INTRODUCTION

Potato is an important commodity of highland vegetable farmers. Potato prices are more stable than other highland vegetable crops. Potato farming has good prospects because its marketing is quite broad, namely domestic and foreign markets. The demand for potatoes continues to increase along with the increase in people’s income and the development of the potato-based food processing industry. The increase in demand for potatoes must be balanced with increased production. The development of potato production in Indonesia fluctuates. Production fluctuations occur due to dependence on weather, market prices, and government policy support. Data shows that in 2012 production reached 1,094,000 tons, in 2014 it was 1,435,000 tons, but in 2016 it decreased to 1,213,000 tons (BPS, 2018).

Potatoes are a horticultural commodity that is planted in more than 150 countries globally, including Indonesia. Food and Agriculture Organization data in 2017 shows that Indonesian potato production is still relatively low and only contributes 2.2% of world production and ranks 43rd in the world’s potato producers. Indonesia has several potato-producing regions, including Java, Sumatra, and Sulawesi. In the last five years, the production of potatoes in Indonesia has shown a rising trend. In 2018 reached 1,284,762 tons with a productivity level of 18.71 t/ha. As production increases, the consumption level also indicates an increase. In 2018, the level of potato consumption was 2.2 kg/capita. The increase in potato consumption was triggered by the development of the potato-based food processing industry and the food diversification program. The increase in consumption must be supported by increased production to decline dependence on imports.

Potatoes in Indonesia are highland vegetable crops because they are generally grown in the highlands, has a high production risk due to sloping land topography and steep slopes. In addition, low managerial ability in responding to sources of production risk results in the input allocation producing non-optimal production. This research aims to identify production fluctuation and farmers’ risk preferences, measure the level of technical efficiency, and determine the effect of risk preference on technical efficiency. The respondents in this study are 83 farmers. The Just and Pope risk function is used with a utility function approach to finding farmers’ risk preferences. The stochastic Frontier Cobb Douglas processes technical efficiency measurements. While to find out the influence of the factors that influence efficiency, Tobit regression is used. The analysis shows that the respondent’s behave risk-takers amounted to 62.65%. Respondents have not yet reached technical efficiency with an average level of technical efficiency of 0.774. Education, frequency of counseling and training, the application of terrace systems have a significant positive effect on technical efficiency, while land slope has a significant negative impact. Risk preference isn’t affected by technical efficiency and shows positive signs.
highlands. The highland/plateau suitable for planting potatoes is above 1000 to 3000 meters after sea level (masl). Indonesia has many plateaus which are the center of potato farming; one of them is the Bromo plateau. However, the plateau/highland has a steep slope causing erosion that does not benefit farmers and crop failure. The recommended slope of the land for potato farming is less than 30% (Henny, 2012). A more than 30% gradient has a sizeable barrier that can reduce production and profits or require substantial resources to sustain production. Farmers have no other choice, so they use the land continuously. Highland potato farming is generally carried out throughout the year without crop rotation. Planting continually in the same land can cause erosion also increase pest attacks so that production decreases. Coupled with climate change causes more diverse types of disease pests, so the use of pesticides is not measurable.

Upland/ highland farmers with steep slopes are faced with conditions that cannot be controlled. Natural disasters, landslides, and degradation of soil quality can disrupt the process of agricultural production. Liu, Zhang, Marley, & Liu (2019) stated that the topography of the land affects farmers’ behavior in increasing production. Agricultural technology to overcome topographic conditions in highlands is the application of land conservation technologies, such as the use of cover crops, the use of mulch, terracing, or crop rotation (Hong, Heerink, Zhao, & van der Werf, 2019; Nyawade et al., 2019). However, the limitation of information, counseling, and training makes farmers unable to farm properly. Farmers cannot adequately absorb innovation and technology. It is proven that not all farmers are willing and able to apply technology.

The obstacles faced by highland potato farmers are how to increase production in such environmental conditions and the weak managerial ability of farmers. Farmer’s organizational ability depends on the characteristics of farmers and the ability to use technology. Farmers in the Bromo highlands are smallholder farmers and farmed for generations. The characteristics of smallholder farmers include low education, limited capital, insufficient knowledge, and application of technology. This characteristic will make different input allocation decisions. The difference in the allocation of inputs in each farmer determines the production achieved. If the expected output is not achieved, there is a technical inefficiency. The characteristics of farmers are closely related to technical definitions, for example, socioeconomic factors, environmental factors, climate change, and the use of technology (Otitoju & Enete, 2014).

