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The Influence of Innovation Characteristics to Farmers' Decision in Accepting Integrated Crop-Livestock Technology in Karanganyar Region, Central Java

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ABSTRACT

Farmer's decision in accepting integrated crop-livestock farming technology was affected by a some factors, including innovation characteristic. This research aimed to figure out the influence of innovation characteristic (relative advantage, compatibility, complexity, triability and observability) to farmer's decision in adopting the innovation. The research was held in Ngargoyoso Subdistrict, Karanganyar Region, Central Java Province. Basic method used in this research was descriptive quantitative using purposive sampling technique to determine research location. Samples were determined using purposive sampling method with total number was 52 respondents. Data were analyzed using several analysis : data normality, validity, reliability, Oneway ANOVA, multiple linear regression and classic assumption. Oneway ANOVA test showed that farmers with different farming experience had different response in deciding to adopt the technology. Multiple linear regression test gave an equation Y = 2.379 + 0.369X_1 + 0.213X_2 + 0.080X_3 + 0.777X_4+ (-0.320X_5) + e. The determination coefficient value (R^2) is 0.647. The conclusion of this research was characteristic of innovation significantly influenced the farmers' decision in accepting the integrated crop-livestock technology simultaneously, but partially only variable relative advantage and triability which significantly influenced to farmers' decision in accepting the integrated crop-livestock technology innovation.

Keywords: Farmers' decision, Innovation characteristic, Integrated crop-livestock

Introduction

Agricultural sector mainly consists of crop and livestock in an integrated and complementary system. Crop-livestock integrated systems are an integrated system between plants and livestock that has the purpose of utilizing waste from one another (Hilimire, 2011). Integrated farming development with livestock sub sector produces several advances such as increase crop production, increasing soil fertility, reduce farmer's cost production and improve environment sustainability was generally a strategic program that needed to be developed through integrated farming system. In fact, crop and livestock sectors were an integrated union that could not be seperated and was a compliment to one another.

Ngargoyoso Subdistrict was part of Karanganyar District area which had many potentials in developing beef cattle farm. Based on Karanganyar District government data on natural resource in husbandry in 2013, there were 5.089 cows in Ngargoyoso Subdistrict with average meat production of 314.523 kilograms per year. Most of farmers in Ngargoyoso Subdistrict had farm fields used to plant crops and horticulture. Ekowati *et al*. (2018) clarified that one of the potential agricultural commodities with an economic value to be developed is beef cattle, nevertheless the farmer's households which generally focused on crop farming or livestock only, not integrated each other. The integration between cattle and crops is generally constrained by the production factors availability, land size and capital (Basuni *et al*., 2010). According to Biniaz *et al*. (2014) stated that increased in the cultivation area of crops, the marginal productivity and average labor has increased. Therefore, the farmers should find the alternative way to reduce cost of production.

Nowadays farming sector played a big role in regional economy development, but farmers' average income was relatively low and some of them were poor. The problem occurred because farming activity done by rural farmers has not been organized well, has not set priority and economic scale, and had in optimum technology implementation (Yulmar *et al*., 2011). Bakhshinejad (2015) argued that the development could achieved through enhancement of agribusiness pattern, especially improvement of production's quality and quantity, diversification of superior commodities, improvement of products' value-added, capital and expansion of market share. Farmers as economic actors always tried to increase their income from their farming activity. Integrated crop-livestock system gave even income for farmers and supported their prosperity and the society as well (Youngberg and Harwood, 1989). According Munandar *et al*. (2015), the pattern of integration of livestock with food crops or crop-livestock system (CLS) is able to guarantee the sustainability of and productivity through the sustainability of existing natural resources. Each mature cow can produce 4-5 kg of organic fertilizer/day after processing, on the other hand each hectare of rice field produces fresh straw 12-15 tons/ha/ season and after fermentation process is produced 5-8 ton/ha. The straw can be used as beef feed about 2-3 head/year.

