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ANALYSIS OF FACTORS AFFECTING ADOPTION OF INTEGRATED CROP MANAGEMENT FARMER FIELD SCHOOL (ICM-FFS) IN SWAMPY AREAS

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Abstract

The main target of Integrated Crop Management Farmer Field School (ICM-FFS) development is to boost rice production in order to accelerate the achievement of sustainable rice self-sufficient in Indonesia. Nevertheless, aside from its achievements, as an approach it was not fully effectual for farmers. The study aims at analyzing factors influencing the adoption of ICM-FFS at swampy lands using survey and stratified random sampling approaches with involving total respondents of 159 people. Analysis the adoption factors were estimated by logistic regression model. Variables significantly affected the level of improvement opportunities of adoption were age, education, distance to agricultural technology information sources, distance to the meeting place and productivity. Among these variables, productivity level was as the main consideration of the farmers to adopt the ICM-FFS program. Therefore, the continuously effort to improve rice productivity should be taken into account as the priority to encourage more farmers to adopt this program. The opportunities for farmers to adopt this program are also expected to be even wider when efforts to increase productivity are also accompanied by efforts to improve quality and increase efficiency of inputs uses.

Keywords: *ICM FFS, adoption, internal factor, swampy lands*

1. Introduction

Implementation of Integrated Crop Management Farmer Field School(ICM-FFS) is one of the efforts managed by the Ministry of Agriculture to boost rice production in Indonesia. It was basically an approach in accelerating the process of technology transfer through a learning process directly from a field laboratory (MoA, 2010), participatory and non-formal learning(Van de Fliert, 2007)as well as engaging farmers as the main subject of that activity (Asiabaka, 2002). It has been applied in many types of agro-ecosystem in which are not only developed in irrigated land but also in swampy land areas. The main reason of ICM-FFS development program in swampy lands is up to now the swampy land has not been used intensively and optimally. It indicated by its productivity is low. In fact, with proper management (good agricultural practices implementation), it has good enough potential to support the improved provision of the national rice production (Sudana, 2005).

During implementation, its success could be seen in several locations as indicated by the increased in rice productivity of around5.91%in 2010(MoA, 2010). However, as an approximation, ICM-FFS was not fully effective for farmers to improve their rice productivity (Jamal, 2009). This happened due to not all technology components of ICM-FFS were applied and adopted by farmers with adoption rates also differ among farmers(Muharam, 2010). This phenomenon also happened in the case of ICM-FFS rice in tidal and swampy lands. Some previous researches showed that factors influencing adoption of a technology are such as the recipient factors of innovation(farmers' characteristics) (Ani et al., 2004;Diederen et al., 2003;Sambodo & Nuthall, 2010;Morris & Doss, 1999; Rogers, 1995)the nature of innovation, social influence and communication resources available (Rogers, 1995). Studies of innovation were generally more focused on the efforts to explore the factors influencing the level of an innovative technology adoption (Feder et al., 1985); Sunding & Zilberman, 2000). Therefore, it has become important to increase productivity as it was not only determined by the technology itself but also influenced by the level and speed of adoption of farmers. Thus, the study to explore the factors affecting the level of adoption of ICM-FFS approach will be essential in attempting to improve its performance implementation in the future.

Referring to those obstacles above, it needs to analysis factors affecting of ICM-FFS adoption. Therefore, this paper was focused on the discussion of the factors recipients' innovation (farmer field school participants) that significantly affected the adoption level of ICM-FFS especially in the case study of ICM-FFS in Riau and West Kalimantan Provinces as source of rice production growth in the future.

2. Methodology

The study was conducted in 2012inSiakandIndragiriHilir Regencies Riau Province and Pontianak Regency, West Kalimantan Province (Figure 1).