Besides being seen from the characteristics of farmers and the application of technology, it is also related to how farmers respond to the existence of risks in agriculture. Agricultural business is constantly faced with risk and uncertainty, where the risk is primarily sourced from climate change, pest attacks, plant diseases, and environmental factors (Duong, Brewer, Luck, & Zander, 2019; Sagib, Ahmad, Panezai, & Rana, 2016). Agricultural activities are very dependent on nature, so changes in natural conditions result in a decrease in total yield. Production risks faced by each farmer can be seen from the differences in productivity gains and income. The managerial ability of farmers to deal with threats is manifested in the strategies made in farming management so that its sustainability is guaranteed (Asravor, 2019; Fahad et al., 2018; Waduge, Edirisinghe, Fernando, Herath, & Jayasinghe-Mudalie, 2015).

Farmers’ attitudes towards production risk are classified into risk-taker, risk-neutral, and risk-averse (Ellis, 1993; Hong, Heerink, Zhao, & van der Werf, 2019; Kahan, 2013). Differences in risk preferences illustrate differences in farmers’ allocation of production inputs. The behavior of risk-averse farmers does not optimize the existing inputs to produce less production and, have lower income than risk-takers. Farmer’s behavior towards production risk influences the amount of production input allocation, where the amount determines the level of technical efficiency (Ellis, 1993; Just & Pope, 1979; Kumbhakar & Tsionas, 2010).

The efficiency determines the production level in allocating inputs into various alternatives of production activities. Therefore, efforts to increase production by applying the principle of allocation of optimal use of inputs become the key to production improvement (Arru, Furesi, Madau, & Pulina, 2019). The efficiency measurement of input use can measure the allocation of production inputs. One of the technical efficiency measurement methods used is the frontier stochastic production function approach. Coelli (1995) explains that the frontier production function is developing a deterministic model that measures unexpected effects (stochastic frontier) within the production limit. Research that discusses the technical efficiency of potato
farming has been carried out (Aheisibwe, Lokina, & Hepelwa, 2018; Gebru, Mohammed, Dechassa, & Belew, 2017; Sapkota & Bajracharya, 2018).

This research aims to the effect of farmer risk preferences on the level of technical efficiency of agriculture, especially in the case of potato farming in the highlands. In addition, this research includes applying technology, especially land conservation technology. In the analysis, the aim is to obtain information about the effects on the level of technical efficiency of highland agriculture. According to Adamie, Balezentis, & Asmild (2019), eliminating environmental factors in the efficiency analysis would result in policymaking, not on target.

MATERIALS AND METHODS

Production is the object of determining risk preferences and measuring technical efficiency. Production is influenced by land area, inputs used, climate, and technology. Production data were obtained from interviews with farmers. The production data used was the planting season in March 2018.

Site Study and Sampling Techniques

The location determination was conducted purposively in the Bromo highlands, considering that this area was the center of Indonesian potatoes. In the Bromo Plateau, many locations became the centers of potato production. The chosen site was Wonokitri village, Tosari sub-district, Pasuruan Regency, East Java Province. This location selection considers that this area has a high production risk because it is closest to Bromo Mountain and has a sharp land slope ranging from 45-60%. The research location was at an altitude of more than 1900 masl. The sample in this study was potato farmers at the study time, and the amount was 83 people chosen randomly from 186 farmers.

Risk Preference Analysis Method

The analysis used is a risk function model developed by Kahan (2013). In this analysis, the farming risk was assumed input and output in a competitive market so that the price is known with certainty or there is no price risk. Another assumption the farmer makes in conducting their farming is maximizing utility. This optimization used the income maximization approach in agriculture, and farmers get production output y at the price level p. Utility maximization (expected utility) is a function of normalized expected profit. The utility function can be written as formula 1):

$$E = \left[ \frac{U(\frac{\pi}{p})}{p} \right]$$

Where: $E = \text{Expected Utility}; U = \text{Utility}; \pi^e = \text{expected profit}; p = \text{price}$

Expected profit ($\pi^e$), formulated as formula 2).

