

Risk Associated with Corn Farming in Madura Island

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ABSTRACT

Corn play an essential role in providing food and feed for living things in Madura Island and other parts of the country. More than 80% of the Madura Island farmer, plant this commodity, thereby, making it a productive farming activity in this region. However, its level of productivity is still below average due to the farmers' risk preference. This research, therefore, aims to analyze the risk preferences and input allocation used in corn farming. The multistage sampling was used to collect data from a total of 120 people in Bangkalan, Sampang, Pamekasan, and Sumenep Regencies located in Madura, while the Kumbhakar parametric model was used to analyze risks. The results showed that farmers are in the Risk Averse category due to poor utilization of seeds, manure, labor, and NPK fertilizer, compared to the recommended level of usage.

Keywords: Risk Preference, Input Allocation, Corn Farming

INTRODUCTION

Corn is a food crop commodity used for various purposes, such as food and in fulfilling the industrial raw materials. In 2018, the total demand for corn in Indonesia was 125,120 tons, with 52.41 tons locally produced, and the rest imported. This showed that Indonesia's ability to be self-sufficient in corn farming is far from realization.

However, various attempts have been made by the government to achieve self-sufficiency in corn production, which includes extending the farming region on marginal lands. According Riwandi (2014), stated that this was carried out because of strong adaptability to grow on marginal land. Madura Island is one of the areas in East Java Province, with approximately 18,998 hectares of marginal land, mostly for corn farming. In 2017, the Central Statistics Agency (BPS) of East Java recorded the total corn production in four regencies on Madura Island at 506,562.2 tons, while the total corn production in East Java Province was

6,335,252 tons. This condition shows that corn production contributes approximately 10.1 percent of economic growth in this Island.

One of the causes of the low contribution is the reduced farm productivity level, which is between 2-4 tons per hectare, against the average level of 7 tons. Low farm productivity is due to inefficiencies and risks (Kumbhakar, 2002; Kumbhakar & Tsionas, 2010; Lien *et al.*, 2017). Nikmah *et al.* (2013), researched the technical, allocation, and economic efficiency of corn farming in Madura. According to the research, the average number of corn farmers in the Pamekasan Regency was not yet technically, allocative, or economically efficient due to poor education and experience. Another research carried out by Isdiana *et al.*, (2014), in Sumenep Regency showed that most corn farmers were also unable to produce efficiently, due to poor farming experience. Furthermore, the research carried out by Fahriyah *et al.* (2012), on the efficiency of corn in Bangkalan, was in line

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with the previous studies. However, there is limited research on a risk assessment, which is also suspected to be the cause of the low corn productivity on Madura Island.

The risk associated with farming is one of the biggest problems in developing countries due to the limited information possessed by farmers on input/output prices, weather conditions, etc. (Aditto, 2012). In production theory, the risk is considered a constraining factor in achieving potential productivity due to the uncertainty of output/input prices, and production. Currently, various researches on risk and uncertainty are carried out using parametric approaches, utility functions, and the term distribution error assumption, which is indicated as production or price uncertainty (Kumbhakar & Tsionas, 2010). Several risk preference studies have been carried out by the following researchers (Asmara & Widyawati, 2019; Battese, 2005; Czekaj & Henningsen, 2013; Erny *et al.*, 2019; Fauziyah, 2010; Kijima, 2019; Kumbhakar & Tsionas, 2010) one faces two main problems. The first problem is associated with the choice of functional forms on the mean production function and the risk (variance, etc, using a parametric approach.

Kumbhakar & Tsionas (2010), formulated the production and risk function as follows.

$$y = f(X) + g(X)\varepsilon$$

The notation **y** denotes the amount of production, **f(X)** is an average production function, while **g(X)** is the output risk generated. In this equation, it is assumed that input and output markets are competitive, and prices are known with certainty. A producer is always expected to obtain maximum profit, and this is mathematically, written as follows.

$$\pi = py - rX = pf(y) - rX + pg(X)(\varepsilon) = \mu\pi + pg(X)\varepsilon$$

Where $\mu\pi = pf(y) - rX$

The notation **r** and **p**, denotes the input and output prices, respectively.

