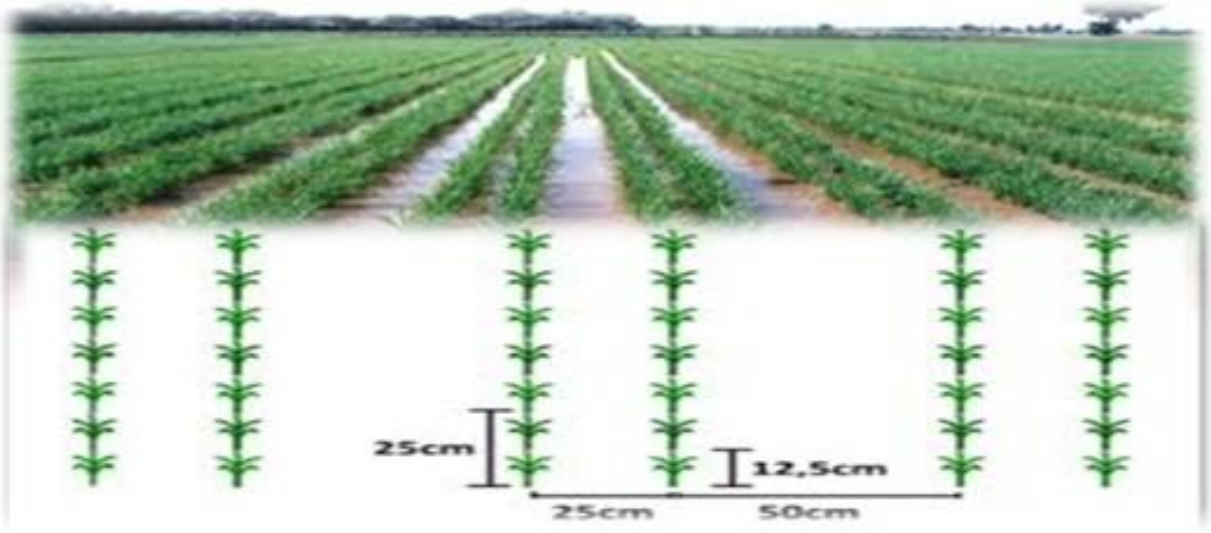

Fig. 1. *Jajar legowo* system

The purpose of the article. This study aims to discover Field Agricultural Counseling (FCA) role in adoption of *jajar legowo* system for rice farmers, rice farmers income before and after adoption of *jajar legowo* system, and factors that influences the adoption process which are age, education, and land area.

This research is using survey method by questionnaire at FCA of Pakisaji, Malang. Target aimed at this research is farmer group built by *Balai Penyuluhan Pertanian* – Agricultural Counseling Center (ACC) of Pakisaji doing farming activity applying *jajar legowo* system. This research uses questionnaire to help researchers mapping the benefit of implement *jajar legowo*. Scientists believe that survey based on questionnaire is able to give valid data from respondent about research topic. The object of this research is rice farmers of *jajar legowo* system incorporated in farmer groups built by ACC of Pakisaji. While the subject of this research is the adoption of technology on the application of rice *jajar legowo* system through the role of FCA. This research activity was conducted from December 2016 until May 2017. The population referred in this research is 18 farmer groups assisted by FCA of Pakisaji. Number of farmer population of rice *jajar legowo* system in this research is 287 farmers. The population of rice farmers of *jajar legowo* are spread in 12 villages in Pakisaji such as Pakisaji, Karangpandan, Gelanggang, Wonokerso, Sutojayan, Karangduren, Kendalpayak, Genengan, Kebonagung, Wadung, Jatisari and Permanu. In this study, the rice farmers who applied *jajar legowo* system are 287 people, which can be grouped according to the group class, namely Beginner Class of 78 people, Advance Class of 59 people, Middle Class of 82 students, and Primary Class of 68 people (stratified population).

Results and discussions.

Respondents Characteristics. There are 74 respondents of 287 *jajar legowo* rice farmer. Their ages and educations are explained in tables below (Table 1, Table 2).

Table 1

Respondents' Age Based On Farmer Class

No	Classes	Age (year)	Number of respondent	%
1	Beginner Class	35–40	2	13.51
		41–45	4	
		45–50	4	
		51–55	4	13.51
		56–60	3	
		61–65	3	
2	Advanced Class	35–40	1	6.75
		40–45	4	
		46–50	4	
		51–55	1	8.10
		56–60	3	
		61–65	1	
		66–70	1	
3	Middle Class	31–35	2	17.56
		36–40	4	
		41–45	3	
		46–50	4	
		51–55	5	10.81
		56–60	2	
		61–65	1	

Continuation of Table 1

4	Primary Class	36–40	3	8.10
		41–45	2	
		46–50	1	
		51–55	4	16.21
		56–60	6	
		61–65	1	
		66–70	1	
Total			74	100

Source: author's data, 2017.