Randall (2003) cited four positive factors associated with livestock being integrated into cropping enterprises: (1) crops produced on the farm can be used to feed the livestock, thus minimizing the importing of outside feedstuffs in livestock production; (2) livestock manure can serve as the primary source of nutrients for crop production, thereby cycling nutrients from the crops through the animals and back out onto the land; (3) livestock can serve as the sink for agricultural byproducts; and (4) ruminant livestock encourage the establishment of perennial grass and legume forages as a primary feedstuff. An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels (Gupta *et al*., 2012). Integrated crop-livestock systems are farms where animals and crops are raised with the goal of utilizing the products of one for the growth of the other. For example, animal waste can be applied to fields for crop nutrient acquisition, forage crops can be cultivated for animal consumption, and livestock can be utilized to manage invertebrate pests of crops (Hilimire, 2011).

Grazing livestock on crop residues after the grain has been harvested represents one of the simplest and most economical methods for producers to integrate livestock into grain crop rotations (Boonyanuwat *et al.,* 2016). Apart from the adoption of crop technologies, by integrating and using crop-livestock farm linkages, farmers can make more efficient use of their marginal land with less chemical fertilizers, improve their economic gains substantially, and achieve a more sustainable agricultural production system (Rundengan *et al*., 2013).

An important component of implementing any conservation action on farms is to investigate what factors might affect the adoption of new farming strategies. Farmers carry out their production activities in localized and diverse ways (Chambers, 1997). They accept interventions consistent with their existing values, past experiences, and needs (Rogers, 1995). Yet any intervention even slightly different from what the farmers do currently may be viewed by them as an innovation and approached with skepticism, uncertainty, and preconceptions (Mapila, 2011). Each farmer considering a new technology has a different objective for profitability that is dependent on resources at his or her disposal (e.g., land, labor, machinery, credit); different levels of knowledge and skills; and different attitudes toward profit, risk, and the environment (Rousan, 2007).

Adoption of Integrated crops-livestock system is not an easy option for farmers and it carries with it several barriers (Purnomo *et al*., 2019). These barriers could be technical, economic, social, cultural or legal (Kaufmann *et al*., 2011). Akudugu *et al*. (2012) also concluded that dealing with issues of social and cultural viability of crop-livestock production more comprehensively, it would overcome a major obstacle for conventional producers and could result in higher rates of conversion. Therefore, some efforts were needed to change rural farmers' behaviour in handling their farms into crop-livestock linkages, and they could be delivered in some counseling and training. The success of an innovation could be seen from how many targets adopted the innovation. An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. The characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption (Rogers, 1995). The characteristics which determine an innovation's rate of adoption are: (1) Relative advantage; (2) Compatibility; (3) Complexity; (4) Trialability; (5) Observability.

Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes. The degree of relative advantage may be measured in economic terms, but social prestige, convenience, and satisfaction are also important factors. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. An idea that is incompatible with the values and norms of a social system will not be adopted as rapidly as an innovation that is compatible. Complexity is the degree to which an innovation is perceived as difficult to understand and use. Some innovations are readily understood by most members of a social system; others are more complicated and will be adopted more slowly. Trialability is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the installment plan will generally be adopted more quickly than innovations that are not divisible. Observability is the degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it (Robinson, 2009).

Integrated crop-livestock as an innovation need to be examine how much influence of innovation characteristics to farmers' decision. Therefore, this research aimed to analyze influence and relationship between the five innovation characteristic (relative advantage, compatibility, complexity, trialability, observability) to farmers' decision to adopt the innovation of integrated farming technology in Ngargoyoso Subdistrict, Karanganyar Region.

Materials and Methods

Research site and sample

The research was done in Ngargoyoso Subdistrict, Karanganyar Region. Method used to determine research location was purposive sampling (Muhidin dan Abdurahman, 2007). The locations were chosen because of their regional potential which most of the population in Ngargoyoso sub-district were farmers who also had beef cattle. Ngargoyoso sub-district has enormous potential for the implementation of integrated crop-livestock technology because it has a large population of beef cattle and plant waste for livestock but has not been well integrated. A survey in Ngargoyoso Subdistrict, Karanganyar District was done by asking questions using questionare to respondents with Likert scale from 1 disagree to 5 very agree. Primary data were obtained from interview with and questionare filling by 52 respondents. The respondents used as samples were representatives of members of livestock groups in the Ngargoyoso sub-district who were invited to the training program on crop waste processing technology as animal feed conducted by researchers. Secondary data were gained from related institutions, literature study and pubicated research results. Sample determination was using purposive sampling method; samples were taken from population elements which has data that were easily taken due to the abundant proper respondents (Darmawan, 2013).