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

Where: $\pi^e = \text{expected profit}; p = \text{output price (Rp)}; y = \text{production/output}; w = \text{variable input price vector (w_1, ..., w_j)}; x = \text{number of inputs used}$

Normalized expected profit is formulated as formula 3).

$$w = y - w'x = f(x, z) - w'x + g(x, z)e = f(x, z) - w'x + g(x, z)e$$

Where: $w = \text{vector of normalized input prices}$

Assuming the producer maximizes the expected utility from the normalized expected profit $\pi^e$, then first-order condition (FOC):

$$E \left[ \frac{U'(\frac{\pi}{p})}{\pi^e} \right] \left( f'(x, z) - \bar{w}g_j(x, z)e \right) = 0 \ \forall j = 1, ..., J$$

Where: $U'(\frac{\pi}{p}) = \text{marginal utility of normalized expected profits}; f' = \text{first derivative from the production function toward input variable } j; g_j = \text{first derivative from the production variability function of input variable } j$

To obtain the function of behavior towards risk:

$$f_j(x, z) = \bar{w} - g_j(x, z) \frac{\left[ U' \left( \frac{\pi}{p} \right) \right]}{\pi^e}$$

Where: $f_j(x, z) = \text{behavior towards risk} \ \forall j = 1, ..., J$

And the value of $\theta$ is the value of behavior towards risk.

So that the function of attitudes towards risk:

$$f_j = \bar{w} - g_j \theta \ \forall j = 1, ..., J$$

If $g_j > 0$ and $\theta < 0$ => $f_j < \bar{w} - g_j \theta$, or input $x_j$ must decrease. Then: $g_j > 0$ and $< 0$ then the producer behaves risk-averse $g_j > 0$ and $> 0$ then the producer behaves risk-taker.

If $g_j < 0$ dan $\theta > 0$ => $f_j < \bar{w} - g_j \theta$, or input $x_j$ must increase. Then: $g_j < 0$ and $> 0$ then the producer behaves risk-seeking $g_j < 0$ and $< 0$ then the producer behaves risk-seeking or risk-taker..
efficiency of potato production was measured using
the following formula (Coelli, 1995):

\[ TE = \frac{y_i}{y'_i} = \frac{\exp(x_i \beta + u_i)}{\exp(x_i \beta + u_i)} = \exp(-u_i) \]

Where: \( y_i \) is actual production from observations, \( y'_i \) is potential production estimation from stochastic frontier functions. Technical efficiency for a farmer ranged from 0 and 1. Technical efficiency has a value opposite of the effect of technical inefficiency.

Method Analysis of Factors on the Level of Technical Efficiency

In estimating the factors that influence the level of technical efficiency, a Tobit regression model was used. In estimating Tobit regression parameters used MLE (Maximum Likelihood Estimator). The factor estimation model that affects the level of efficiency uses the Tobit regression model, namely:

\[ TE = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 D_1 + \delta_7 D_2 + \varepsilon \]

Where: \( TE \) = the value of technical efficiency, \( Z_1 \) = farmer age (year), \( Z_2 \) = length of education (year), \( Z_3 \) = farming experience (year), \( Z_4 \) = family size (person), \( Z_5 \) = The frequency of counseling and training participated by farmers during the growing season (number), \( D_1 \) = land slope (%), \( D_2 \) = risk preference valued 1 if risk-taker and 0 if not, \( \delta_n \) = parameter coefficient of the estimated variable, \( \varepsilon \) = random error term assumed independent and distributed freely, and its distribution was cut typically with N (0, \( \delta \)).

This technical efficiency analysis was intended to determine the level of technical efficiency in the study area. The analysis of technical efficiency in this study used the frontier production stochastic approach, which was analyzed using the Frontier 4.1 program.

RESULTS AND DISCUSSION

Based on Table 1, the potato production of respondent farmers shows 18 farmers produce potatoes above 20 tons. The average output of respondent farmers is 19.2 t/ha. Potato production for each farmer is different, influenced by land area, technology, climate, and production inputs. Differences in potato production at the farmer level also indicate the technical efficiency of farmers in farming and farmers’ responses to the production risks.

Respondents’ Risk Preference

The analysis model for determining risk preference is developed by (Kahan, 2013), based on utility function derivatives. The stages in this analysis are analyzing the production function and risk function from Just and Pope’s model first. Then the estimation results are used to analyze the behavior of farmers towards production risk. The estimation result of the production and risk function coefficient parameters are included in the expected and normalized profit function. Table 2 shows the estimation results of the production function and risk function.

