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ANALYSIS OF FARMER PERCEPTIONS IN ADOPTING THE INTEGRATED FARMING SYSTEM: A CASE STUDY OF OIL PALM PLANTATION IN RIAU PROVINCE

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Abstract: Crop-livestock integration is a future agricultural system that can increase the added value of farming while and being environmentally friendly. However, it is not widely used by oil palm farmers. Oil palm integration with cattle is expected to meet the demand for oil palm organic fertilizer and utilize palm fronds as animal feed. The objective of this research is to analyse the factors that influence farmers' decisions to implementing oil palm-cattle integration. A survey was conducted with 300 respondent who were chosen with purposive sampling with two categories: integrated farming and non-integrated farming. The logistic model was used to analyze adoption factors. The result shows that factors influencing the decision of farmers to adopt oil palm-cattle integration are the time of involvement of household head in farming, extension services, income from oil palm, and the household's dependent ratio. Meanwhile, the factors that do not encourage farmers to adopt oil palm-cattle integration are formal education and involvement in farmer groups. The results observed several socio-economic factors that can lead to the increase of the crop-livestock integration such as farmers still requiring good extension and training.

Keywords: adoption, logistic model, oil palm-cattle integration, smallholders

Abstrak: *Integrasi tanaman-ternak merupakan sistem pertanian masa depan karena mampu meningkatkan nilai tambah usahatani dan ramah lingkungan, tetapi belum banyak diterapkan oleh petani kelapa sawit. Integrasi kelapa sawit dengan ternak sapi diharapkan dapat memenuhi kebutuhan pupuk organik kelapa sawit dan memanfaatkan pelepah sawit sebagai pakan ternak. Penelitian ini bertujuan untuk menganalisis faktor-faktor yang memengaruhi keputusan petani dalam melaksanakan integasi kelapa sawit-sapi. Data dikumpulkan melalui survei dengan 300 responden, yang dipilih purposif dalam dua kategori yaitu usahatani integrasi dan non integrasi. Model logit digunakan untuk menganalisis faktor adopsi. Penelitian ini menunjukkan bahwa faktor positif mempengaruhi keputusan petani untuk melakukan integrasi kelapa sawit-sapi adalah waktu keterlibatan kepala rumah tangga di perkebunan kelapa sawit, penyuluhan yang diterima petani, pendapatan petani dari kelapa sawit dan dependen ratio rumah tangga. Sedangkan faktor yang mendorong petani untuk tidak melakukan integrasi kelapa sawit-sapi adalah pendidikan formal dan keterlibatan dalam kelompok tani/koperasi. Untuk itu, penyuluhan dan pelatihan yang efektif masih diperlukan pada petani sehingga meningkatkan akses pada pengelolaan sistem integrasi tanaman-ternak.*

Kata kunci*: adopsi, integrasi kelapa sawit-sapi, model logit, perkebunan kelapa sawit rakyat*

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INTRODUCTION

The integrated farming system (IFS) is a recycling-based effort to reduce wasted waste from various farming sub-systems and create synergies, allowing for the most efficient use of available resources to increase job opportunities, nutritional security, and community income. areas in the rural (Sasikala et al. 2015). Integration of crops (food and plantations), livestock, and legume development can reduce the agricultural sector's reliance on external inputs (mineral fertilizers, feed, protein, pesticides), maintain land productivity, and minimize nutrient loss in agro-ecosystems, increase the agricultural sector's resilience to climate and economic constraints (Peyraud et al. 2014). IFS are the main solution for increasing production and protection of the environment through wise and efficient resource use (Gupta et al. 2012; Peyraud et al. 2014; Peterson et al. 2020). IFS are sustainable with the concept of conservation through anticipatory and integrated environmental policies (Li and Min, 2018). Hence, IFS is an effort to maximize farmer resources (especially by-products) from two or more farming branches that are integrated into the agricultural system, with the goal of increasing farmer profits by lowering input costs or increasing farm production.

The integration of oil palm plantations with livestock can help farmers to provide fertilizer for crops, to improve oil palm productivity (Romelah, 2016) and to reduce production expenses related to inorganic fertilizer procurement and eradication of nuisance plants (Wijono et al. 2003). According to Erniwati (2018), integration is likely to give additional fertilizer for oil palm because smallholders farmers use fertilizer inaccurately. Smallholder plantation farmers' improper fertilization results in fertilization with low doses (Euler et al. 2016). Peterson et al. (2020) discovered that integrating livestock with crops seems to have no negative impact on crop yield. Integrated agriculture can improve soil fertility by increasing the use of organic fertilizers (Sasikala et al. 2015; Edwina et al. 2019). The application of livestock integration in oil palm plantations can save the cost of purchasing fertilizer by 66% and the cost of purchasing animal feed by 50%, and can increase oil palm production and farmers' income by 25% (Romelah, 2016).