Data analysis

This study seeks to determine the factors that influence adoption of integrated crop-livestock technology using the theory of diffusion of innovation (DOI) by Rogers (1995). Rogers indicates that there are 5 variables characteristic of innovation that can influence technology adoption, namely (1) Relative advantage; (2) Compatibility; (3) Complexity; (4) Trialability; (5) Observability. Relative advantage is that innovation is perceived as better than the idea it supersedes. The compatibility is considered as being consistent with existing values, past experiences, and needs of potential adopters. Complexity is considered as difficult to understand and use. Trialability is an innovative method that can be experimented with on a limited base. Observability is the results of innovation are visible to others.

Data analysis used *Software SPSS* 22 *for windows.* Data normality test was a test to measure whether the data had normal distribution so that could be used in statistic (Ghozali, 2009). Validity test was used to measure whether a questionare was valid or not. A questionare was valid when the questions were able to reveal intended things (Ghozali, 2009). Reliability was a scale to measure whether a questionare which was an indicator of a variable. A variable was reliable when the value of *Cronbach Alpha* was > 0.6. Reliability coefficient was calculated using Alpha coefficient (Algifari, 2003).

The data analysis used in this study are descriptive analysis, oneway ANOVA and Multilinear regression. Descriptive analysis aimed to describe a situation, an occurrance or a relation between phenomena, to predict and to implicate a certain problem (Syamsu *et al*., 2013). Oneway ANOVA analysis is used to determine the differences between the demographic characteristics of respondents in integrated crop-livestock adoption decisions, while multilinear regression analysis is used to determine the effect of each variable characteristic of innovation on the adoption of integrated crop-livestock system technology decisions. Oneway Analysis of variance or Oneway ANOVA was a parametric test to differenciate an average value from two or more groups of characteristics demographics data by comparing their variances (Ghozali, 2009). Regression analysis was used to figure out perception of innovation characteristic to farmers' decision in adopting the integrated crop-livestock technology. This research only used one assumption test, that was classic assumption test. Classic Assumption Test was done to find out whether there was a deviation or not. Classic Assumption Test consisted of multicolinierity, heteroscedasticity and autocorrelation tests.

Result and Discussion

Ngargoyoso Subdistrict was one of the 17 subdistricts in Karanganyar District. In accordance with its natural condition, most of Ngargoyoso Subdistrict population worked in farm sector (farmer and farm labor). Beef cattle population in Ngargoyoso Subdistrict in 2015 were 5321 cows (BPS, 2016).

Respondents' demographic characteristic

Respondents in this research were farmers who were members of Livestock Farming Group, and were easily met during the research. Farmers had various demographic characteristics, such as demographic character, social character, and economic character. Those characters differenciated farmers' behaviour in certain condition. According to Rousan (2007) that there were some primary factors correlated with voluntary adoption of crop-livestock system, these include farmers' socio demographic background, farm characteristics, participation in social organizations, communication and information networks, and real and perceived barriers and incentives.

There were 6 respondents' demographic characters in this research: sex, age, education level, income level, cattle ownership and the duration of farming experience.

Based on Table 1, men sit as majority in demography characteristic with total of 47 persons (90.4%). Most of the respondents were in the age of 41-50 years old with total of 17 persons (32.7%). Elementary School was the education level of the most of the respondents, there were 25 persons (48.1%) who only attended Elementary School. Most of the respondents got Rp1,000,000-2,000,000 as their income, there were 41 of them (78.8%). Cattle ownership of the respondents was mostly 1-2 cows, there were 36 of them (69.2%) and duration of the farming experience was mostly >20 tahun; 18 respondents (34.6%). The results of the respondent demographic characteristic analysis indicate that farmers are still in productive age, have low education, proven by most primary schools, low income and cattle ownership. This is an obstacle that must be overcome during implementing new technologies such as integrated crop-livestock.

