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Determinant factors of farmers attitudes toward risk of potato production in Bromo plateau, Indonesia

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Farmers 'attitudes towards production risk influence farmers' decisions in managing their farming. The attitude of farmers on production risk is influenced by socio-economic factors and the application of technology. The purpose of this study is to determine the attitudes of farmers towards production risk and the determinant factors of farmer's attitude towards the risk. The study was carried out in the Indonesian bromo plateau which has a high risk due to hilly topographical conditions and steep slope. There were 160 respondent farmers taken using multi stage random sampling. The analytical method to determine the risk attitude of production uses a risk function approach developed by Just and Pope (1979) and probit regression analysis method to analyze the factors that determine farmers' attitudes towards production risk. The research results showed that 36.87% of Bromo highland potato farmers were risk takers and 63.13% were risk averse toward the production risk. Factors that influence the attitudes of farmers towards the production risk are age, education, family size, land slope, and off farm work. The making of strategies of productivity improvement and welfare of farmers need to pay attention to farmers' attitudes towards risk so that the development of agricultural management is right on target and efficient.

Keywords: risk attitude, production risk, determinant, plateau.

INTRODUCTION

Business in agriculture field is faced with a situation of risk and uncertainty. The dependence of agricultural activities on nature results in production risks, where the adverse effects of nature have greatly influenced the total agricultural yields. Production risks faced by each farmer can be seen from the existence of variations in production and acceptance. Production risk results in a decrease in the quality and quantity of the crop, even though production is the main source of income for farmers Agricultural production risks among others caused by pests and diseases, rainfall, seasons, humidity, technology, inputs and natural disasters.

Farmers as business actors must have an attitude towards production risk, because it is important making decision for farming management as well as investment decisions (Iqbal et al.,2016). Farmers' attitudes towards risk are related to the allocation of inputs because they have the hope to obtain optimal production and income. This attitude can also help farmers in measuring the prospects for business sustainability and the magnitude of the consequences of the risks they must bear. Farmers' willingness to accept or reject the risks has the great relation with the attitude of these farmers. Attitudes toward risk are divided into accepting risk, neutral and rejecting risk.

In Indonesia, potato is a vegetable commodity that is widely grown by highland farmers, the reason is that the price is competitive with other vegetable commodities such as cabbage, carrots and cauliflower. In addition, the demand for potatoes continues to increase either the local market, inter-island and exports become good business opportunities for farmers. Most of the demand for potatoes is for food (90%) and the rest is for seeding (Ministry of Agriculture, 2017). The increasing demand for potatoes must be balanced with production. The development of potato production and productivity in Indonesia is quite good although from year to year it is still experiencing fluctuations. Fluctuations in production due to a very large dependence on the weather, market prices and government policy support. Therefore, although the consumption needs of potatoes in Indonesia have been met, but potatoes still need special attention in its development so that Indonesian potatoes have the competitiveness and farmer's welfare increases.

Bromo plateau is one of the highlands in Indonesia which is the center of potato production in Indonesia. In this plateau most farmers are smallholder farmers with an average land ownership of less than 1 hectare. Characteristics of smallholder farmers in addition to land ownership namely limited socio-economic factors among others education, capital, technological and subsistem mastery. This becomes their own problem in facing production risk. Several studies have found that farmers' socioeconomic factors influence the determination of attitudes towards production risk (Ullah et al., 2015; Saqib et al., 2016; iqbal et al., 2016; Ahmad et al., 2019). Therefore the purpose of this study is to determine the attitudes of farmers toward production risks and analyze the factors that influence farmers in determining attitudes toward production risks.

MATERIALS AND METHODS

Study Area and Research Time

The location of the study was intentionally determined in Pasuruan Regency. Purposive technique was carried out based on the consideration that Pasuruan Regency was in the Bromo highlands and the center of potato cultivation. The study was conducted in July - October 2018.