Figure 1. Map of Indonesia Showing the Study Areas (Riau and West Kalimantan Provinces)

The data were collected by a survey using a structured questionnaire. Selection of farmer respondents was conducted by a stratified random sampling approach. At the first step, the farmers were segregated into two groups namely ICM-FFS and non ICM-FFS farmers. In each group, then the farmer was selected randomly. The number of respondents for Riau Provincewas80 farmers that consisting of 40 ICM-FFS farmers and 40 farmers of non ICM-FFS, respectively, whereas in West Kalimantan Province was 79 farmers that consisting of 40ICM-FFS farmers and 39 farmers of non ICM-FFS, respectively. Therefore, the total farmer-respondents were 159 persons. The collected data was analyzed by employing descriptive and qualitative approaches in particular the variable data of respondents' characteristics, whereas to estimate the chances of ICM-FFS adoption was estimated by using logistic regression models by the following equations (Gujarati, 1999):

$$Ln = (\frac{P_i}{1-P_i}) = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8$$
$$+ a_9X_9 + a_{10}X_{10} + a_{11}X_{12} + a_{13}D_{13} + e_i \quad (1)$$

$$Z_i = (\frac{P_i}{1-P_i}) = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8$$
$$+ a_9X_9 + a_{10}X_{10} + a_{11}X_{12} + a_{13}D_{13} + e_i \quad (2)$$

$$Z_i = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8$$
$$+ a_9X_9 + a_{10}X_{10} + a_{11}X_{12} + a_{13}D_{13} + e_i \quad (3)$$

$$D_1 \begin{cases} 1 \ if \ ICM - FFS \\ 0 \ if \ non \ ICM - FFS \end{cases}$$

Annotation:
P_i = probabability of ICM-FFS was adopted
$(1 – P_i)$ = probabability of ICM-FFS is not adopted
Z_i = changes due to changing probability of ICM-FFS adoption variables
X_1 = lnage of respondents (year)
X_2 = lnformal education (year)
X_3 = lnrice farming experience of farmer(year)
X_4 = lnfamily size (persons)
X_5 = lnaverage size of land holding(ha)
X_6 = lninvolvement in the group (measured by frequency of attendance at meetings/times)
X_7 = lnriceproduction cost (IDR/ha)
X_8 = lnriceproductivity (kg/ha)
X_9 = lndistance to farmlandrice(km)
X_{10}= lndistance to production input market (km)
X_{11}= lndistance to output market (km)
X_{12}= lndistance to source of agricultural technology information (km)
e_i = error term

Positive coefficient of the independent variable (Xi) indicated that the increased value of the variable leads to the probability of ICM-FFS adoption increasing and vice versa if the coefficient is negative.

3. Results and Discussion

3.1. Variability of family members

Characteristic of respondents was important to be revealed because it was one of the major variables affecting the adoption degree of innovation including the adoption of ICM-FFS. The interesting characteristics to be analyzed are rice farming experience, varying ages and family size, educational level, main occupation, sources of income and holding of land size both for ICM-FFS and non ICM-FFS farmer-respondents.

Based on data analysis, the average age of respondents were 46 years for ICM-FFS and 43 years for non ICM-FFS, respectively. Thus, the average age of the farmer-respondents in both categories was still in the productive age group. This condition indicated that there was an opportunity to enhance the performance of rice productivity through applying ICM-FFS technology in those study areas. At bearing age, the respondents had a longer opportunity to improve technology through the adoption of technological innovations suggestions including the introduction of ICM in the case of rice as well as the age of the wife with the average age was 41 years and 38 years for ICM-FFS and non ICM-FFS respectively. The wife can play a double role as housewives on one side, and the other side as the recipients of innovation, and the chances to apply the technology together with the head of the family (husband) was very released (Table 1).

Table 1. Variability characteristics of farm households both of ICM-FFS farmers and non ICM-FFS in study areas, 2012

No	Variables	Average	
		ICM-FFS	non ICM-FFS
1	Age of respondents (year)		
	a. Husband	46	43
	b. Wife	41	38
2	Rice farming experience (year)	22	20
3	Number of dependents (persons)	4	4
4	Formal education (year)		
	a. Husband	7	7
	b. Wife	7	6
	Average size of land holding (ha)	1.17	0.83
	Livelihoods and the main source of livelihood	Rice cultivation	Rice cultivation

Source : Primary data (processed)

From the experience in managing rice farming, it was illustrated that in general the respondents had long experience to cultivate rice or it was hereditary farming, i.e., more than 20 years. This situation could indicate that the respondents had enough knowledge and experiences in rice farming activity and mastered on its technology. Farming experience could be an opportunity to support in promoting of new technologies including ICM-FFS because rice technology basically was not a new technology and it was not contrary to the habits of the farmers. However, this phenomenon could not be a guarantee that the degree of adoption was high and generated production at higher levels.