Riau Province has a significant role in Indonesia's oil palm sector, with 2.85 million ha of oil palm plantations in 2020. This is accounted for 19.21% of Indonesia's total oil palm plantations, with 61.91% of them being smallholder plantations (Directorate General of Estates, 2020) . However, at 13.39 tons/ha, Riau Province's average smallholders oil palm productivity is extremely low (Ariyanto, 2019). According to Bell et al. (2014), crop-livestock integration will be able to improve and increase productivity in both crop and livestock production, so it is believed that the development of oil palm-cattle integration would help to close the productivity gap. Integration of oil palm with cattle on smallholder plantations is one type of integration developed in Riau Province.

Smallholder farmers encounter many challenges to integrate oil palm with cattle. These challenges include lack of capital in implementing the integration (Zaimah et al. 2018), notion that livestock will damage the crops (Silalahi et al. 2018), and spread of disease in oil palm plantations. Moreover, the problems faced in implementing cattle-oil integration by small-scale farmers are the difficulty of obtaining palm kernel cake and poor feed processing technology. It indicates that the dependence of farmers on inputs from outside the farm is still quite large. Farmers still rely on some inputs from outside due to limited resources and lack of capability in processing manure (Widadie and Agustono, 2015). The availability of family labor is also an obstacle in the implementation of integrated farming. Farmers are faced with various activities that require farmers to be able to allocate their workforce efficiently (Handayani, 2009).

Other studies have demonstrated yield differences between integrated farming and monoculture farming. Ryschawy et al. (2012) found that integrated farming has a higher gross income than monoculture crop farming, but lower labor productivity. Integrated farming has greater input costs than monoculture farming, but lower inorganic fertilizer expenses. According to Sneessens et al. (2016), integrated farming is more profitable than non-integrated farming in Brazil. Profits are higher because the amount of fertilizer purchased is less, and the price of feed is below commercial feed. In India, Rao et al. (2017) found that integrated farming has a greater income than non-integrated farming but requires more effort, and it is also known that labor productivity is lower in integrated agriculture. According to Handayani (2009), rice-livestock integration generated 20.94% higher income than non-integration in Central Sulawesi Province. According to the findings of Herawati et al. (2004), not all livestock can be integrated with crops

since cattle integration can diminish farmers' revenue. The development of oil palm-cattle integration is expected to reduce the negative impacts of monoculture oil palm plantations. This is related to the reasons that intensive plantations will impose a pressure on productivity and cause environmental damage. It is possible to reduce soil erosion, decrease soil carbon, acidify the soil, and improve water drainage in the soil by integrating plant-livestock integration (Hacker et al. 2009).

Household farming activities are aimed at increasing earnings. The allocation of labor is associated to the household's goal of maximizing profit. Chayanov, Barnum-Squire, and Low proposed the concept of the agricultural household (Elly, 2008). Using an economic approach, several models of farm household behavior have been developed and evaluated (Ellis, 1988). From a neoclassical microeconomic perspective, a farm household's decision to adopt new technology is based on the individual's expected utility, or if the expected marginal benefits of adoption exceed the marginal costs of this decision (Carrer et al. 2020).

Farmers' productivity and revenue are predicted to rise as a result of the adoption of a participatory crop-livestock integration system on their land. However, most farmers have not yet implemented the livestock crop integration system (Priyanti, 2007). Many factors determine farmers' decision to use this integration technology from an economical perspective. One of the factors to consider is resource availability and the ability to implement integration technology (Handayani, 2009). New technologies may actually require an upfront capital investment and raise farm operating costs (Carrer et al. 2020).

Although integrated oil palm and cattle has been introduced, not all farmers in the region have applied it. The farmer perceptions in adopting the integrated farming system is important to analyze the current practice of an integrated farming system of oil palm and cattle. This study could assist policymakers in improving agricultural policies, should the need for revision arise in the future. The study's goals are to analyze the factors that influence farmers' decisions to implement the oil palm-cattle integration in household level.