Table 2

Respondents' Education Background Based On Farmer Class

No	Classes	Education	Respondent	Total	%
1	Beginner Class	Elementary school	4	7	9.45
		Junior high school	3		
		Senior high school	12	13	17.56
		University	1		
2	Advanced Class	Elementary school	2	4	5.40
		Junior high school	2		
		Senior high school	10	11	14.84
		University	1		
3	Middle Class	Elementary school	6	18	24.32
		Junior high school	2		
		Senior high school	10		
		University	2	2	2.70
		Polytechnic	1		
4	Primary Class	Elementary school	5	11	14.86
		Junior high school	6		
		Senior high school	6	7	9.45
		University	1		
Total				74	100

Source: author's data, 2017.

Analysis of FCA Role in* Jajar Legowo *Technology Adoption. The application of *jajar legowo* system which is a technology adoption technique in rice cultivation has been followed through FCA activities with various approaches method: individual approach, group approach through group meeting, and mass approach through counseling activities. Counseling is an educational tool for farmers to improve their knowledge of the latest agricultural innovations. One of them by using technology management system of *jajar legowo* system. The role of FCA agents in the adoption of *jajar legowo* system in this study covers:

1. The role of FCA agents in the field school of *jajar legowo* rice planting every planting season (demonstration plot).
2. The role of FCA agents in implementing the planting of *jajar legowo* every planting season.
3. The role of FCA agent in evaluating the planting system of *jajar legowo*

every planting season.

4. The role of FCA agents in the follow-up to the benefits of planting rice using *jajar legowo* system.

Respondents of rice farmers of FCA role in the adoption of *jajar legowo* system can be known through the highest responder respondents in each item namely:

1. *The role of FCA in the demonstration plot system of* jajar legowo *every planting season.* 43 respondents of rice farmers of *jajar legowo* system consisting of 10 person in Beginner Class, 15 person in Advanced Class, 8 person in Middle Class, and 10 person in Primary Class gave a statement that FCA is quite instrumental in holding demonstration plot of *jajar legowo* system by 58.0 %.

2. *The role of FCA in implementing* jajar legowo *system*. 40 respondents of rice farmers of *jajar legowo* system consisting of 10 person in Beginner Class, 15 person of Advanced Class, 5 person of Middle Class, and 10 person of Primary Class gave a statement that agricultural extension is quite instrumental in doing the application of *jajar legowo* system by 54.05 %.

3. *The role of FCA in evaluating the planting* jajar legowo *system every planting season*. 32 respondents of rice farmers of *jajar legowo* system consisting of 9 person of Beginner Class, 11 person of Advanced Class, 2 person of Middle Class, and 10 person of Primary Class gave a statement that the agricultural extension is less to evaluate the *jajar legowo* system each planting season by 43.24 %.

4. *The role of FCA in the follow up* jajar legowo *system*. 48 respondents of rice farmers of *jajar legowo* system consisting of 10 person Beginner Class, 15 person of Advanced Class, 13 person of Middle Class, and 10 person of Primary Class gave statement that agricultural extension often play a role in follow-up *jajar legowo* system by 64.0 %.

The results of descriptive analysis of the question items about the role of counseling in the adoption of technology planting of *jajar legowo* system can be concluded that FCA is quite instrumental in adopting the technology of *jajar legowo* system by 55.0 %.

***Analysis of Rice Farmers Income Before and After Adopting* Jajar Legowo *System*.** The adoption of technology of *jajar legowo* system gives real earning increase in every class of farmers. Income level of rice farmer who adopt *jajar legowo* system for each class are different and explained as follows (Table 3).

1. Income level of 20 persons Beginner Class rice farmers before adopting *jajar legowo* system is 2815 thousand Rp, and increase to 5709 thousand Rp – after adopting *jajar legowo* system.

2. Income level of 15 persons Advanced Class rice farmers before adopting *jajar legowo* system is 3766 thousand Rp, and increase to 5795 thousand Rp – after adopting *jajar legowo* system.

3. Income level of 21 persons Middle Class rice farmers before adopting *jajar legowo* system is Rp 7510 thousand Rp, and increase to 11447 thousand Rp –

after adopting *jajar legowo* system.

4. Income level of 18 persons Primary Class rice farmers before adopting *jajar legowo* system is 9755 thousand Rp and increase to 13527 thousand Rp – after adopting *jajar legowo* system.

Table 3

Comparation Data of *Tegel* System and *Jajar Legowo* System of Rice Farming of 0.88 Ha Area

Description	Beginner Class		Advanced Class		Middle Class		Primary Class	
	Tegel	*Jajar legowo*	*Tegel*	*Jajar legowo*	*Tegel*	*Jajar legowo*	*Tegel*	*Jajar legowo*
Fixed cost (thousand Rp)	2285	2555	3057	3333	4522	4938	4225	4256
Variable cost (thousand Rp)	3400	4636	3927	5571	5968	6717	6020	7417
Total cost (thousand Rp)	5685	7191	6984	8905	10490	11655	10244	11673
GKG* production (kg)	3400	3700	4300	4900	7200	7700	8000	8400
Price GKG/kg	2500	3000	2500	3000	2500	3000	2500	3000
Income (thousand Rp)	8500	12900	10750	14700	18000	23100	20000	25200
Nett income (thousand Rp)	2815	5709	3766	5795	7510	11447	9755	13527

Note. * GKG is *gabah kering giling* (dried milled rice grain).