Table 1 showed that the number of dependents in both groups of farmers and non ICM-FFS was about 4 people per household respectively. It is not only illustrating the large number of people who had been financed but it could also be viewed as the potential main

provider of family labor in rice farming. Besides the head of the family, potential sources of family labor were a wife and children. The existence of family labor could also reduce the need of hired labor (non-family labor). It is potential to reduce the cost of rice production.

Factor of formal educational background is also interesting to be assessed since it is dealing with the attitudes and acceptability of respondents to information, including ICM-FFS. The analysis results of this study the showed that the average education of respondents ranged from 6 to 7 years (graduate school). Although it was not very high, at least the respondents could read and write a new technology introduced. Therefore, the respondents were still able to properly receive the information or to decide to adopt a new agricultural technology innovation. Land tenure mainly for agricultural land was very essential for farmers. The land was the main asset owned by farmers besides livestock, vehicles or homes. The amount of land acquisition would affect the total cost of production and income. The average size of landholding of ICM-FFS and non ICM-FFS were around 1.17 ha and 0.83 ha respectively. This amount was relatively high when compared with national level, which is less than 0.5 ha. Meanwhile, rice cultivation was the main livelihood and source of income for two groups of farmer.

3.2. Implementation Level of Technology Components and Reason

The number of farmers who implemented each of ICM technology components was quite diverse. For brief description, technology components mostly implemented by respondents were new superior varieties (NSV), high quality and labelled seeds as well as handling harvest and post-harvest properly by more than 90%. The highest level of implementation was related to the ability of these three technology components. According to farmers, NSV, labelled seeds as well as harvest and post-harvest handling technology components could support the improvement of rice production so that the farmers tended to adopt. Most of respondents chose the higher production aspect as a main reason (by 65%) compared with easily to apply and other reasons (Table 2).NSV generally had the higher potential yield of about 5% (IAARD, 2005). Moreover, it was part of influential and ground breaking technologies to improve productivity(Sembiring, 2008; Suhendrata, 2008).

Table 2 showed that the components of the other technologies also being applied by many farmers were land preparation, planting 1-3 stems per hole and integrated pest management that were adopted by around 87%, 79%and 75% of total farmer-respondents, respectively. The highest percentages of the application of these three components were also based on the same reason that is increased yield as indicated by about 60% of farmer-respondents. Furthermore, the components that were not widely implemented by the farmers were watering and weeding activities of by less than 10%. It was closely associated with the farmers' habit in swampy land areas those depended on the condition of river water or seawater, so that farmers tended not to apply water management technologies properly. In addition, the weeding technology in particular using a weeding tool was not also widely adopted because it was difficult to apply in the swamp lands which were likely to continue to stagnate and the texture was not as dense as irrigated land.

Low level of implementation in some technology components might be due to some constraints such as a lack of guidance for agricultural extension workers caused farmers were less accessible to sources of information, or the dissemination approaches used by the extension workers were not fully appropriate or fit with farmers' condition. Thus, these results can be used as the basis of the need to optimize the performance of educators, to enhance the farmers' accessibility of information resources as well as to improve the dissemination approach.

Table2. Percentage of farmers who implemented ICM components and its reasons in study areas, 2012

ICM components	% farmers who implemented	Reasons		
		Higher production	Easily to apply	Other reasons*)
New superior varieties	96.2	71.4	7.10	21.4
High quality and labeled seeds	94.9	78.0	6.0	16.0
Organic matters	57.7	60.0	8.60	31.4
Crop population managements ("legowo")	51.3	34.1	17.1	48.8
Fertilizing	47.4	59.3	3.7	37.0
Integrated pest management	75.6	61.4	2.3	36.4
Land preparation	87.2	60.0	4.4	35.5
Planting young seedlings	56.4	65.5	0.0	34.5
Planting 1-3 stems per hole	79.5	60.5	0.0	39.5
Watering plants effectively and efficiently	7.7	100	0.0	0.0
Weeding plant	5.1	33.3	0.0	66.7
Handling harvest and post-harvest properly	96.2	67.9	0.0	32.1

Note:*)a combination of reasons just want to try, follow the advice of group/extension staff and technology already available in the village
Source :primary data (processed)