The main purpose of the analysis of the production function and the risk function is to determine the magnitude and sign of the parameter coefficients of each variable. The results are used to determine the farmer’s risk preferences using a utility function with a normalized profit function approach. The results of the analysis can be seen in Fig. 1.

![Fig. 1. Percentage of farmer respondents based on risk preferences.](image)

Table 1. Potato production based on farmer information.

<table>
<thead>
<tr>
<th>Production (tons)</th>
<th>No. of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5.0</td>
<td>3</td>
</tr>
<tr>
<td>5.1 – 7.5</td>
<td>13</td>
</tr>
<tr>
<td>7.6 – 10.0</td>
<td>8</td>
</tr>
<tr>
<td>10.1 – 12.5</td>
<td>16</td>
</tr>
<tr>
<td>12.6 – 15.0</td>
<td>16</td>
</tr>
<tr>
<td>15.1 – 17.5</td>
<td>5</td>
</tr>
<tr>
<td>17.6 – 20.0</td>
<td>4</td>
</tr>
<tr>
<td>≥ 20.0</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>83</strong></td>
</tr>
</tbody>
</table>
Fig. 1 describes that the percentage of risk takers towards production risk is 62.65% (52 respondents) and the percentage of risk averse is 37.35% (31 respondents). Farmers are more likely to behave risk-takers because of environmental factors that support potato farming. The research location at an altitude of more than 1900 meters above sea level and located on the volcano's slopes allows it to have fertile soil and climatic conditions that are still following potato cultivation. Farmers at an altitude of more than 1900 masl assume that the profession as a farmer is the primary profession even though some have jobs outside of agriculture. Farmers at this height are hereditary farmers, so the existence of various obstacles in farming, they try to find solutions and are active in training and counseling. Farmers dare to invest in technology because they believe that being a farmer is a job that must be preserved as ancestral heritage. It is proven that this work provides sufficient income for family needs. The technology investment conducted now is the cooperation in procuring superior seeds, both with the local government and the private sector. Besides that, cultivation technology innovations have been developed; one of them is mulch and a terrace system. The results of this study are reinforced by statements from Kidane, Lambert, Eash, Roberts, & Thierfelder (2019) that farmers in the lower plains are ambiguous towards production risk. However, this research contradicts several other studies stating that farmers tend to be risk-averse (Ahmad, Afzal, & Rauf, 2019; Chen, Zeng, Xu, & Fan, 2018; Fausayana et al., 2017).

**Table 2.** Estimation of the coefficient of production function and risk function parameters uses multiple regression.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimation of Production Function</th>
<th>Estimation of Risk Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>S.E.</td>
</tr>
<tr>
<td>Constants</td>
<td>3.86</td>
<td>0.98</td>
</tr>
<tr>
<td>Land Area</td>
<td>0.55</td>
<td>0.14</td>
</tr>
<tr>
<td>Seed</td>
<td>0.31</td>
<td>0.12</td>
</tr>
<tr>
<td>Chemical Fertilizer</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Manure</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>Pesticide</td>
<td>-0.36</td>
<td>0.19</td>
</tr>
<tr>
<td>Labor</td>
<td>0.38</td>
<td>0.13</td>
</tr>
<tr>
<td>R-square</td>
<td>0.92</td>
<td>0.02</td>
</tr>
<tr>
<td>F-calculate</td>
<td>149.24</td>
<td>0.32</td>
</tr>
</tbody>
</table>
Technical Efficiency of Potato Farming

The analysis shows the average level of technical efficiency in the altitude area of more than 1900 masl is 0.774 (Fig. 2B). It means that farmers in the research location are not yet technically efficient. The results also show that farmers’ ability to manage inputs needs to be improved to produce optimal output. Farmers are still able to increase their production by 22.6%.

The distribution of technical efficiency of potato farmers can be seen in Fig. 2. Farmers who have efficiency above the average value amounted to 50.6% and below the average 50.4%. This number indicates a gap in the value of technical efficiency. This gap occurs because of differences in each farmer’s allocation of production inputs. In addition, the existence of different managerial abilities of farmers in managing to farm.

Factors that Affect Technical Efficiency

Factors that influence technical efficiency or the occurrence of technical inefficiencies in this study are age, education, farming experience, family size, frequency of counseling and training, land slope, application of the terracing system, and farmers’ risk preferences. The previous chapter determined that risk preference in the study area is that respondents behave as risk-takers and risk-averse. The results of the analysis of these factors on the level of technical efficiency available at Table 3.