Normality data

Normality test in this research used Statistic Test by examining *skewness value* and *kurtosis value* from the data. Data normality test result in table 2 showed *skewness value* of -0.431 devided by *kurtosis value* of 0, 330 so the *skewness value* was -1.306 and *kurtosis value* of 0.573 was got from deviding 0.373 with 0.650, which meant that data used in this research were normal. This result was in accordance with Santoso (2016) who stated that *skewness* ratio and *kurtosis* ratio could be indicators whether a series of data normally distributed or not. *Skewness* ratio was *skewness* value devided by *skewness* standard error, and *kurtosis* ratio was *kurtosis* value devided by *kurtosis* standard error. *Kurtosis* ratio and *skewness* ratio between -2 and +2 indicated that the data were normally distributed.

Based on the validity test, this research was valid, with result showed that 22 question gave $r_{cal} > r_{table}$. r_{table} was significant in level 5% with total respondents of 52 people; 0.273. Validity was tested by comparing values of r_{cal} dan $r_{table.}$ The criteria was determine when $r_{cal} > r_{table}$ so item questions were valid (Abdurahman *et al*., 2011). Realiability test showed *Cronbach's Alpha* >0.600. Ghozali (2009) stated that a variable was reliable if had *Cronbach's Alpha* value was equal or bigger than 0.600.

Table 1. Respondents' demographic characteristic

No.	Demographic characteristic	Number (people)	Percentage (%)
1.	**Sex**		
	Men	47	90.4
	Women	5	9.6
2.	**Age (year)**		
	20-30	4	7.7
	31-40	11	21.2
	41-50	17	32.7
	51-60	16	30.8
	>60	4	7.7
3.	**Education level**		
	No education	3	5.8
	Elementary school	25	48.1
	Junior high school	17	32.7
	Senior high school	7	13.5
4.	**Income level**		
	Rp. 1.000.000-2.000.000	41	78.8
	Rp. 2.100.000-3.000.000	9	17.3
	Rp. 3.100.000-4.000.000	1	1.9
	> Rp. 4.100.000	1	1.9
5.	**Cattle ownership**		
	1-2 cows	36	69.2
	3-4 cows	11	21.2
	5-6 cows	4	7.7
	> 7 cows	1	1.9
6.	**Duration of farming experience**		
	0-10 years	17	32.7
	11-20 years	17	32.7
	> 20 years	18	34.6

Source: Processed primary data, 2017.

Table 2. Data normality test

	Skewness		*Kurtosis*	
	Statistic	Std. Error	Statistic	Std. Error
Unstandardized Residual	-.431	.330	.373	.650
Valid N (listwise)				

Source : Processed primary data, 2017.

Oneway ANOVA analysis

Oneway ANOVA test done in this research was to find difference among the variables: sex, age, education level, income level, cattle ownership and duration of farming experience to farmers' decision to adopt integrated farming technology innovation, and the results were showed in Table 3.

The table showed that there were no differences among the variables sex, age, education level, income level, cattle ownership to farmers' decision to adopt integrated farming technology innovation, while duration of farming experience showed a significant difference ($P<0.01$) to farmers' decision to adopt the technology. This finding explained that duration of farming experience is one of important characteristics which need to be consider before implementation of technology. This was in line with research done by Musyafak and Ibrahim (2005), that explained farmers' internal characteristics such as age, non formal education, family member, reason in doing the farming activity, man power numbere, cosmopolitanism, frequency of contact with instructor did not show differences among groups of variables toward the adoption of technology.

