

The Willingness to Adopt Local Feed Innovation Among Cattle Farmers

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Abstract. This study aimed to analyze the farmers' willingness to adopt local feed innovation and their background factors. A total of 106 cattle farmers in Malang Regency, East Java were engaged in personal interviews using structured questionnaires. Data were subjected to descriptive statistics and Probit regression. The results showed that most of the farmers were willing to partially adopt local feed innovation. Farmers' willingness was negatively affected by their age and number of cattle, but positively affected by their membership in a farmer's group and perception towards the cattle farming conditions. Farmers managing feedlot business have a higher probability to reject local feed innovation. Conclusively, optimizing coaching and assisting activities through farmers' groups can be an effective way to increase their willingness to fully adopt local feed innovations.

Keywords: feed innovation, technology adoption, local resources

Abstrak. Penelitian ini bertujuan untuk menganalisis kesediaan peternak untuk mengadopsi inovasi pakan lokal, dan untuk menganalisis faktor yang mempengaruhi kesediaan peternak tersebut. Responden pada penelitian ini yaitu 106 peternak sapi potong yang di Malang, Jawa Timur. Pengumpulan data dilakukan melalui wawancara dengan menggunakan kuesioner terstruktur. Analisis secara deskriptif dan regresi menggunakan probit pada penelitian ini dimanfaatkan untuk mengukur pengaruh antar variabel. Hasil penelitian menunjukkan bahwa sebagian besar peternak bersedia untuk mengadopsi inovasi pakan lokal secara parsial. Faktor sosial ekonomi yang secara signifikan berpengaruh terhadap kesediaan peternak untuk mengadopsi inovasi pakan lokal adalah umur, jumlah ternak, jenis agribisnis sapi potong, keanggotaan dalam kelompok ternak, dan persepsi terhadap kondisi usaha peternakan yang dijalankan. Umur dan jumlah ternak berpengaruh negatif terhadap kesediaan peternak untuk mengadopsi inovasi pakan lokal, sedangkan keanggotaan dalam kelompok ternak dan persepsi terhadap kondisi usaha peternakan yang dijalankan berpengaruh positif terhadap kesediaan peternak untuk mengadopsi inovasi pakan lokal. Peternak yang menjalankan usaha penggemukan memiliki probabilitas yang lebih besar untuk menolak adopsi inovasi pakan lokal. Optimasi kegiatan pendampingan melalui kelompok ternak merupakan salah satu cara yang efektif untuk meningkatkan kesediaan peternak untuk mengadopsi inovasi pakan lokal secara penuh.

Kata kunci: inovasi pakan, adopsi teknologi, sumber daya lokal

Introduction

Poor availability of quality feed, particularly sustainable and abundant forage fodder (Salendua et al., 2018), has fueled issue among farmers (Dung et al., 2019). While Indonesia has extensive areas of agriculture and high potentials for local feed production (Delima et al., 2015; Hifizah, 2016), Indonesian farmers need to improve their capacity in managing these potentials because they may still lack

knowledge and understanding of feeding systems (Sodiq et al., 2019). Pressures on the agricultural land and the increasing demand for livestock products may continue to drive the effective use of resources (Gupta et al., 2012; Widarni et al., 2020).

The efforts for developing farms, especially traditional farming system, must be carried out through empowering farmers to implement technology innovation particularly on feed

based on local resources (Agus & Widi, 2018). While attempts to develop local feed innovation are many, technology adoption among farmers remains low (Mulatmi et al., 2016). It is known that only a few large-scale farmers have adopted the local feed innovation of cattle (Guntoro et al., 2016). This characteristic of Indonesian farmers has challenged the application of local feed innovation in traditionally-managed cattle farm as a smallholder and a side business (Sodiq et al., 2019).

The strategy to introduce local feed innovation to the smallholder farmers can work best if responded by farmers' willingness to adopt the innovation. Therefore, understanding the nuance of farmers' willingness to adopt local feed innovation is crucial to formulate the best practice in technology adoption strategy. The right strategy to introduce local feed innovation is expected to contribute to increasing the level of adoption because farmers tend to adopt technology that suits to their needs (Fatchiya et al., 2018).

There have been extensive studies on technology adoption in the field of livestock farming. Some examples include analysis factors influencing the adoption of grass technology (Keba, 2019), the correlation between farmer characteristics and the adoption of artificial insemination technology (Sirajuddin et al.,

2018), and behavior analysis factors influencing the adoption of sustainable livestock farming (Dessart et al., 2019). Few studies connect these influencing factors with the availability of alternative local resources, including one by Fatchiya et al. (2018) which report the benefits of local resources as an alternative feed, such as accessible at farming area, affordable prices, and available at any time or season (Fatchiya et al., 2018). Therefore, this study is intended to obtain information on farmers' willingness to adopt local feed innovation and the impact of farmers' characteristics towards their willingness to adopt local feed innovation.