Data collection Techniques and Sampling Techniques

The type of data used is cross section data taken through direct interviews with respondents. Determination of the sample is done by multistage random sampling technique. In the first stage, Pasuruan Regency was chosen deliberately because it became the largest potato center in East Java and located in the Bromo Plateau. Pasuruan Regency contributes 67% of East Java potato production. The second stage determines the sub-district of Tosari because this sub-district become the largest potato center in Pasuruan district/regency which located in the Bromo Plateau. The third stage is to determine villages that represent several heights. Tosari Subdistrict is located at an altitude of 1000-2200 meters above sea level, then selected 4 villages which represent various levels of altitude. The fourth stage determine the number of samples intentionally namely 50% of the number of farmers in each village, so that obtained 160 respondent farmers.

Analysis Method

Analysis of attitudes toward risk :

The analysis used to determine farmers' attitudes towards production risk is the function of production risk of Just and Pope (1979). This model explains that production is not only determined by the production function but also pay attention to the risk function. The model is :

$$y = f(x,z) + u = f(x,z) + g(x,z) \quad (1)$$

Where : y = production (kg); f(x,z) = production function; g(x,z) = risk function; x = production input; z = the number of inputs remains quasi; ε = error term. The stages of estimating production risk are carried out in two stages: first, estimating the production function f (x,z). Second, calculate the absolute value of the remainder of the production function, the dependent variable in estimating the function of production risk g(x,z). Here, the independent variable of risk function is the same as the independent variable of production function. This step is as suggested by Asche and Tveteras (1999); Kumbhakar and Tveteras (2003).

Furthermore, to determine farmers' attitudes towards risk, the Just and Pope (1979) model assumes that producers are trying to maximize the utility measured through the income maximization approach. The utility function can be written as $E =$

$\left[U\left(\frac{\pi^e}{p}\right)\right]$. Expected profit (π^e), formulated as follows :

$$\pi^e = py - w'x = pf(x,z) - w'x + pg(x,z)\varepsilon \quad (2)$$

Where : π^e = expected profit, p= output price,y = production/output, w = variable input price vector (w_1, ..., w_j), x = number of inputs used
Normalized expected profit is formulated as follows :

$$\frac{\pi^e}{p} = y - \frac{w'}{p} = f(x,z) - \frac{w'x}{p} + g(x,z)\varepsilon = f(x,z) - \widetilde{w'}x + g(x,z)\varepsilon \quad (3)$$

$\widetilde{w}$: vector from normalized input prices $\widetilde{w_j} = \frac{w_j'}{p}\ \forall j = 1, \ldots\ldots j$
By assuming the producer maximizes the expected utility from the normalized expected profit, then *first-order condition* (FOC) :

$$E\left[U'\left(\frac{\pi^e}{p}\right)\ (f_j(x,z) - \widetilde{w_j} + g_j(x,z)\varepsilon\right] = 0 \quad \forall j = 1, \ldots\ldots j \quad (4)$$

Where :
$U'\left(\frac{\pi^e}{p}\right)$ = marginal utility of normalized expected profits
f_j = first derivative from the production function toward input variable to-j
g_j = first derivative of the production variability function from input variable to-j
To obtain the function of behavior towards risk, then:

$$f_j(x,z) = \widetilde{w_j} - g_j(x,z)\frac{E\left[U'\left(\frac{\pi^e}{p}\right)\varepsilon\right]}{E\left|\frac{\pi^e}{p}\right|} = \widetilde{w_j} - g_j(x,z)\theta_1\ \forall j = 1, \ldots\ldots j \quad (5)$$

Where
$:\frac{E\left[U'\left(\frac{\pi^e}{p}\right)\varepsilon\right]}{E\left|\frac{\pi^e}{p}\right|} = \theta_1$, is to determine the attitude toward risk, so that the function of attitude towards risk becomes:$f_j = \widetilde{w_j} - g_j\theta_1$ (6)
If $g_j > 0\ and\ \theta_1 < 0 \Rightarrow f_j < \widetilde{w_j} - g_j\theta_1 \Rightarrow f_j$must increase so that$f_j = \widetilde{w_j} - g\theta_1$, or input x_1 must fall. Then :$g_j > 0$ and $\theta_1 < 0$ then producer is risk averse; $g_j > 0$ and $\theta_1 > 0$ then producer is risk taker