When the producer maximizes their profit, then the function needs to be reduced and accompanied by zero, also known as the First Order Condition. Equation 2, therefore, leads to the following.

$$\pi' = pf'(X) - ri + pgi(X)\varepsilon = 0$$

$$f'(X) = ri/p - gi(X)\theta (.)$$

$$\theta (r,p,X) = \frac{U''(\mu\pi).p.gi(X)}{U'(\mu\pi)}$$

Where First-order condition is a risk preference function associated with production. The criteria for risk preference are as follows:

- if the value is smaller than zero or negative, then farmers are categorized in the risk-averse group
- if the value is positive, then the farmer is in the risk-taker category, and
- if the value is 0, then the farmer is included in the risk-neutral category.

Risk as one of the determinants of the success of corn farming and has a significant effect on productivity. Most corn farmers in Madura are unable to produce the average required number of corns yearly maximally. According to Amzeri (2018), the corn productivity potential on Madura Island with superior techniques and varieties is approximately 10 tons per hectare. Some field extension officers stated that the sources of risk for corn farming come from diseases, pests, weather uncertainty, and availability of inputs, which are responded by farmers in different ways. Battese (2005), stated that farmers are categorized into 3 groups in accordance with how they respond to risk as follows: risk-averse, those that neutral towards it, and risk-takers.

Furthermore Frank (1988), explained that risk preferences tend to determine the level of farm productivity. Risk averse farmers tend to allocate inputs in small amounts or below the recommended standard. Therefore, the productivity level is low. Conversely, farmers that choose to be risk-takers, provide input in greater

amounts. Therefore, farm productivity is higher than risk-averse farmers. This theory is supported by Fauziyah (2010), risk production and technical inefficiency on Tobacco farming in Pamekasan. Frontier production function model with heteroskedastic error structure estimated by Maximum Likelihood estimation developed by Kumbhakar is adopted to analyze the goals. The results show that farmers allocate inputs under optimal condition. The Consequences are productivity and efficiency at low level. Asmara & Widyawati (2019), which stated that risk-averse farmers, have a lower level of technical efficiency and allocate a smaller number of inputs, compared to those in the risk-taker category. Therefore, based on the background, knowing the risk preferences of corn farmers in Madura is a basis for determining the solutions of low productivity problems. This research aimed to analyze the risk preferences of corn farmers in Madura, and the allocation of inputs used based. It is highly important to understand the risk preferences because it helps policymakers to design effective laws, thereby assisting farmers to overcome the sources of risk (Jin *et al.*, 2017).

METHODOLOGY

This research was conducted on Madura Island due to the following considerations. First, the island has a very large marginal location, approximately 18, 998 hectares,

and a greater percentage in Bangkalan, Sampang, Pamekasan, and Sumenep regencies are not utilized as shown in table 1.

Table 1
Marginal Land Area in Madura Island from 2013-2015

Regency	Marginal Land Area (Hectare)		
	2013	2014	2015
Bangkalan	2.867	2.867	2.867
Sampang	2.270	2.270	2.270
Pamekasan	6.987	2.966	2.966
Sumenep	10.154	10.154	10.895

Source: East Java Forest Office, 2016

Secondly, the large marginal potential is utilized as a means to achieve self-sufficiency in corn on Madura Island (Riwandi, 2014). Thirdly, the productivity of corn farming on the island is still very low, which is around 2-3 tons per hectare.

The data used in this research were primarily collected through interviews, using a structured questionnaire on the amount of input and output used in corn farming on Madura Island. The multistage sample method was used to obtain the required data from a total sample of 120 farmers with details of the number of samples shown in Table 2.

The method used to analyze the research objectives was the double logarithmic production and risk function adopted from the (Kumbhakar dan Tsionas

Table 2
Number of Research Samples of Risk Reduction on Corn Farming in Madura of 2019

Regency	Selected Village	Sample
Bangkalan	Pandebah and East Gili villages, Kamal Sub-district	15
	LombangDaya Village, Blega Sub-district	15
Sampang	Karang Penang Oloh Village, Karang Penang Sub-district	15
	East Ketapang Village, Ketapang Sub-district	15
Pamekasan	Pamoroh Village, Kadur Sub-district	15
	BatuBintang Village, Batumarmar Sub-district	15
Sumenep	West Lenteng Village, Lenteng Sub-district	15
	AengPutih Village, Sumenep Sub-district	15

Source: Primary Data, 2019

2010). The specifications of the model used are as follows.

$$y_{corn} = f(sd, fk, tk, fur, npk) + g(sd, fk, tk, fur, npk) \varepsilon$$

Where y is the production of corns, while $sd, fk, fur, and tk$ are the successive inputs used, which include seeds (kilograms), manure (kilograms), urea fertilizer (kilograms), labor (HOK), and NPK fertilizer (Kilogram). Meanwhile, risk preferences are calculated using the formulation as follows.

$$\theta(r, p, X) = \frac{U''(\mu\pi) \cdot p \cdot gi(X)}{U'(\mu\pi)}$$

with the following criteria,

- If θ is > 0 : Corn farmers are included in the category of risk-takers
- If θ is < 0 : Corn farmers are included in the category of risk-averse
- If θ is $= 0$: Corn farmers are included in the category of risk-neutral farmers

After the risk preferences of corn farmers are identified, they are categorized, and inputs allocated based on risk preferences.