Materials and Methods

Respondents to this study were 106 farmers residing in Arjowilangun village and Kucur village, Malang Regency, East Java. Having potential local feeds, both villages were selected through purposive sampling due to their status as the centers of beef cattle farming in Malang Regency and their respective potentials for local feed. The local feed innovation in this research included agricultural waste that is abundant and easily obtained in each area, but has not been widely used as livestock feed. The local feed innovation in Arjowilangun is processed feed from coffee husks waste, while in Kucur is processed feed from sugarcane tops waste.

Table 1. Definition of variable and type of measurement

Variable Name	Definition	Type of Measurement
Dependent variable		
Adoption	Willingness to adopt local feed innovations	Nominal (1= Full adoption, 2= Partial adoption, 3= No adoption)
Independent variables		
Age	Farmers' age in years	Ratio
Formal education	Farmers' formal education background in years	Ratio
Cattle Fattening	Farmers' total number of cattle in AU Type of cattle farm	Ratio Nominal (1= Fattening, 0= Breeding/rearing)
Member Perception	Membership of a farmer's group Farmers' perception of their cattle management status	Nominal (1= Member, 0= Not a member) Nominal (1= Satisfied, 0=Not satisfied)
Crop residue	Utilization of crop residue	Nominal (1= Yes, 0= No)

Livestock farmers in each village were selected as study respondents through the purposive sampling and involved in personal interviews in August 2020 during which data were collected using structured questionnaires to gather information about the farmers' willingness in adopting local feed innovation and farmers' characteristics (age, formal education, number of cattle, type of cattle farming, membership in farmer's group, perception of farm management status, and the utilization of crop residue). The definition of each variable in this study is presented in Table 1.

The obtained data were descriptively presented to provide an overview of the farmers' social-economic conditions. Meanwhile, Multinomial Logit regression models were applied to create an estimation on the effect of independent variables towards farmers' probabilistic classification into one of three adopter categories (Rathod et al., 2017). As a development of binary logistic regression which allows more than two categories of dependent variables (Aldrich and Nelson, 1984), MNL regression model is the right choice if the dependent variables are truly discrete, nominal, or unordered (Liao and Liao, 1994). The assumption tests that must be fulfilled on the MNL regression model are multicollinearity, whereas linearity, normality, and homoscedasticity are considered less important (Mustapha, 2017). The following is the Multinomial Logit regression model equation used in this study:

$$\Pr Pr (y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^J \exp(X_i\beta_j) \exp(X_i\beta_j)}$$

(Ojo et al., 2013)

Where y_i is the dependent variable for farmers' willingness in adopting local feed

innovations. Farmers who were willing to adopt both forage fodder innovation and local concentrate were categorized into the full adoption group, those who adopted either forage fodder innovation or local concentrate were categorized in partial adoption group, and farmers who refused both innovations were categorized in no adoption group. X_i is a vector of the explanatory variables (independent) analyzed in this study and β_i is other unknown variables.

Results and Discussion

Socio-economic Characteristics of Farmers

Socioeconomic characteristics bring an impact to the farmer's ability to adopt the technology (Putra et al., 2017). Distinctive characteristics of farmers requires a different approach in introducing farming innovations that include local feed innovations. Therefore, the socioeconomic characteristics of farmers are important variables in developing the smallholder farms. The socioeconomic characteristics of farmers in this study are presented in Table 2.

Cattle farmers in this study are classified into three categories, full adoption, partial adoption, and no adoption. While the productive-aged farmers are those 15-45 years old, farmers in the partial adoption group were averagely older than those in full adoption and no adoption. The average length of attending formal education of all farmers was 7.45 years, and the longest (7.59 years) was the partial adopter farmers.

Farmers in the partial adoption group tend to have a larger number of cattle by 2.57 Animal Unit (AU) than those in full adoption and no adoption groups. However, this average Animal Unit (2.32) is still considered low because, according to Agus & Widi (2018), most cattle farmers in Indonesia, especially Java Island, still maintain the traditional farming management.