Multiple linear regression analysis

This test was held to test the effects of independent variables, namely relative advantage (X1), compatibility (X2), complexity (X3), triability (X4) and observability (X5) to farmers' decision in adopting the integrated crop-livestock technology (Y). Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. Complexity is the degree to which an innovation is perceived as difficult to understand and use. Trialability is the degree to which an innovation may be experimented with on a limited basis. Observability is the degree to which the results of an innovation are visible to others. The result of analysis was as shown in Table 4. Based on Table 4 we got a double linear regression equation :

$$Y = 2.739 + 0.369X_1 + 0.213X_2 + 0.080X_3 + 0.777X_4 + (-0.320)X_5 + e$$

The equation explained that the constant value of 2.739 meant if independent variables (relative advantage, compatibility, complexity, triability and observability) was zero in value, so dependent variable Y (farmers' decision to adopt the innovation) would be equal to 2.739. Coefficient X1 of 0.369 meant that every 1 point increase in relative advantage would give 0.369 point increase in variable Y (farmers' decision to adopt the innovation). Coefficient X2 of 0.213 meant that every 1 point increase in compatibility would give 0.213 point increase in variable Y (farmers' decision to adopt the innovation). Coefficient X3 of 0.080 meant that every 1 point increase in complexity would give 0.080 point increase in variable Y (farmers' decision to adopt the innovation). Coefficient X4 of 0.777 meant that every 1 point increase in triability would give 0.777 point increase of farmers' decision to adopt the innovation. Coefficient X5 of -0.320 meant that every 1 point increase in observability would give 0.320 point decrese of farmers' decision to adopt the innovation. The results of this study indicate that the characteristics of innovation in the form of relative advantage, compatibility, complexity and trialability variables have the effect of increasing decisions of farmers to adopt integrated crop-livestock. This means that the integrated crop-livestock system has high potential to be applied to farmers in the research area. There is only one characteristic of innovation that is observability which has the effect of decreasing innovation adoption decisions.

Determination coefficient (R^2) was used to measure precision degree as a contribution percentage to the variation of Y. Based on the analysis, the value if R^2 was 0.647. It meant that independent variable innovation characteristics

Table 3. Oneway ANOVA test result

Variable	Between	Within	F	Sig.
Sex	0.014	8.235	0.002	.967
Age	7.504	8.122	0.924	.458
Education level	19.396	7.366	2.633	.061
Income level	11.823	7.839	1.508	.224
Cattle ownership	1.600	8.478	0.189	.904
Duration of farming exp	63.207	5.823	10.854	.000

Source: Processed primary data, 2017.

Table 4. Multiple linear regression analysis

Variable	Regression coeffisient	t_{cal}	(sig.t) α = 0.05
X1 (Relative advantage)	0.369	2.409	0.020
X2 (Compatibility)	0.213	1.163	0.251
X3 (Complexity)	0.080	0.408	0.685
X4 (Triability)	0.777	3.154	0.003
X5 (Observability)	-0.320	-1.591	0.118
Contant value	2.739		
F calculated	16.850		0.000
R square (R^2)	0.647		
Dependent variable = Y (adopsi inovasi)			

Source: Processed primary data, 2017.

influenced farmers' decision in adopting the integrated farming technology innovation in 64.7%, while 35.3% could be explained by other variables that were not included in the research.

Analysis of classic assumption

This research conducted several analysis of classic assumption to prove the goodness of regression model were multicolinearity, heteroscedaticity and autocorrelation. Multicolinearity test result gave these values VIF $X_1 = 2.448$; $X_2 = 2.828$; $X_3 = 2.813$;$X_4 = 3.851$ and $X_5 = 3.121$. This meant that multicolinearity test was accomplished because there were no multicolinearity in the regression model. Ghozali (2009) said that Value Inflation Factor (VIF) could be used to detect multicolinearity. If VIF > 10 so there were multicolinearity, and if VIF < 10 meant there were no multicolinearity. Heteroscedaticity test using *park* test showed statistically insignificant (level of significance more than 0.05), this meant that there were no heteroscedaticity in the research model and vise versa (Ghozali, 2009). Variables' significance level in the research was more than 0.05 so in could be infered that there were no heteroscedaticity. Autocorrelation test was done using Durbin Watson method. Durbin Watson value was around between upper limit (du) and 4-du, so it was predicted that autocorrelation did not happen Santoso (2016). DW value of 2.116 was more than 1.7694 and smaller than 2.2306 which meant in the area where there was no autocorrelation, so linear regression model used in this research did not experience autocorrelation.