METHODS

The study was conducted in Riau Province and the location was chosen purposively. The province is one of the areas that has quite a lot of smallholder oil palm plantations and is an integrated cattle development area in Indonesia. There are five district locations observed, namely Siak, Kampar, Kuantan Singingi, Pelalawan, and Indragiri Hulu districts. The study was conducted for six months from February to July 2021.

The data type used is cross-sectional data, and the data sources are primary and secondary data. Direct interviews were required to acquire primary data, which was subsequently examined with the help of a standardized list of questions (questionnaires). Secondary data was gathered from a variety of sources, including the Central Statistics Agency, Riau Province's Animal Husbandry and Animal Health Service, and others.

The object of this research is farmer households who cultivate oil palm commodities with beef cattle and those who cultivate oil palm only. The sample used was 300 farmer households consisting of 165 integrated oil palm farming households and 135 non-integrated oil palm farming households. The respondents' criteria used are (1) smallholder plantation farmers, (2) the area of land cultivated at least 1 ha, (3) having have sold their products both oil palm fruit and livestock, (4) experience in integration is at least 2 years, specifically for integrated farming.

The logistic analysis is used to determine the factors that influence farmers' decisions regarding the oil palm-cattle integration system's adoption. The farmer's decision to adopt an integrated crop-livestock farming system was evaluated using the logit model. The logistic function form of the regression model is the most often used model for better describing the diffusion process. Farmers' desire or decision is a categorical dependent variable, but the elements that influence it as an independent variable are multilateral (Widadie and Agustono, 2015).

Adoption of the oil palm-cattle integration system is a binary event with values of 0 and 1, and this action is treated as a dummy variable. Farmers who use the integration model receive a score of 1, while those who do not use the integration model receive a score of 0. The general form of the logit function model as (Gujarati, 2003; Hosmer et al. 2013):

$$P = \frac{1}{1+e^{-(\alpha+\beta_i X_i)}}$$

where: P is farmer's opportunity to implement oil palm-cattle integration (value between 0 and 1); X_i is independent variable; α is intercept; β_i is logit function parameter; e is natural number (2.72)

In this study, the adoption model estimated with the logit function consists of five groups of variables, namely (1) farmer characteristics including age, formal education, and experience of the head of the family; (2) farming conditions including oil palm area, oil palm productivity, and age oil palm plantations; (3) the availability of family labor including the allocation of the use of labor for the head of the family in oil palm, the number of household members and the dependent ratio; (4) oil palm income; and (5) access to farming information including the participation of household members in farmer institutions and the frequency of participating in extension programs.

The selection of variables for logistic function estimation is based on previous research by Syaukat and Julistia (2019), and Priyanti (2007). This simple relationship between the coefficient and the odds ratio is the fundamental reason logistic regression has proven to be such a powerful analytic research tool (Hosmer et al. 2013). Independent variables for the logit function estimation model's are chosen based on the potential for growth of oil palm-cattle integration, whith equation:

$$P^* = \ln \frac{P}{1-P}$$

$$= \alpha + \beta_i umur + \beta_2 pddkn + \beta_3 jsawit + \beta_4 tksswt + \beta_5 ukrt + \beta_6 updpts + \beta_7 klpkop + \beta_8 pylhn + \beta_9 pdvts + \beta_{10} umrt + \beta_{11} pglmn + \beta_{12} depenr + \varepsilon_i$$

where: α is intercept; βi is parameter coefficient for independent variable; umur is age of head of household (years); pddkn is education of the head of the family (years); pglmn is oil palm farming experience (years); jsawit is land area (hectare); pdvts is palm oil productivity (tonnes/ha/yr); umrt is age of oil palm (years); tkss is allocation of husband's labor use in oil palm farming (man-days); ukrt is number of household members (person); depenr is dependent ratio (number of household members not working divided by number of household members); Pdptsw is palm oil farming income (Rp/year); klpkop is participation in groups or cooperatives (1: member, 0 : no); Pylhn is frequency of attending mixed farming counseling and livestock waste treatment (1: receiving counseling, 0 : no); ε is residual

Expected coefficient value is $\beta 1, \beta 7 < 0$ and $\beta 2, \beta 3, \beta 4, \beta 5, \beta 6, \beta 8, \beta 9, \beta 10, \beta 11, \beta 12 > 0$. The odd ratio value is used to estimate farmers' willingness to implement integration. The odd ratio is a measure of association that expresses the likelihood of a successful event versus an unsuccessful event based on the response variable. By looking at the value of the variable coefficient, if the value is positive, the opportunity for implementing integration is greater, and vice versa.