Table 2. Farmers' Socioeconomics Characteristics

Variable	Unit	Mean (St. Dev)	Category		
			Full Adoption Mean (St. Dev)	Partial Adoption Mean (St. Dev)	No Adoption Mean (St. Dev)
Age	Year	47.96 (12.06)	45.16 (9.97)	49.26 (12.56)	48.76 (13.38)
Formal education	Year	7.45 (3.63)	7.16 (3.08)	7.59 (3.80)	7.52 (4.04)
Cattle	Animal Unit	2.32 (1.79)	1.82 (1.11)	2.57 (1.64)	2.40 (2.72)
Fattening	Dummy	0.69 (0.47)	0.68 (0.48)	0.63 (0.49)	0.86 (0.36)
Member	Dummy	0.86 (0.35)	0.90 (0.30)	0.89 (0.32)	0.71 (0.46)
Perception	Dummy	0.30 (0.46)	0.39 (0.50)	0.28 (0.45)	0.24 (0.44)
Crop residue	Dummy	0.72 (0.45)	0.58 (0.50)	0.81 (0.39)	0.67 (0.48)

Most cattle farms in this study (69%) were feedlot businesses. The average farmers' participation in a farmer group is quite high (86%), but the highest (90%) was observed in full adoption group. The percentage of crop residue utilization was the highest in partial adopter.

The willingness of beef cattle farmers to adopt feed innovations.

It is important to obtain information on farmers' willingness in adopting local feed innovation as it plays a role in determining the strategy to introduce the technology adoption. This study shows that 51% of farmers were willing to partially adopt local feed innovation (either forage fodder or concentrate), while 20% not willing to adopt any local feed innovation.

The following table compares farmers' willingness to adopt local feed innovation.

Traditional cattle farmers tend to maintain their cattle and try to minimize risks in running cattle farming (Asravor, 2019). Farmers may not have complete willingness to fully adopt the local feed innovations because they consider the risk of failures associated with local feed innovation. This condition is compounded by the fact that most cattle farming in Indonesia is intended to be financial savings and managed traditionally (Agus & Widi, 2018). Feed is a major risk factor in traditional cattle farming businesses (Hayran & Gül, 2015). Therefore, it is important to obtain comprehensive information on local feed innovation to formulate effective introductory strategies.

Table 3. Beef cattle farmers' willingness to adopt new forages

Adoption	Location		Total
	Arjowilangun	Kucur	
No Adoption	n (% within the column)	3 (9)	18 (24)
Partial Adoption	n (% within the column)	23 (72)	31 (42)
Full Adoption	n (% within the column)	6 (19)	25 (34)
Total	n (% within the column)	32 (100)	74 (100)

Table 4. Estimates of the multinomial logit (MNL) regression model

Variables	Partial adoption			Full Adoption		
	Coefficient	Std. Error	z	Coefficient	Std. Error	z
Age	-0.02040	0.02567	0.79	-0.05360*	0.02967	1.81
Formal education	0.02756	0.08618	0.32	0.02815	0.10016	0.28
Cattle	0.01981	0.15317	0.13	-0.44460*	0.23948	1.86
Fattening	-1.73818**	0.77729	2.24	-1.88582**	0.86070	2.19
Member	1.50561**	0.75607	1.99	2.25107**	0.93123	2.42
Perception	0.70088	0.73848	0.95	1.95177**	0.81588	2.39
Crop residue	0.66243	0.64199	1.03	-0.66052	0.68831	0.96
Constanta	1.10377	1.82928	0.60	3.04634	2.13142	1.43

Base category was no adoption; Number of observations = 106; LR χ^2 (14) = 29.69; Prob > χ^2 = 0.0084; Pseudo R^2 = 0.1368; *Significant at level 10%; **Significant at level 5%

Factors that affect the willingness of farmers to adopt local feed innovations

This study used MNL model regression to obtain information about the effect of characteristics on farmers classification into a different category of adoption groups. The multicollinearity test was conducted in this analysis to ensure no correlation among the independent variables (Mustapha, 2017). The results showed that indeed each independent variable was not correlated with each other. The estimation result of MNL regression in Table 4 with no adoption group as reference shows that the *Likelihood Ratio* (LR) χ^2 model is 29.69 with a $\text{prob} > \chi^2$ is 0.0084 ($P < 0.01$). The pseudo R^2 (0.1368) also confirms that all slope coefficients are not equal to zero. These results indicate that the independent variables in the model may explain the dependent variable farmers' willingness to adopt local feed innovations (Ojo et al., 2013). However, the predictions generated by this model are suboptimal because there are several other factors that have not been accounted for. This can occur because farmers' decision-making is influenced by a dynamic and complex environment, including changes in social, economic, political, and ecological conditions (Hayden et al., 2021).

Cattle farm type and membership in a farmers' group have a significant effect on farmers classification into partial adoption and

full adoption, compared to no adoption group as a reference. Farmers who raised cattle for fattening purpose tended to refuse to adopt local feed innovation, but farmers who joined farmer group were more likely to either partially or fully adopt the local feed innovation.

Other variables like age, number of cattle, and farmers' perception of cattle farming significantly affected farmers classification to full adoption. The positive coefficient shows that the probability of farmers entering the full adoption group is lower than no adoption group. Lack of full adoption increased with age and the number of cattle. Meanwhile, the farmers' perception of their current farm management would contribute to the full adoption. Table 5 illustrates the marginal effects of the explanatory variables on the probability of different adoption categories.