3.3. Factors Affecting Adoption of the ICM Components

Development of ICM-FFS rice was expected not only adopted by its participants or farmers whom their home is close to the location of the learning process(field laboratory and/or meeting place) but also by farmers outside the scholar the farmers surrounding. In fact, many aspects influenced the degree of adoption and one of them was characteristics of farmers besides infrastructure and advantages of technology introduction. The analysis results of the factors affecting the probability of ICM-FFS adoption were presented in Table3. The coefficient of each estimated parameter showed that whether the adoption probabilities of ICM-FSS were increasing or not. It appeared that over all the variables included in the model were strongly influencing the adoption as indicated by value of Chi2was significantly different at the 1% probability level (Pro>chi2=0.0016). However, the included variables in the model could not better explain the variation of the probability degree of ICM-FFS adoption as is shown by the value of Pseudo R2 of less than 60%.

Variables farming experience of the household head(X3) and the number of family members(X4), respectively, had appositive estimated coefficient toward the probability of adoption, but it was not significant at the5% probability level. Numbers of family members also significantly affect the adoption of variety at level 10%(Ntege-Nanyeenya et al., 1997). The age variables (X1) and educational level (X2) had a positive estimated coefficient and significant at 5% probability level to increase probability of adoption. It means that more mature of age and higher education of farmers then their response to the new technology was also higher as demonstrated by the increasing of opportunities for them to adopt ICM-FFS. Increasing age and education level by one year, for instance, then the chances they are going to adopt ICM-FFS program has risen of by 2.04%and 0.35%, respectively. The more productive of age, they tended to be more eager to learn and know about new knowledge so

that it could accelerate the process of transferring and adoption of technology (Kusmiati et al.,2007).Likewise, the higher education respondents, their attitudes and thoughts were usually more open, rational and able to analyze the benefits or advantages of the technology so that it made much easier to introduce a new innovation that it ultimately affected the adoption process(Kusmiati et al., 2007;Suharyanto et al., 2005;Isgin et al., 2008).These results were consistent with research on study of the determinants of adoption of maize technology in Uganda which was significant at the 10% level(Ntege-Nanyeenya et al., 1997)which was also expressed in the adoption of precision agriculture research (Daberkow & McBride, 2003)as well as in adoption of organic fertilizer using t-test (Susanti et al., 2008). Nonetheless, these results were not in line with the research on technology adoption system of rice intensification(SRI) in which the factors of age and education level did not significantly affect the adoption of SRI(Ishak & Afrizon, 2011)and implementation of organic fertilizer (Susanti et al., 2008).

Table 3. Logic analysis results to demonstrate the factors that influence the adoption of ICM-FFS inswamp rice fields in Indonesia, 2012

Explanatory variables	Alleged parameter	Odds ratio
Intercept	-18.23856 (4.64587)	
Farming experience (X_3)	0.2917007[NS] (0.314716)	1.338702 (0.421311)
Number of dependents (X_4)	0.4311367[NS] (0.5043626)	1.539006 (0.776217)
Age of household (X_1)	2.041514** (0.9074349)	7.702265 (6.989304)
Education level (X_2)	0.7466354** (0.3466058)	2.102265 (0.7312999)
Distance to production input markets (X_{10})	0.1768795[NS] (0.1588392)	1.193487 (0.1895726)
Distance to output markets (X_{11})	-0.0313509[NS] (0.1817711)	0.969135 (0.1761608)
Distance to source of information (X_{12})	-0.2722512* (0.1600435)	1.312917 (0.2101238)
Distance to meeting place (X_9)	-0.4629516** (0.1960895)	0.629423 (0.1234233)
Size of land holding (X_5)	0.0116362[NS] (0.2339659)	1.011704 (0.2367043)
Productivity (Y)	0.9029249*** (0.3369886)	2.466808 (0.8312862)
Prob> chi^2	0.0016***	
Pseudo R^2	0.1283	
Number of samples (n)	159	

Note:***, ** and * indicate significant at 1%, 5% and 10% probability levels, respectively Ns is not significant within the 10% level of significance, Figures in parentheses are the standard errors
Sources: primary data (processed)