RESULTS AND DISCUSSION

The risk preferences that exist in farmers influence the productivity level. In several studies, risk preferences have an impact on the allocation of the use of inputs provided in the commodity. However, in this research, the Kumbhakar parametric method is used to identify the risk preferences for corn farmers. In some stages, the production and risk functions are also analyzed. Therefore, based on the two functions, risk preferences are analyzed using the theta formula, with the amount determined by the derivation of the production/cost function, and input/output price.

Based on the analysis results, the functional form of the production function is obtained, as shown in Table 3.

Table 3
The Cobb Douglas Production Function of Corn Farming on Madura Island in 2019

Parameter	Coefficient	Standard Error	T count	
Konstanta	0.974	0.790	1.233	
Benih	0.219	0.204	1.073	
PupukKandang	-0.137	0.169	-0.811	
TenagaKerja	0.203	0.137	2.150	*
Pupuk Urea	-0.333	0.129	-2.427	*
Pupuk NPK	0.457	0.999	3.523	*

Description of t table: 1.979, Significant at 5% level

Source: Primary Data, 2019

Table 4
Risk Function of Corn Farming on Madura Island in 2019

Parameter	Coefficient	Standard Error	T count	
Constant	1.842	0.954	1.933	
Seed	-0.367	0.246	-1.490	**
Manure	0.0351	0.217	0.162	
Labor	-0.488	0.312	-1.565	**
Urea fertilizer	0.194	0.377	0.515	
NPK fertilizer	0.341	0.237	-0.014	

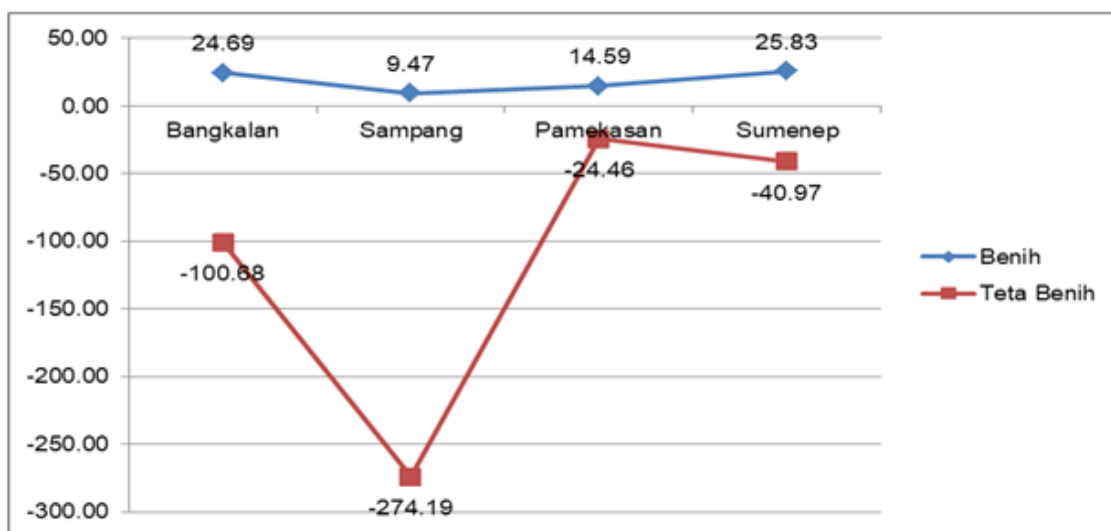
Description of t table: 1.289, significant at 10% level

Source: Primary Data, 2019

Table 5
Risk Preference of Corn Farmers in Madura and Allocation of Input Use

Description	Seed	Manure	Labor	Urea fertilizer	NPK fertilizer
Theta Value (θ)	-128.53	-0.93	-0.40	16.36	-2.06
Risk Preferences	Risk Averse	Risk Averse	Risk Averse	Risk Taker	Risk Averse
Allocation of Input Use	18.6 Kg/Ha	726.9 Kg/Ha	43.7 HOK	362.6 Kg/Ha	200.5Kg/Ha