RESULTS

Characteristics of Farming Households

In Riau Province, oil palm plantations are a main and have developed into a source of livelihood for farmers. The management of smallholder oil palm plantations is managed independently or in partnership with oil palm companies. The farmers in this study, which compares farmer families that combine oil palm plantations and livestock with those that do not, have the characteristics given in Table 1.

The average age of the total respondents was 47.67 years, with the highest proportion (33%) being 41-50 years old. Farmers of integrated farming are older on average than farmers of non-integrated farming. The tendency of farmers to integrate will increase with increasing age. Generally, the average education level of respondents is at the junior high school with a percentage of 42%. An average of education among non-integrated farmers is higher than of integrated farmers. Non-integrated farmers have a higher education, with the highest percentage at the senior high school (39.26%), while integrated farmers have the highest education at the elementary school (50.91%).

Males operate more than 96% of smallholder oil palm plantations. Households with a female head of home account for 3.64% of integrated and 3.70% of non-integrated farmers, respectively. Because her husband is not there, the head of the family is a widow. The number of household members in integrated and non-integrated farms is almost the same, with an average

of four individuals. However, for farmers with 4 to 7 household members, integration farmers outnumber non-integrated farmers (60% versus 55%). The average farming experience of respondents is 20.14 years, with integration farmers having higher experience (20.72 years). The most farmers had 16-20 years of experience, with 23.03% and 20.74% for integrated and non-integrated farms, respectively. Farmers' job experience will influence their proclivity to learn new developments and handle areas of farming management more readily (Carrer et al. 2020).

Table 1. Characteristics respondent of smallholders oil palm farmer households

Farmer Characteristics	Integrated Farmer		Non-Integrated Farmer		Total Respondents	
	Frequency	%	Frequency	%	Frequency	%
Farmer's age, years						
< =30	14	8.48	12	8.89	26	8.67
31-40	25	15.15	32	23.70	57	19.00
41-50	53	32.12	46	34.07	99	33.00
51-60	51	30.91	31	22.96	82	27.33
> 60	22	13.33	14	10.37	36	12.00
Average	48.81		46.24		47.67	
Formal education, years						
Not school	2	1.21	2	1.48	4	1.33
Primary school	84	50.91	39	28.89	123	41.00
Junior high school	33	20.00	32	23.70	64	21.33
High school	42	25.45	53	39.26	96	32.00
Bachelor	4	2.42	9	6.67	13	4.33
Average	8.30		9.71		8.93	
Gender						
Male	159	96,36	130	96,30	289	96.37
Female	6	3.64	5	3.70	11	3.67
Number of household members, persons						
1	2	1.21	3	2.22	5	1.67
2	26	15.76	13	9.63	39	13.00
3	38	23.03	44	32.59	82	27.33
4	60	36.36	47	34.81	107	35.67
5	33	20.00	17	12.59	50	16.67
6	5	3.03	9	6.67	14	4.67
7	1	0.61	2	1.48	3	1.00
Average	3.67		3.72		3.71	
Farming experience, years						
< 5	9	5.45	8	5.93	17	5.67
6-10	20	12.12	24	17.78	44	14.67
11-15	21	12.73	24	17.78	45	15.00
16-20	38	23.03	28	20.74	66	22.00
20-25	25	15.15	21	15.56	46	15.33
26-30	35	21.21	20	14.81	55	18.33
>30	17	10.30	10	7.41	27	9.00
Average	20.72		19.44		20.14	

Influencing Factors on The Adoption of Integrated Oil Palm-Cattle

The logit regression model was used to determine the elements that may impact farmers' decisions to integrate oil palm and cattle. In this research, 12 factors were measured (Table 2). The results of the goodness of fit test resulted in a significant p-value, so the model developed is able to identify the elements that influence farmers' decisions to integrate oil palm and cattle. The likelihood ratio is 82.56, and the total p-value is 0.0000, which is less than 0.05, indicating that at least one variable influences farmers' decisions to combine oil palm and cattle production. If the significance value of Hosmer Lemeshow's Test is more than 0.05, the regression model can be used for the model, and the resulting model can be regarded to be a good model because there is no significant difference between the predicted and observed classifications.