Distance to production input markets did not significantly affect the probability of adoption at 10% probability level. Further, it could be interpreted hat adoption of the technology was not strong/significantly affected by the location of the input markets, but it was more influenced by the accessibility of farmers' inputs. Accessibility of farmers could be represented by the purchasing power level and input available as well as the responsiveness/to what extent of farmers' knowledge level about the importance of input uses in the production process. In addition, some research results indicated that the composition of input costs such as fertilizers; seeds and pesticides generally less than 40% of total production costs. Conversely, the highest portion of the production cost was labor input of about 30%-50% of total production cost. The same thing happened at a distance of output markets, where this variable was not significant at 10%probability level. The analysis showed that the farther of the output market distance from farmer's location, the lower chances of ICM-FFS to be adopted by rice farmers, but it was not significant at 10% probability level. It was allegedly related to the increased farmers' access to various information sources of output prices (not only rely on market)as well as the generally made farmers sell rice in the fields or at home(traders who came) therefore the farmers did not have to carry and sell their produce to the output market. In some cases, farmers also sold their rice to rent seeker. These results were consistent with a study using a meta-regression analysis conducted by (Rubas, 2004)that showed outreach was not important aspect influencing adoption in farmer level

The different effect was encountered in the distance to the source of information technology like research and extension institutes and the distance to the laboratory field. Logic analysis results showed that the greater distance had an impact on the decline in the level of adoption probability and significant at 10% and 5% probability levels, respectively. In other words, the closer distance between the location of information technologies sources and the meeting place to farmer's home, it would increase the probability of the farmers to adopt ICM-FFS program.

Extensive of land holdings had no significant effect on the degree of ICM-FFS adoption probability. It was indicated by the insignificance of estimated parameter of this variable was until at 10% probability level. The result was in line with other studies stating that the increased ownership of assets had no significant effect on adoption(Kusmiati et al., 2007;Rubas, 2004).However, these findings were not consistent with the other studies mentioned that land holdings significantly influenced the adoption at the5%of significance level (Daberkow & McBride, 2003).Meanwhile, the productivity of the land due to apply the ICM-FFS technology had been one of very strong consideration for farmers in making decision to adopt this technology. This proven by the estimated coefficient of this variable was significant at 1% probability level. It means that if the introduced technology is able to show its advantages through yielding higher productivity than of those existing practices, its chance to be adopted by farmers is also increasing. Furthermore, from the estimated coefficient, it can be interpreted that every increasing of productivity of 1 kg that can be showed by introduced ICM-FFS, then the probability of farmers to adopt it was increasing of by 0.9%.

4. Conclusion

From the above information it can be concluded that even though in general farmers applied the components of technology of ICM-FFS, but the implementation of some particular components was not completely optimal yet. This supposed as the cause of the performance of ICM-FSS was not as expected. Therefore, it is needed to redesign and modify some technology components of ICM-FFS based on farmer's problem, needs, and social.

The variables significantly affected the improvement degree of ICM-FFS probability adoption at farmers level were age and education level of respondents, distance to agricultural technology information sources, distance to the meeting place and the level of productivity. However, from these variables, it seemed that the level of showed productivity was the main driver movement to increase the adoption level of ICM-FFS. It means that the capability of ICM-FFS farmer technology yields higher productivity than existing practices was as the main reason of the respondents in deciding to adopt the being developed ICM-FFS in the study areas. Therefore, this condition could be used as a basic consideration in designing new innovative technology. The opportunities for farmers to adopt this program were also expected to be even wider when efforts to increase productivity were also accompanied by efforts to improve quality and to increase efficiency of production inputs uses, as well as it developed bases on local resource advantages.

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References

Ani, A. O., Ogunnika, O., & Ifah, S. S. (2004). Relationship between socio-economic characteristics of rural women farmers and their adoption of farm technologies in Southern Ebonyi State, Nigeria. *International Journal of Agriculture & Biology*, 6(5), 802–805.

Asiabaka, C. (2002). Promoting Sustainable Extension Approaches: Farmer Field School (FFS) and its role in sustainable agricultural development in African. International *Journal of Agriculture and Rural Development*, 3, 46–53.

Daberkow, S. G., & McBride, W. D. (2003). Farm and Operator Characteristics Affecting the Awareness and Adoption of Precision Agriculture Technologies in the US. *In Precision Agriculture* (Vol. 4, pp. 163–177). The Netherlands: Kluwer Academics.

Diederen, P., van Meijl, H., Wolters, A., & Bijak, K. (2003). Innovation Adoption in Agriculture: Innovators, Early Adopters and Laggards. *In Cahiers d'économie et sociologie rurales* (Vol. 67, pp. 29–50). Wageningen University and Research Centre, Agricultural Economics Research Ins- titute (LEI), P.O. Box 29703, 2502 LS The Hague, The Netherlands.

Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A Survey. *In Economic Development and Cultural Change*.

Gujarati. (1999). *Basic econometrics*. Jakarta: Erlangga.

Indonesian Agency for Agricultural Research and Development. (2005). Prospects and direction of agribusiness development of rice. Indonesia: Indonesian Agency for Agricultural Research and Development. Ministry of Agriculture.

Isgin, T., Bilgic, A., Forster, D. L., & Batte, M. T. (2008). Using count data models to determine the factors affecting farmer's quantity decisions of precision farming technology adoption. *Computer and Electronic in Agriculture, 62*, 231–242.

Ishak, A., & Afrizon. (2011). Perception and adoption rates of farmers on the application of the system of rice intensification (SRI) in Bukit Peninjauan I, Talbot Sub district, Seluma District. *Journal of Agricultural Informatics, 20*(2), 76–80.

Jamal, E. (2009). Assessment of farmer field school in intergrated crop management of rice commodity: Case study in Blitar and Kediri Regency, West Java. *Journal Policy Analysis, 7*(4), 377–349.

Kusmiati, I., Subekti, U., & Windari, W. (2007). Adoption of livestock farmers against implementation of artificial insemination in goats nuts in Sawahan sub district Madiun Regency, East Java. *Journal of Agriculture Sciences, 3*(1), 36–47.

Ministry of Agriculture. (2010). Guidelines to implement farmer field school of rice, maize, soybean and peanut. Indonesia: General Directorate of Food Crop. Ministry of Agriculture.

Morris, M. L., & Doss, C. R. (1999). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. Presented at the he Annual Meeting, American Agricultural Economics Association (AAEA), Nashville, Tennessee.

Muharam, A. (2010). Evaluation characteristic of agriculture technology innovations.

Ntege-Nanyeenya, W., Mugisa-Mutetikka, M., Mwangi, W., & Verkuijl, H. (1997). An assessment of factors affecting adoption of maize production technologies in Iganga District, Uganda. Addis Ababa, Ethiopia: National Agricultural Research Organization (NARO) and International Maize and Wheat Improvement Center (CIMMYT).

Rogers, E. M. (1995). Diffusion of innovations (Fourth Edition). New York: Free Press.

Rubas, D. (2004). Technology adoption: who is likely to adopt and how does the timing affect the benefits? Office of graduate studies of Texas A&M University.

Sambodo, L. A. A. T., & Nuthall, P. L. (2010). A Behavioural approach to understanding semi-subsistence farmers' technology adoption decisions: the case of improved paddy-prawn system in Indonesia. *Journal of Agricultural Education and Extension, 16*(2), 111–129. doi:10.1080/13892241003651373

Sembiring, H. (2008). Policy research and a summary of the Indonesian Center for Rice Research research in support of national rice production. In Seminar appreciation of increasing national rice production program support rice research. Sukamandi: Indonesian Center for Rice Research.

Sudana, W. (2005). Potency and prospect of swamp lands as agriculture production sources. *Journal Policy Analysis, 3*(2), 141–151.

Suharyanto, Destialisma, & Parwati, I. A. (2005). Factors influencing technology adoption of direct seeding ("tabela") in Bali Province. In Proceedings of the National Seminar. Correctional Efforts Accelerate Innovation Technology In Agriculture and Rural Revitalization in Marginal Land (pp. 122–128). West Nusa Tenggara.

Suhendrata, T. (2008). The role of agricultural technology innovation in increasing rice productivity in support of food security. In Proceedings of the National Seminar on Agricultural Engineering. Yogyakarta.

Sunding, D., & Zilberman, D. (2000). The agricultural innovation process: Research and technology adoption in a changing agricultural sector. In B. L. Gardner & G. C. Rausser (Eds.), *Handbook of agricultural economics* (Vol. IA). Amsterdam: Elsevier.

Susanti, L. W., Sugihardjo, & Suwarto. (2008). Factors affecting decision making rice farmers in the application of organic agriculture in Sukorejo village, Sambirejo sub district, Sragen district. Agritexts, 24.

Van de Fliert, E. (2007). Communication and sustainable rural development. Communication for Social Change (pp. 85–96). Queensland: Communication for Social Change Faculty. Queensland University.