Source: Primary Data, 2019



Source: Primary Data, 2019

Figure 1
Description of the Allocation of Use and Teta Value of Corn Seeds in 4 Regencies on Madura Island

In general, corn farmers in Madura use 5 inputs, namely seeds, manure, labor, urea, and NPK, with a significant at least at the 5% level, leading to a total of 3 inputs with significant effects. The labor and NPK fertilizer, have a positive effect, while urea is negative.

The use of labor still needs to be increased due to its ability to encourage and raise production. However, the average use is still very poor, especially in the plant rearing phase. The results of this research are in accordance with a study conducted by (Tiedemann & Latacz-Lohmann, 2013), and contrary to the (Lawalata, 2017). Meanwhile, the use of NPK fertilizer is small and is still less than the recommended limit (300 kg/ha), with an average of 200.1 kg/ha. This study is in accordance with research carried out

by (Lawalata, 2017; Nikmah *et al.*, 2013). However, it is not in accordance with the research of Battese (2005), and Ogunniyi (2015), which stated that NPK fertilizer had no effect on rice farming activities. The use of urea fertilizer among Madura corn farmers has exceeded the recommended limit (350 kg/ha), with an average of 362.9 kg/ha. The risk function also needs proper analysis to identify potential preferences. The following table is a risk function of corn farming on Madura Island.

The results of using the production and risk functions in determining its preferences are shown in Table 5.

The risk preferences of corn farmers are analyzed based on the type of input used. In seed input, farmer risk preferences are categorized as Risk-Averse Farmers, which is indicated by negative theta values

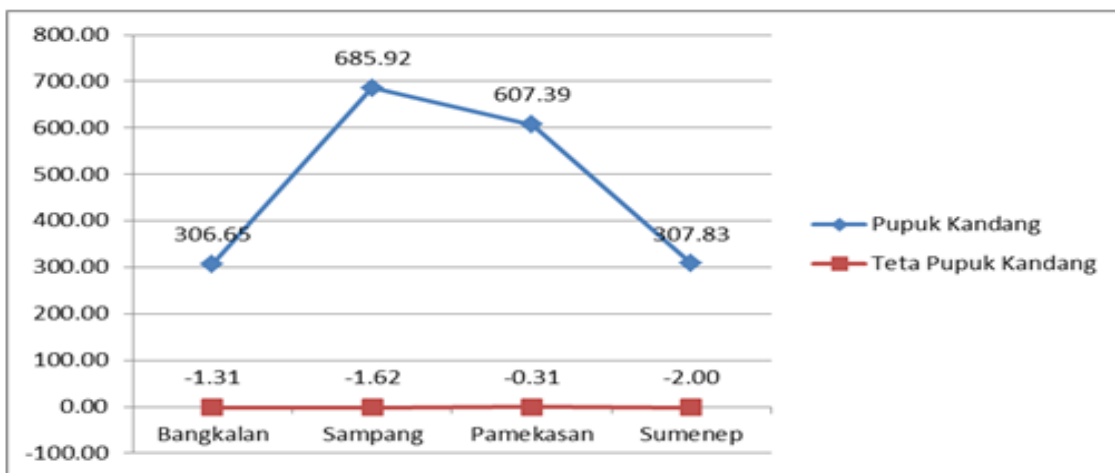
with fewer inputs. The number of corn seeds recommended by extension officers in Madura Island is 30 Kg/ha, however, an average of 18.6 Kg/ha is used by farmers.

Figure 1, showed that the average use of corn seeds in Sampang District is the lowest, with the highest Risk-Averse behavior, as indicated by the large negative teta value.