Source: author's data, 2017.

Based on this data, it can be explained that the income of rice farmers before adopting the *jajar legowo* system is 5962 thousand Rp and increase to 9120 thousand Rp after adopting *jajar legowo* system with land area 0.88 Ha. So it can be said that *jajar legowo* system need to be improved because it has significantly given increase of income for every farmer class.

The Influence of Age, Education, and Land Area. The influence of age, education, and land area as variables in *jajar legowo* system adoption can be seen through multiple linear regression analysis (Table 4).

Table 4

Coefficient of regression, t count, F count, significant and determination (R^2) for dependent and independent variables

Indexes	Coefficient regression	t count	F count	Significant	(R^2)
Constanta	6.995	3.309	21.122	0.001	0.475
Age (X_1)	0.191	1.486		0.142	
Education (X_2)	0.248	2.078		0.041	
Land area (X_3)	0.369	3.022		0.004	

Source: author's research.

Based on the value of the regression coefficient (b), and the constant (a), then the regression equation is:

$$Y = a + bX_1 + bX_2 + BX_3 + e$$

Adoption *jajar legowo* system = a + b · Age + b · Education + c · Land Area

Regression analysis results have been done, regression testing:

$$Y = 6.995 + 0.191X_1 + 0.248X_2 + 0.369 + e$$

To separate the significance of each independent variable to the unusable variable:

$$H_0 : b_1 = b_2 = b_3 = 0$$
$$H_1 : b_1 \# = b_2 \# = b_3 \# = 0$$

T test with significant t-test calculation result (t count) with the level of significance that is 0.05. Counting significant are as follows:

1. Age (X_1): Significance value is 0.142 > 0.05 then H_0 is accepted and H_1 is rejected which means that the age is not significant to adoption of *jajar legowo* system.
2. Education (X_2): Significance value is 0.041 which means that < 0.05, then H_0 is rejected and H_1 is accepted which means that the education is significant to adoption of *jajar legowo* system.
3. Land area (X_3): Significance value is 0.004 which means that < 0.05, then H_0 is rejected and H_1 is accepted which means land area is significant to adoption of *jajar legowo* system.

Thus it can be concluded that the more experienced or the older, the more the adoption rate of *jajar legowo* system. Increasing education level means increasing the adoption of *jajar legowo* system. Increasing land area means increasing the adoption of *jajar legowo* system.

The result of multiple linear regression shows that the value of R Square is 0.475 which means the remaining 0.525 % is explained by other factors outside the variables studied by the regression equation. The value of coefficient of determination (adjusted R^2) obtained 0.453 which means the remaining is explained by other factors outside the three independent variables.

Hypothesis testing. The *F test* results explain that the calculated F value of 21.122 > greater than (>) 0.05 is known that the significant value is 0.000 less than (<) the significance value of 0.05. This means simultaneously or simultaneously age, educational, and land area has a significant effect on adoption of *jajar legowo* system.

The *t test* is intended to determine the partial effect between the independent variables (X_1, X_2, X_3) and the dependent variable (Y). It is found that the value of *t* arithmetic in the known age is 1.486, educational is 2.078, and land area is 3.022. The significant value of the age is 0.142 > of significant value 0.05; the significant value of education is 0.041 < of significant value 0.05; and the significant value of land area is 0.004 < of significant value 0.05. The results of this *t test* show that partially there is a significant influence between education and land area, while age has no significant effect.

Conclusions. It is known that different class of rice farmers adopting *jajar legowo* system has different perceptions of FCA role regarding their work in counseling rice farmers to adopt *jajar legowo* system. Most of farmers (58.0 %) agrees that FCA is quite instrumental in holding demonstration plot of *jajar legowo*

system, quite instrumental in doing the application of *jajar legowo* system (54.1 %), less to evaluate the *jajar legowo* system each planting season (43.2 %), and often play a role in follow-up *jajar legowo* system (64.0 %).

It is also found out that by adopting *jajar legowo* system, rice farmer income has increased. The income of rice farmers before adopting the *jajar legowo* system is 5962 thousand Rp and increase to 9120 thousand Rp after adopting *jajar legowo* system with land area 0.88 Ha. *Jajar legowo* system needs to be improved because it has significantly given increase of income for every farmer class.

Factors that have significant influence on adoption of *jajar legowo* system are education and land area, but age has no significant influence. The more experienced or the older, the more the adoption rate of *jajar legowo* system. Increasing education level means increasing the adoption of *jajar legowo* system. Increasing land area means increasing the adoption of *jajar legowo* system.

In this research, we studied only application of *jajar legowo* system and its benefits. Management and economic impacts were not discussed. This research also does not take into account whether field Agricultural Counseling varies in different areas. Based on these limitations, a future research of other factors affecting an adoption of *jajar legowo* system could bring important results to regional development.

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