Based on Table 5, farmers who raised cattle for fattening purpose had a higher probability to not adopt the local feed innovation. The marginal effect value shows that farmers running feedlot businesses are more likely to shun local feed innovation ($P < 0.05$). This is probably because feed is considered the major risk in the cattle fattening businesses (Cahyadi et al., 2019). Therefore, farmers who run cattle fattening businesses tend to maintain their existing type of feed.

Table 5. Marginal effects of the explanatory variables on the probability of different adoption category

Variables	No adoption		Partial adoption		Full Adoption	
	dy/dx	p value	dy/dx	p value	dy/dx	p value
Age	0.00428	0.193	0.00231	0.582	-0.00660	0.073*
Formal education	-0.00382	0.739	0.00250	0.860	0.00132	0.918
Cattle	0.01786	0.372	0.06087	0.052*	-0.07873	0.021**
Fattening	0.24611	0.013**	-0.14374	0.179	-0.10238	0.264
Member	-0.24057	0.006***	0.04602	0.742	0.19454	0.132
Perception	-0.15206	0.101	-0.09344	0.394	0.24550	0.005***
Crop residue	-0.03264	0.681	0.23005	0.020**	-0.19741	0.016**

*Significant at level 10%, **Significant at level 5%, ***Significant at level 1%

Membership in a group of farmers has a significant and positive effect on the classification of farmers into different categories of adoption. Farmers who joined the farmer's group had a higher probability to accept local feed innovation. The marginal effect value shows that farmers' involvement in the group of farmers has a significant and negative effect ($P < 0.01$) on their probability to refuse the local feed innovation. In other words, farmers who engaged with fellow farmers in a common group tended to partially and/or fully adopt the local feed innovation.

Farmer's involvement in the farmer's group also encourages the adoption of technology (Putra et al., 2017). Farmers involved in a farmer's group have a wider access to more extensive information (Teklay and Teklay, 2015). Counseling and monitoring activities for farmers in groups also positively affected their ability to adapt to technology (Guntoro and Priyadi, 2012). Therefore, optimizing farmers' coaching programs especially through farmers' groups is expected to improve the effectiveness of adopting local feed innovation.

Farmers' age has a significant and negative effect ($P < 0.10$) on their willingness to fully adopt the local feed innovation. In other words, age is inversely proportional to the probability of farmers who are willing to adopt feed innovation, thus indicating that elderly farmers are less motivated to grow and develop their business, while younger farmers show enthusiasm in adopting technology to gain more benefits in their business (Setiana et al., 2020).

The number of cattle has a significant effect ($P < 0.10$) on farmers' willingness to adopt local feed innovation. This study shows that the greater the number of cattle, the lesser the possibility of farmers to fully adopt a new local feed innovation. This relation can also be associated with the farmers' characteristics of risk aversion (Asravor, 2019) because the more cattle they have, the more feed they must provide. For large-scale farmers, adopting the local feed innovation may pose them to a bigger risk than small-scale farmers. Also, large-scale farmers tend to have an established practice (Sohrah & Baba, 2019) which compels them to maintain their feeding strategy instead of adopting the new one.

Farmers' perception towards the cattle farming business has a positive effect ($P < 0.05$) on their willingness to fully adopt the local feed innovation. Farmers who perceive that they are satisfied with their cattle farming business tend to adopt local feed innovation. Their positive perception in cattle farming as a sustainable business are inspired by the utilization of rice straw as a feed resource for their cattle (Baba et al., 2019).

Conclusion

The willingness of beef cattle farmers to adopt local feed innovation is at a medium level where most e farmers are willing to adopt only one type of local feed innovation, either forage fodder or concentrate. Some socioeconomic factors that significantly determined the farmer's willingness to adopt local feed

innovation were the type of cattle farm, membership in the group farmer, age, the number of cattle, and farmers' perception of cattle farming business. Farmers who run a feedlot business tend to resist the efforts to adopt local feed innovation, but those who are members of a farmer group have a higher probability to fully and/or partially adopt local feed innovation. The younger farmers have more probability to adopt local feed innovation than their older counterparts, and interestingly, farmers with more cattle tend to avoid the adoption of local feed innovation. Farmers who have a positive perception of their sustainable cattle farming business have a higher probability to adopt local feed innovation. The introduction of local feed innovation to livestock farmers should consider their willingness to adopt the innovation, which can be improved by promoting sustainable cattle farming business through farmer group. This study shows that membership in a farmer's group and farmers' perception of sustainable cattle farming business had the biggest influence on the farmers' probability to fully adopt the local feed innovation.

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