If $g_j < 0\ and\ \theta_1 > 0 \Rightarrow f_j < \widetilde{w_j} - g_j\theta_1 \Rightarrow f_j$must increase so that$f_j = \widetilde{w_j} - g_j\theta_1$, or input x_1 must rise. Then :$g_j < 0$ and $\theta_1 > 0$ then the producer behaves risk averse; $g_j < 0$ dan$\theta_1 < 0$ then the producers behave risk taker

Analysis of determinant factors of attitude towards production risk

Probit model or probit regression, is a model that analyzes the dependent variable with only two values. Observations with certain characteristics will be one of the categories as the main objective of probability estimation. The probit model is a nonlinear model so the method used to estimate the probit model is the Maximum Likelihood (ML) model. To interpret the probit model coefficient values, the probit model estimator values cannot be interpreted directly because the probability values are based on the normal distribution Z. So that it can only interpret directly the sign of the coefficient. The probit model equation is :

$$Y_{ij} = X'\beta + \varepsilon \quad (7)$$

Where Y is dependent variable and X is an independent variable that explains the Y variable. B_i is the estimated parameter coefficient and ε_i is error term. In equation 8 we can see :

$$Y_{ij} = \sum X'\beta + \varepsilon \quad (8)$$

The dependent variable in binary form is indicated by Y_{ij}. Y valued 1 and 0. In this study Y shows the attitude of farmers towards production riskvalued 1 if the farmer is brave to take risks and 0 if he refuses risk. Variable X consists of socioeconomic factors such as age, education, farming experience, family size, work outside of agriculture and application of technology, namely the use of mulch and terracing application. Further explanation about the variables used in the probit model can be seen in table 1.

Table1. The variables used in the probit model

No	Variable	Data type	Measurement
1	PR : Attitudes toward production risks	Nominal	Risk taker farmer valued 1 and if risk averse valued 0
2	X1 : Farmer age	Ratio	Farmer age, variable unit is year.
3	X2 : Education	Ratio	The length of time a farmer take education is measured by years
4	X3 : Farming experience	Ratio	The length of time a farmer in farming is measured by years
5	X4 : Family size	Ratio	The number of family members, measured by people
6	X5 : Frequency of counseling and training	Ratio	The frequency of farmers participating in counseling and training in one planting season, measured its frequency
7	X6 : Land slope	Ratio	The slope of the farmer's land is measured by %
8	D1 : Off-farm work	Nominal	Farmers who do other work outside agriculture valued 1, valued 0 if only farming
9	D2 : Dummy Mulch	Nominal	Using mulch valued 1, not using valued 0
10	D3 : Dummy terracing	Nominal	Using terracing valued 1 and not using valued 0

RESULTS AND DISCUSSION

Description of the characteristics of the respondent farmers

The average age of respondent farmers was 43 years and the average potato farming experience was 22 years. The average time of education is 7 years this means the average level of education of the respondent farmers is primary school. Family size is the number of family members to be borne by farmers, the average number of family members is 4 people. The average number of family members to be borne by farmers is the productive age, that is, their children range in age from 10 - 20 years. The frequency of counseling and training is the frequency of farmers participating in training and counseling in one growing/planting season, the average farmers attending counseling and training is 3 times. Farmers who do other work outside agriculture equal to 42% and those who rely on the profession of farmers as the main job equal to 58%. Farmers began to apply land conservation technology, namely the use of mulch and terracing. Farmers who use mulch amounted to 39% and those who use terracing amounted to 42%.

Farmers' Attitudes Towards Production Risk

The results of the analysis of the Just and Pope (1979) model in determining farmers' attitudes towards production risk can be seen in table 2.