Logistic model coefficient value in Table 2 show that the husband's time managing oil palm plantations (tkss) and extension services (pylhn) is a variable that has a positive effect on the farmer's desire to adopt oil palm-cattle integration. Farmers who have more time allocation for farming, and received more mixed farming counseling and livestock waste treatment are more likely to adopt an integrated oil palm-cattle than who seldom get extension services. Contact with extension agents allows farmers greater access to the newest information in agricultural practices will increase the probability of the adoption of any agricultural technology (Widadie and Agustono, 2015). The farmer's education variable (pddkn) has a negative and substantial effect on farmers' intention to pursue oil palm-cattle integration. This result is different from the research of Ariyanto et al. (2020) that education has a positive effect on the ability of farmers to adopt technology. However, Priyanti (2007) found that the education and career of wives had no impact on farmers' decisions to implement crop-livestock integration.

Furthermore, farmer membership in groups or cooperatives (klpkop) have higher income from oil palm (pdptsw) have a positive and significant effect, and the dependent ratio (depenr) has a negative and significant effect. Farmers who have higher income will increase a farmer's ability to invest in integrated oil palm-cattle, especially to purchase of cattle, and to purchase equipment for compost processing. Other factors, such as age, the number of oil palm plantations (jsawit), household size (ukrt), oil palm productivity (pdvts), plant age (umrt), and experience (pglmn), have no effect on farmers' decisions to integrate oil palm and cattle. There are variations between this study and Ningsih (2014) report because three variables, namely education, employment status, membership, and organizational experience in *Gapoktan* (farmer group associations), have an effect on the adoption of integrated farming systems.

Table 2. Logit model for factors influencing smallholder decisions in implementing oil palm-cattle integration

Variabel	Coefficient	Odds Ratio	Marginal Effect
umur	0.0078	1.0079	0.0019
pddkn	- 0.1873****	0.8292	- 0.0445
jsawit	- 0.1802	0.8351	- 0.0428
tkss	0.0219****	1.0221	0.0052
ukrt	0.1585	1.1718	0.0376
Pdptsw	0.0097*	1.0097	0.0023
klpkop	- 0.6876***	0.5028	- 0.1632
pylhn	2.4797****	11.9374	0.5886
pdvts	- 0.0313	0.9692	- 0.0074
umrt	- 0.0098	0.9902	- 0.0023
pglmn	- 0.0162	0.9839	- 0.0038
depenr	- 1.2638**	0.2826	- 0.3000
Intersept	1,319	4,0224	
Goodness-of-fit test		0.54	
Hosmer-Lemeshow test		4.49	
Predicted value		71%	
p value		0,0000	

Note: *** Significant at the 0.01 level, ** Significant at the 0.05 level, * Significant at the 0.10 level

Based on the odds ratio, the probability for oil palm farmers to integrate is 0.83 times lower for those with a higher education than for those with a lesser and significant education. These findings suggest that as farmers' education levels increase, their desire to integrate oil palm cattle decreases. The marginal effect value of the education level is -0.0445, which means that adding one unit of education level will reduce integration adoption rate by 0.0445 or 4.45%. This finding contradicts with recent research by Widadie and Agustono (2015) and Ningsih (2014) on the adoption of crop-livestock integration. They found that the higher the education of the household's head, the greater the likelihood of implementing integration. This is achievable because farmers with a higher education have more opportunities to spend their time doing things than others. Furthermore, integration activities are unpopular since they demand more physical exertion and appear to be filthy. This finding is similar to that of Syaukat and Julistia (2019), who discovered that education has no impact on farmers' decisions to mix rice and fish. This is due to the fact that the respondent's farmer education is same at the study area. Meanwhile, according to Carrer et al. (2020), the lack of influence of education in influencing crop-livestock integration adoption in Brazil demonstrates the adoption's uniqueness, as it is determined more by institutional and structural variables than by farmers' knowledge.

The variable receiving extension has an odds ratio value of 11.93, which indicates that farmers who have got integration counseling have an 11.93 times greater chance of integrating than farmers who have never received extension, which is significant. These findings suggest that offering advice on oil palm-cattle integration, such as compost and feed processing, will motivate farmers to do so. The same results were achieved by Widadie and Agustono (2015) when it came to rice-cattle integration. Farmers' decisions to accept integration programs were not influenced by the frequency of interaction with extension workers, , but farmers' membership in agricultural organizations influenced farmers' decisions to adopt integrated farming (Priyanti, 2007). Extension service and training will be able to improve farmers' skills and abilities in implementing new innovations (Ahmad and Nasir, 2020), and to reduce barriers to accessing the information on the adoption and management of crop-livestock integration systems (Carrer et al. 2020).