Parameters testing is simultaneously carried out to determine whether the parameters used simultaneously have a significant effect on the model. The statistical test used is the Likelihood Ratio Test. Table 3 shows that the Likelihood Ratio test value equal to 83.56 with a probability of 0.0000 means that together the independent variable (X) in the model can represent the value of Y, namely the level of technical efficiency. Table 3 shows that the factors that have a significant positive effect on the level of technical efficiency are education, frequency of counseling and training, dummy of terrace system. In contrast, the land slope has a significant negative impact.

Education level becomes an indicator of the diffusion of power and adoption of agricultural technology. Education level becomes an indicator of the distribution of power and adoption of agricultural technology. The level of education affects the quality of human resources, where the higher the level of education, in general, the higher the quality of human resources. Higher education is easier to accept and apply farming technology. Farming management is more efficient because farmers tend to have greater motivation for the progress of their farming. Education is essential because it is considered a means of investment where higher education can help improve farmers’ knowledge, skills, and expertise as capital to work more productively to improve their managerial skills and income in the future.

### Table 3. Results of Analysis of Factors that influence Technical Efficiency

| Independent Variable                        | Coefficient | Std. Err | t-value | P>|z|  | dy/dx |
|--------------------------------------------|-------------|----------|---------|-----|------|
| Constants                                  | 0.6643      | 0.1219   | 5.45    | 0.000|      |
| Age                                        | 0.0018      | 0.0021   | 0.88    | 0.383| 0.0018|
| Education                                  | 0.0104      | 0.0052   | 2.00    | 0.049*| 0.0014|
| Farming experience                         | -0.0005     | 0.0017   | -0.33   | 0.739|-0.0005|
| Number of family members                   | 0.0854      | 0.0076   | 1.12    | 0.266|      |
| Frequency of Counseling and training       | 0.0436      | 0.0111   | 3.94    | 0.000***| 0.0436|
| Land slope                                 | -0.0056     | 0.0014   | 3.44    | 0.000***|-0.0056|
| Dummy terrace                              | 0.0362      | 0.0214   | 1.69    | 0.095*| 0.0362|
| Production risk behavior                   | 0.0167      | 0.0216   | 0.77    | 0.441| 0.0167|

Number of observations = 83

LR Chi² = 83.56

Prob > chi² = 0.000

Remarks: * significant at α = 0.1; ** significant at α = 0.05; *** significant at α = 0.01
The respondent who had been educated for six years or equivalent to elementary school amounted to 48.2%, while those who had an education above equal to 39.8% and the rest had never been educated or did not complete primary school. From the analysis results, education has a positive effect on technical efficiency, meaning that farmers who take higher education have a greater efficiency level. The data shows that farmers with an education above primary school are less. Still, they are trying to maximize their ability to manage their farming in various ways, including applying cultivation technology and trying to obtain information and increase skills by attending counseling and training. The results of this study are in line with (Anang, Bäckman, & Sipiläinen, 2016; Dessale, 2019) research showed that education affects the improvement of technical efficiency.

The frequency of counseling and training is essential in building farmer managerial capacity (Dessale, 2019). The research results showed that the frequency of counseling and training had a significant positive effect on the technical efficiency of potato farming. It means that counseling and training participated by farmers increase the level of technical efficiency of potato farming. The value of marginal effects on the variable frequency of counseling and training is 0.0436. Each increase of one frequency of counseling and training followed by farmers, the change in the level of technical efficiency increases by 4.36%. Farmers actively participate in counseling and training held by the government or other institutions. Farmers understand that counseling and training are helpful for their agriculture, especially regarding technological innovations. Sapkota & Bajracharya (2018) explained that farmers' knowledge must be adequate in potato farming. Increasing knowledge can optimize the use of resources to help increase potato production. Counseling and training are a means for farmers to obtain information about potato farming from the aspects of cultivation, marketing and other information that farmers need. This activity is routinely carried out every month at least once by farmer groups or scheduled by field extension officers. Fillers/speakers can come from the government, academics, the private sector, or the officials themselves. This activity is largely an initiative of the farmers due to the geographical condition of Tosari which is far from downtown Pasuruan and the difficulty of getting information from information technology. Farmers participate in counseling and training activities ranging from 0-7 times in a single growing season. For farmers at an altitude of more than 1900 meters above sea level this activity is carried out an average of 3 times. Besides participating in extension activities and training held in the Tosari sub-district, there are also some farmers who take part in training outside the sub-district.