Statistics test

Based on Table 4 the value of F_{cal} was 16,850 with significacy of 0.000. F_{tabel} in 5% significacy level df 1 (number of variable -1) = 5 and df 2 (n-k-1) = 46, was 2,417. Analysis result showed that $F_{cal} > F_{table}$ (16.850>2.417), it meant that H_0 was rejected and H_a was accepted, in other words independent variables (relative advantage, compatibility, complexity, triability and observability) simultaneously influenced the farmers in deciding to adopt the integrated farming technology innovation.

Analysis result of t-test showed in table 4 gave significant value of independent variables namely relative advantage (X1) and triability (X4) which meant that relative advantage and triability influenced farmers' decision to adopt the innovation, while the other independent variables compatibility (X2), complexity (X3), and observability (X5) did not give a significant value. It meant that compatibility, complexity and observability did not individually influence farmers' decision to adopt the innovation.

Discussion

Based on the regression analysis shows that the relative advantage, compatibility, complexity and trialability variables have a positive effect on increasing innovation adoption decisions, only one variable observability has an effect on reducing innovation adoption in beef cattle farmers in Ngargoyoso sub-district Karanganyar.

According to the result of t test, variable relative advantage gave P value of 0.020 with t_{table} df 46 confidence level 95% was 2.013 thus could be concluded that relative advantage significantly influenced farmers' decision in adopting the integrated crop-livestock technology. It was a clue that there were a lot of relative advantage from the integrated crop-livestock technology, relative advantage from all aspects like economic advantage, status and others. This was in correspondence with Musyafak and Ibrahim (2005) who mentioned that technology should give concrete advantage to increase the technology adoption interest. Technology innovation that would implemented should be guaranteed to give more advantage than the previous one.

Variable compatibility gave P value of 0.251 with t_{table} df 46 confidence level 95% was 2.013 therefore compatibility did not influence farmers' decision in adopting the integrated farming technology innovation. The results of this study indicate that there is no difference between respondents in responding to the compatibility (suitability) of integrated crop-livestock system innovation in their farming practices. Compatibility (suitability or appropriateness) of the integrated farming technology innovation with the respondents' situation was seen from respondents' valuation wheter it suitable to their needs and experiences.

Variable complexity gave P value of 0.685 with t_{table} df 46 confidence level 95% was 2.013 which meant that complexity did not influence farmers' decision in adopting the integrated farming technology innovation. The results of this study indicate that there is no difference between respondents in responding to the complexity of the innovation of integrated crop livestock systems in their farming practices. Respondents assumed that complexity that they got from the technology innovation did not affect significantly to their decision to adopt it. This was in line with Rahab (2009) who stated that an innovation would be adopted when it was easily implemented.

Variable triability gave P value of 0.003 with t_{table} df 46 confidence level 95% was 2.013 so this could be infered that triability significantly influenced farmers' decision in adopting the integrated farming technology innovation. Respondents were able to try it first in a small scale to smallen the risk when implementing the integrated farming technology innovation. Van den Ban and Hawkins (1996) mentioned that adopter would tend to adopt the innovation which previously be tried in a small scale.

Variable observability gave P value of 0.118 with t_{table} df 46 confidence level 95% was 2.013 therefore could be concluded that observability did not influence the farmers' decision in adopting the integrated farming technology innovation. This characteristic was a stage where results of the innovation could be seen and this innovation was still in a trial and not yet been applied a farming activity before so the results could not be observed. Kurnia and Johnston (2000) stated that an innovation which the result was easy to observe would also be easily accepted by respondents and in the contrary, innovation with no result to observe then would need longer time to be accepted.

Conclusions

Innovation characteristics (relative advantage, compatibility, complexity, triability and observability) simultaneously and significantly influenced the farmers' decision in accepting the integrated farming technology innovation, but partially (individually) only variable relative advantage and triability which significantly influenced to farmers' decision in accepting the integrated farming technology innovation, while compatibility, complexity and observability did not.

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