The risk preference of Madura corn farmers based on the use of manure is included in the Risk-Averse category due to its negative theta value. Farmers allocate the use of these fertilizers less than the

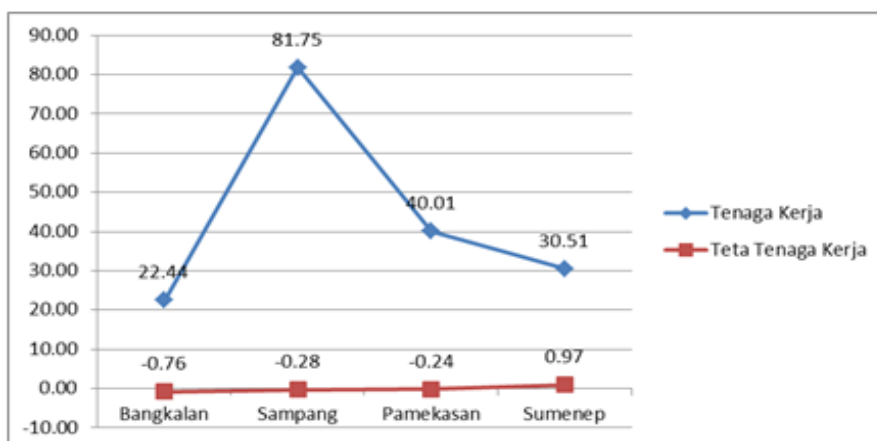
recommended use of 1000 kg/ha. Figure 2, shows that all corn farmers in Madura use less manure from chicken or cow dung, which are not advisable. In general, they buy fertilizers from breeders because the majority believes that the provision of manure does not affect the level of corn production. Therefore, they are reluctant to pay too much for their purchase.

Based on the use of labor, most of the Madurese corn farmers are grouped into Risk Averse, except those in Sumenep Regency, as shown in Figure 3. Most farmers use family labor, and only a few



Source: Primary Data, 2019

Figure 2
Description of the Allocation of Use and Teta Value of Manure in 4 Regencies on Madura Island



Source: Primary Data, 2019

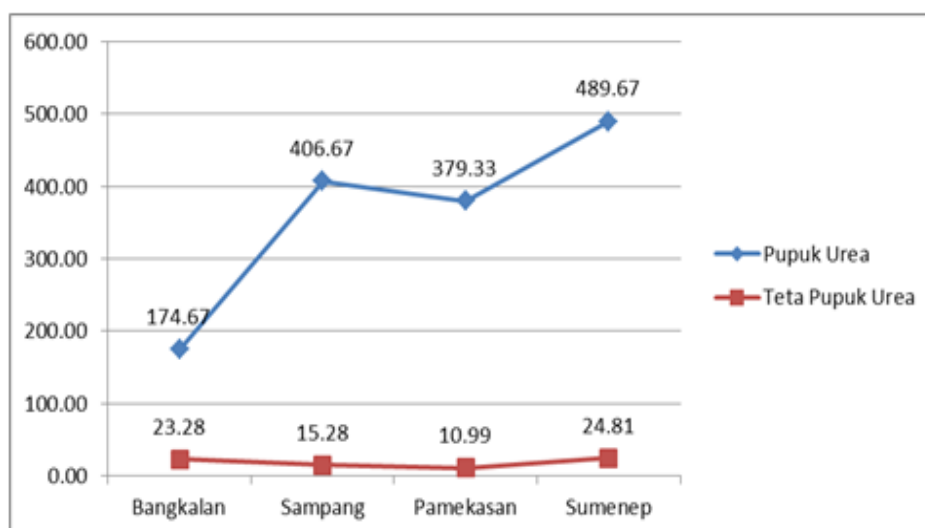
Figure 3
Description of the Allocation of use and Teta Value of labor in 4 Regencies on Madura Island

employ workers due to their inadequate income. In addition, most corn farmers do not provide intensive care in their cultivation activities because many of them have off-farm jobs that they use to fulfill their daily needs. Therefore, care is only carried out a maximum of twice in 1 growing season and during their free time. The use of labor in the Sampang Regency is more than Sumenep with Risk Taker farmers. This is due to the value of theta, which is determined by the allocation of input and output price. The price of corn in the Sumenep Regency is higher (Rp. 6000 per Kilogram) than Sampang (Rp. 4,000 per Kilogram). Therefore, the value of theta in Sumenep Regency is greater, as shown in figure 3.

Risk preference assessment based on the use of urea fertilizer shows that farmers are Risk Takers because the value of the tetra is positive. The average farmer uses the fertilizer in large quantities and exceeds the local extension officer recommended limit. According to farmers' perceptions, plants with very green leaves encourage increased corn production. This perception is not entirely true, because excessive vegetative inhibit generative growth, thereby reducing the amount of production.