The labor factor in the household, particularly the head of the family, has a significant impact on the decision to implement oil palm-cattle integration (husband). Farmers who spend more time on oil palm farming have 1.02 more opportunities than farmers who spend less time on oil palm farming activities, and the differences are significant. Many activities on oil palm plantations encourage farmers to maximize their time by bringing compost to the garden, which can lead to this condition. The compost is applied to oil palm trees as fertilizer. Widadie and Agustono (2015) reported the same result, finding that farmers with more household members who could work in farming had a higher likelihood to integrate. Farmers with the ability and skills gained through training or experience are the workers who can integrate (Ahmad and Nasir, 2020).

Farmers' participation in farmer groups or cooperatives has a coefficient value of -0.69, indicating that being a member of groups and cooperatives motivates farmers not to integrate oil palm-cattle. Based on the odds ratio value, it can be explained that the possibility for oil palm farmers to integrate is 0.50 times lower for farmers who belong to groups or cooperatives compared to farmers who do not belong to groups or cooperatives. This condition may occur if indeed the focus of farmer group/cooperative activities is not on oil palm-cattle integration activities. Farmers also participate out integration activities because they already have a large passion in and experience in implementing integration activities.

The decision to implement oil palm-cattle integration is also determined by the dependant ratio factor of farmer household ratio and farmer's income from oil palm. Farmers with a lower dependent ratio have a 0.28 higher chance than farmers with a higher and more significant dependent ratio. These findings suggest that increasing the number of household members who can work on farms will encourage farmers to diversify their farming such as oil palm farming and cattle farming. The use of domestic labor for cattle farming, according to (Ahmad and Nasir, 2020), has an influence on the level of adoption of the crop-livestock system integration program. Meanwhile, Syaukat and Julistia (2019) argue that the number of household members born has no influence on farmers' decisions to integrate plant fish. Since family members are important factors of production (labor) in farming, there is no need to spend money on labor costs (Suwandi, 2005).

Farmers are encouraged to integrate by the income generated by oil palm plantations. Farmers' decisions to integrate are strongly influenced by increasing their income from oil palm farms. Farmers with higher oil palm yields had a 1.00 times larger probability than farmers with lower oil palm revenues, and this difference is significant at the 10% threshold of significance. The development of oil palm-cattle integration requires capital support (Ahmad and Nasir, 2020; Gil et al. 2016). Farmers' resources will substantially influence the development of palm oil-cattle integration (Nur et al. 2021). Farmers need to additional costs to implement this integration (Ahmad and Nasir, 2020), which are likely to be covered through government support or loans from financial institutions.

Managerial Implication

The involvement of the head of the household and the use of family labor in farming influence the implementation of integrated oil palm-cattle farming. Moreover, the accessibility of integration counseling can encourage farmers to apply integrated farming. Increasing managerial capabilities will result in higher-quality decision-making for an integrated oil palm-cattle system, particularly in the management of household human resources to boost competitiveness and productivity. The regular publication of successful oil palm-cattle integration implementation is expected to change the mindset of oil palm farmers toward using this integration model. Farmers' capacities and capabilities must be increased by stakeholders and the Indonesian government in order to improve their integrated oil palm-cattle system.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Farmers' decisions to integrate oil palm-cattle are significantly influenced by the time of involvement of the head of household in oil palm farms, the extension received by farmers, farmers' revenue from oil palm, and the dependent ratio of the household. Farmers' formal education and involvement in farmer groups/ cooperatives are variables that urge farmers not to integrate oil palm-cattle. The oil palm-cattle integration activity is not appealing to farmers with a higher level of formal education, and that farmer participation in farmer groups/cooperatives does not increase farmers' interest in integrating. For variables those impact is not significant on farmers' desire to integrate, it shows that there are similarities in conditions between integrated and non-integrated farmers.

Recommendations

Activities in integration are not popular among younger farmers with a higher education level because they involve more physical activity and require extra costs. Therefore, for young farmers, lessons learned from farmers who have successfully adopted an integrated farming system are important as a success story. Therefore, effective extension services and training for farmers, as well as better accessibility to the management of an integrated crop-livestock system and special financial support from the government, are still required. Furthermore, it is necessary to explore other related variables that might encourage smallholders to adopt oil palm-cattle integration.

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