Agriculture in the Tosari sub-district is on the slopes of the Bromo mountain, which has a sloped topography, the land slope at an altitude of more than 1900 masl between 45-60%. This slope has consequences for soil erosion. The steep slope accelerates the rate of erosion and accelerates land degradation, namely a decrease in land quality. Nyawade et al. (2019) garden pea (Pisum sativa L. state that the potato cultivation area in East Africa has a rough topography and high soil disturbance resulting in loss of nutrients and erosion. Steep slopes require technology to prevent erosion, such as perennials as soil reinforcement, mulch use, or terrace system. Erosion will harm farmers because the plant growth is not optimal, so it affects crop yields or causes crops to damage and crop failure. Several potato farmers in the research area have implemented land conservation technology. Land conservation technologies have been applied, among others the application of terrace systems. The terrace system is adjusted to the level of the land slope. Farmers at the study site used the Gulud terrace system. The Gulud terrace system makes mounds/guludan in the land contour direction and creates an irrigation flow under the mounds/guludan. Most farmers have used the terrace system to cultivate potatoes, namely 66 people or 79.5%. The results show the land slope was significantly negative towards the level of technical efficiency, meaning that if the land gets steeper, the level of technical efficiency is lower. The value of marginal effects on the variable slope equal to -0.0056 implies that with each increase in one degree of land slope, the technical efficiency level changes decrease by 0.56%. This result is consistent with Mirie, Dessie, & Mekie (2019) state that land slope is negatively related to technical efficiency. The steep slope of the land makes it difficult for farmers to take care of plants such as pesticides. Many plants are unreachable in the higher ground with steep slopes and require a long time in pesticide spraying. In addition, steep slopes require more labor in the harvesting process.
The terrace system is one of the land conservation technologies practiced at the study site. Terrace dummy shows a significant positive effect on technical efficiency. The marginal effects value on the terrace dummy variable is 0.0362, which means that farmers who apply the terrace system tend to be efficient in farming, with a value of change amounted to 3.62%. It means that farmers who use terracing will be more efficient in agriculture. Making a terrace for sloping land is necessary to prevent erosion and landslides because if a landslide occurs, the potato tubers in the ground will disappear and cause crop failure.

In this study, farmers’ behavior towards production risk is categorized into two, namely risk-takers and risk-averse. This refers to the research results where farmers in the research location behave risk-averse and risk-takers in dealing with production risks. The analysis shows that the risk preference variable on production risk has no significant effect and is positive. However, several studies state that risk-taker farmers in allocating production inputs are more efficient than risk-averse farmers (Alam, Guttormsen, & Roll, 2019; Ellis, 1993; Kumbhakar & Tsionas, 2010). Farmers who are risk-takers tend to be efficient because they can improve their farm management strategies by applying technology, following counseling and training. Asravor (2019) states that risk-averse farmers improve farming management strategies. Liu, Langemeier, Small, Joseph, & Fry (2017) state that risk-averse farmers tended to use superior seeds and benefitted from the choice, namely an increase in income.

CONCLUSION
Agricultural production results from a combination of production factors used such as land, labor, and capital (seeds, fertilizers, pesticides). Suboptimal production is an indication of technical inefficiencies in farming. The analysis result shows that farmers tend to be risk-takers, namely 62.65% of the respondents, and risk-averse, equal 37.35%. The average efficiency level of the respondent is 0.774, which means that farmers are still not efficient in the allocation of production inputs. The factors that significantly affect technical efficiency are education, frequency of counseling and training, and application of the terracing system. In contrast, the slope of the land has a significant negative effect. Therefore, to increase the production and income of potato farmers in the research location, it is necessary to have intensive scheduled counseling and training, considering that the education level of farmers is mostly still at the elementary school level. The application of land conservation technology is significant to overcome the slope of the land. The improvement of farmer managerial ability can increase the capacity of farmers to respond to the occurrence of production risk sources so that farmers more efficiently manage their farming.

ACKNOWLEDGEMENT
The authors are grateful to the local government of Pasuruan Regency, participants, and all respondents who were supportive so that this research could be completed.

REFERENCES


Rosihan Asmara et al.: Risk Preference of Potato Farming