Based on table 2, it can be seen that the bromo highland potato farmers are mostly risk averse towards production risk, namely equal to 63.13%. Farmers who are risk takers are 36,87%. This research is in line with several previous studies which stated that farmers tend to be risk averse toward the risk of productioni (Addey, 2018; Waweru, 2017;Chen et al., 2018; Moser et al., 2015; Iyer et al., 2019). This shows that the existence of large risk in the form of climate change, pest attacks, and natural disasters that make many bromo highland potato farmers have risk averse attitude toward production risk. Duong et al., (2019) state that studies in developing countries cite that the source of production risk is related to climate change. Furthermore Riswan et al., (2019) in a study of rice farmers found that floods, the high price of input, increase in temperatures, and crop diseases are a source of perceived risk to farmers.

Determinant factors of farmer's attitude towards production risk

Significant factors in determining risk attitudes of farmer behavior are education, family size, land slope. Probit regression analysis results can be seen in table 3.

Table 2. Distribution of farmers' attitudes towards production risk in the Indonesian bromo plateau

Farmer's Attitude	Farmers (people)	Percentage (%)
Risk Taker	59	36.87
Risk Neutral	0	0
Risk Averse	101	63.13
Total	160	100

Source: Analysis of primary data, 2019

Table 3. Estimation of probit model parameter

Independent Variable	Coefficient	Std. Err	Z	P>|z|	dy/dx
Age	* -0.0446	0.0244	-1.83	0.0674	-0.0028
Education	*** -0.2082	0.0744	-2.79	0.0052	-0.0355
Farming experience	0.0303	0.0188	1.59	0.1114	0.0069
Family size	** 0.2354	0.0992	2.37	0.0176	0.0655
Frequency of Counseling and training	0.1956	0.1228	1.59	0.1114	0.0239
Land slope	* -0.0222	0.0120	-1.85	0.0641	-0.0068
Off-farm work	** -0.6579	0.2703	-2.43	0.0149	-0.1254
Dummy Mulch	0.0374	0.2563	0.14	0.8839	0.0409
Dummy terracing	0.0885	0.2782	0.31	0.3181	0.0869
Constanta	1.7555	1.4764	1.19	0.2344	
Number of observation = 160					
LR Chi^2 = 54.98					
Prob > chi^2 = 0.0004					

Source: Analysis of primary data, 2019
Information : ***: Significant in α =1%, ** : Significant in α =5%, *: Significant in α =10%

Table 3 shows the results of the probit regression analysis for the determinant factors of farmers' attitudes towards production risk. The purpose of probit regression in this study is to look at the effect of changes in several independent variables, among others age, education, farming experience, family size, frequency of attending training counseling, land slope, work off farm job, the use of mulch and the use of terracing toward risk behavior. From these results then the probit model of production risk attitude is:

$Pr(Z)= 1.7555 - 0.0446X_1 – 0.2082X_2 +0.0303X_3 + 0.2354X_4 + 0.1956\ X_5 – 0.0222\ X_6 – 0.6579\ D_1 + 0.0374D_2 + 0.0885D_3 +ε$

Probit analysis results show that the age variable has a significant negative affect on production risk attitude, this is not in line with research Saqib et al. (2016), Fahad et al. (2018), and Ahmad et al. (2019) which states that age has a significant positive effect on farmers' attitudes towards production risk. The value of marginal effects on the age variable amounted to -0.0028 it means that each farmer's age increases by one year, then the probability of changes in the risk attitude of someone's production equal to 0.28%. Education variable has a significant negative effect on production risk attitudes. This shows that education has the opposite relationship toward risk behavior. Farmers who are highly educated more risk-averse. Farmers who have higher education get more knowledge and technology of agricultural innovation so that they are more likely to have strategies in their farming. The value of Marginal Effects on the education variable is -0.0355 meaning that the longer the education, then the probability of a change in a person's risks behavior has decreased by 3.55%. The results of this study are in line with the research of Ullah et al. (2015), Saqib et al. (2016) and Iqbal et al. (2016), Fahad et al,. (2018), and Ahmad et al. (2019). Based on observational data, the average respondent farmer had elementary school education so for farmers whose education level is high school or undergraduate will tend to avoid risk. The experience of farming does not significantly influence on the production risk attitude. The average experience of farming is 22 years, because most farmers in the Bromo highlands are farmers from generation to generation. The coefficient of the variable is positive and has a

marginal effect of 0.0069 meaning that the longer the experience of farmers in managing their farming, then the farmers tend to be risk taker. The results of this study are contradict with research by Fausayana et al., (2017) that education has a negative effect on production risk attitudes so that farmers are more risk averse. But the results of this study consistent with the research of Saqib et al., (2016) and Iqbal et al., (2016).