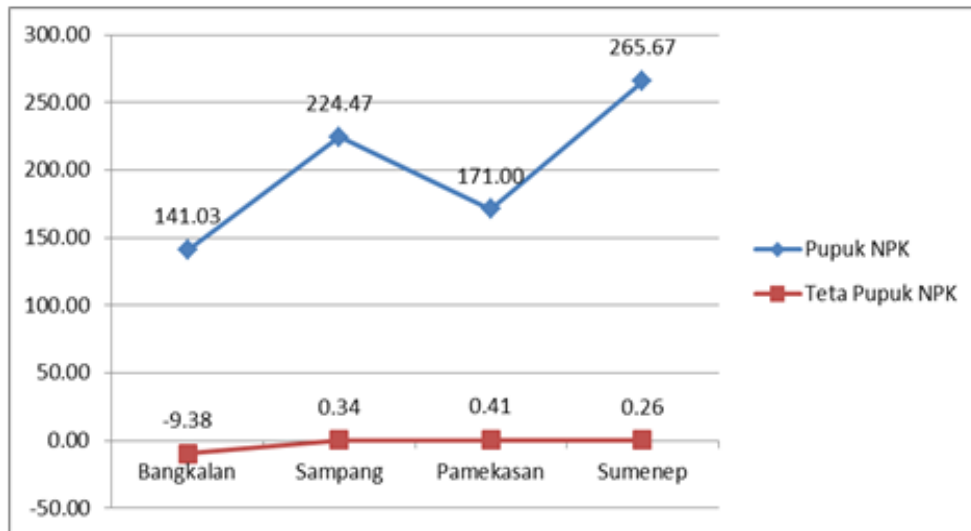
In contrast to the use of urea fertilizer, NPK is, on average, used in small amounts per hectare (200.1 kg/ha) and is not in accordance with the standard recommended use (300 kg/ha). Based on the use of these inputs, farmers' preferences are categorized as Risk Averse, with an average value of -2.06. The results of this study support the theory (Frank, 1988) and studies conducted by Asmara & Widyawati, (2019); Fauziyah (2010), risk production and technical inefficiency on Tobacco farming in Pamekasan. Frontier production function model with heteroskedastic error structure estimated by Maximum Likelihood estimation developed by Kumbhakar is adopted to analyze the goals. The results show that farmers allocate inputs under optimal condition. The Consequences are productivity and efficiency at low level.

In general, the results of the study showed that the allocation of input use by corn farmers on Madura Island is, on average, below the recommendation of the agricultural extension officer. Furthermore, their decisions are consistent with the consequences of risky behavior. Farmers groups in risk-averse, tend to reduce the input use due to the fear of loss. According to their perception, when fewer inputs are allocated, the cost is not too high.



Source: Primary Data, 2019

Figure 4
Description of the Allocation of Use and Urea Fertilizer Tetra Value in 4 Regencies on Madura Island



Source: Primary Data, 2019

Figure 5
Description of the Allocation of use and NPK Fertilizer Teta Value
in 4 Regencies on Madura Island

Therefore, assuming risk occurs, the impact they need to bear tends to be small. Besides that, they still have reserve funds to continue their farming activities.

Another factor that causes farmers to allocate fewer inputs is in their poor relationship in the groups due to the obligation for them to buy subsidized fertilizer. Therefore, the role of groups that should be a means of increasing knowledge and skills is not realized. The lack of activities, therefore, makes the group less able to contribute to improving farmers' knowledge and skills. Conversely, the activities often carried out by farmer groups to create more insights do not also provide a positive response from their members. Therefore, they do not have an adequate understanding of the technique associated with corn cultivation. However, the risk often occurs due to the allocation of non-optimal inputs and poor care, which leads to pests and diseases. Another example is the use of manure and NPK, which are not optimal, thereby affecting the growth and flowering process in line with Suprpti, (2014).

This research, therefore, provided ways to increase the productivity of corn farming on Madura Island by changing

the risk-averse behavior of most farmers. However, the process requires several key figures such as the head of the farmer group and Agricultural Extension Officers. Persuasive efforts aimed at changing risk-averse behavior into "risk-neutral" or "risk-takers," need to be carried out continuously through various program designs including visits to farmers. These efforts tend to help to obtain a high level of productivity, make demonstration plots around the Agricultural Counseling Center (BPP), optimize mutual cooperation activities among farmer group members, and increase individual visits to farmers.

CONCLUSION

Based on the results, it was concluded that corn farmers in Madura Island are mostly risk-averse, which adversely affects the low allocation of seed inputs, labor, NPK fertilizer, and manure in corn farming. This condition causes low productivity of corn farming in Madura.

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