The family size variable has a significant positive effect on production risk attitudes. Marginal effect of 0.0655 means that if a family member increases by 1 person, then change in attitude towards risk is 6,55%. Farmers with larger families are more willing to accept risks, because they feel that family members can help in managing farming, especially in labor supply. The results of this study are in line with research by Patil et al. (2018). The variable of counseling and training frequency did not significantly influence on production risk attitudes. Farmers have problems in participating in counseling and training organized by farmer groups by inviting sources either from extension workers or others. These constraints are a matter of time and topography of the location, because the activities are carried out at night and the difficulty of reaching the location of the activity. On average farmers attend counseling and training 3 times during the growing/planting season or once a month. This frequency is almost the same in every farmer because in addition to time and location constraints also because of their busyness in managing their farming. The land slope variable has a significant negative effect, meaning that if the slope of the land increases, then the farmer's attitude towards risk tends to turn into risk averse. Steep slopes have a great risk on production so that farmers who have land with sharp slopes are more risk averse.

Off-farm job variable has a siqnificant negative affect on the production risk attitude. The coefficient with negative sign means that farmers who have work outside of agriculture will tend to be risk averse. Farmers who do work outside of agriculture have more extensive information about the sector outside agriculture and business opportunities, this causes them to have different perceptions about the agricultural sector and influence the business strategies they make. The results of this study are not in line with the research of Iqbal et al., (2016), Fahad et al., (2018), dan Ahmad et al., (2019). The application of land conservation technology represented by dummy mulch and dummy terracing has no effect on production risk attitudes because there are not many Bromo highland farmers applying this technology. Conventional technology is still widely used in the cultivation of potatoes such as planting according to soil contours that have the risk of erosion. Some research states that risk averse farmers are stronger in adopting technology as a risk management strategy (Liu et al., 2013; Crentsil et al., 2018; Akhtar et al., 2019). Jumare et al., (2015) asserted that advancement of agricultural technology become a means for farmers to maintain productivity from climate change, but in developing countries the absorption of this technology is slow

CONCLUSION

Farmers in the Bromo highlands on average are risk averse farmers toward production risks, this is due to topography and climate change. Determinant factors that influence farmers' attitudes towards production risks among other age, education, family size, land slope, and off farm work. Highland farmers need attention to the dissemination of agricultural technology information through counseling and training so that farmers dare to take risks and have strategies in increasing productivity and farm efficiency so that welfare increases.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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All authors have reviewed this article and made equal contributions in this study.

REFERENCES

Addey, K. A. (2018). Determinant factors of rice farmers' risk-attitudes in rural Ghana: An operational domain scale approach. Journal of Agricultural Studies, 6(1), 116-130.

Ahmad, D., Afzal, M., & Rauf, A. (2019). Analysis of wheat farmers' risk perceptions and attitudes: evidence from Punjab, Pakistan. Natural Hazards, 95(3), 845-861

Akhtar, S., LI, G. C., Nazir, A., Razzaq, A., Ullah, R., Faisal, M., ...&Raza, M. H. (2019). Maize production under risk: The simultaneous adoption of off-farm income diversification and agricultural credit to manage risk. Journal of integrative agriculture, 18(2), 460-470.

Asche F and Tveteräs R, 1999.Modeling Production Risk with a two-step procedure. J. Agric. Resour. Econ. 24(2):429-439.

Asravor, R. K. (2018). Farmers' risk preference and the adoption of risk management strategies in Northern Ghana. Journal of Environmental Planning and Management, 1-20.

Chen, X., Zeng, D., Xu, Y., & Fan, X. (2018). Perceptions, risk attitude and organic fertilizer investment: evidence from rice and banana farmers in Guangxi, China. Sustainability, 10(10), 3715.

Crentsil, C., Gschwandtner, A., &Wahhaj, Z. (2018). The Effects of Risk and Ambiguity Aversion on Technology Adoption: Evidence from Aquaculture in Ghana (No. 2229-2019-1877).

Duong, T., Brewer, T., Luck, J., & Zander, K. (2019). A global review of farmers' perceptions of agricultural risks and risk management strategies. Agriculture, 9(1), 10.

Fahad, S., Wang, J., Khan, A. A., Ullah, A., Ali, U., Hossain, M. S., ...& Bilal, A. (2018). Evaluation of farmers' attitude and perception toward production risk: Lessons from Khyber Pakhtunkhwa Province, Pakistan. Human and Ecological Risk Assessment: An International Journal, 24(6), 1710-1722.

Fausayana, I., Abdullah, W. G., Susanti, F., Sidu, D., Arimbawa, P., &Yunus, L. (2017).Factors affecting the behavior of farmers toward the risk of seaweed farming in the Bungin Permai village, southeast Sulawesi, Indonesia. Aquaculture, Aquarium, Conservation & Legislation, 10(6), 1647-1653.

Iqbal, M. A., Ping, Q., Abid, M., Kazmi, S. M. M., &Rizwan, M. (2016). Assessing risk perceptions and attitude among cotton farmers: A case of Punjab province, Pakistan. *International Journal of Disaster Risk Reduction*, *16*, 68-74.

Iyer, P., Bozzola, M., Hirsch, S., Meraner, M., & Finger, R. (2019).Measuring Farmer Risk Preferences in Europe: A Systematic Review. Journal of Agricultural Economics.

Jumare, H., Visser, M., & Brick, K. (2018). Risk Preferences and the Poverty Trap: A Look at Technology Uptake amongst Smallholder Farmers in the Matzikama Municipality.

Just, R. E., & Pope, R. D. (1979). Production function estimation and related risk considerations. *American Journal of Agricultural Economics*, *61*(2), 276-284.

Kementan. 2017. Statsitik Konsumsi Pangan. Pusat Data Sistim Informasi Pertanian.

Kumbhakar SC and Tveterås R, 2003. Risk Preference, Production Risk and Firm Heterogeneity. Scandinavian J. Econ. 105(2): 275-293.

Liu, E. M. (2013). Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in China. Review of Economics and Statistics, 95(4), 1386-1403.

Moser, S., &Mußhoff, O. (2015). Comparing the use of risk-influencing production inputs and experimentally measured risk attitude: Do decisions of Indonesian small-scale rubber farmers match? (No. 14).EFForTS Discussion Paper Series.

Patil, V., &Veettil, P. C. (2018).Experimental Evidence of Risk Attitude of Farmers from Risk-Preference Elicitation in India.

Rizwan, M., Ping, Q., Saboor, A., Ahmed, U. I., Zhang, D., Deyi, Z., & Teng, L. (2019).Measuring rice farmers' risk perceptions and attitude: Evidence from Pakistan. Human and Ecological Risk Assessment: An International Journal, 1-16.

Saqib, S. E., Ahmad, M. M., Panezai, S., &Rana, I. A. (2016).An empirical assessment of farmers' risk attitudes in flood-prone areas of Pakistan. *International journal of disaster risk reduction*, *18*, 107-114.

Ullah, R., Shivakoti, G. P., & Ali, G. (2015). Factors effecting farmers' risk attitude and risk perceptions: the case of Khyber Pakhtunkhwa, Pakistan. *International journal of disaster risk reduction*, *13*, 151-157.

Waweru, C. W., Nyikal, R., &Busienei, J. R. (2017). An Analysis Of Risk Attitudes And Risk Management Strategies Among Dairy Farmers In Murang'A County, Kenya (No. 1720-2018-2446).