Sugarcane Farming Risk Analysis in Malang Regency

Nuhfil Hanani(✉), Rosihan Asmara, Fahriyah, Condro Puspo Mugroho, Mahfudlotul Ula, and Susanti Evie Sulistiowati

Departement of Agricultural Economics and Rural Development, Faculty of Agriculture, Universitas Brawijaya, Brawijaya, Indonesia
nuhfil.fp@ub.ac.id

Abstract. The development of sugarcane farming needs to be done in looking for the raw material needs of the sugar industry. So that, in managing the sugarcane farming, farmers will face various risks, including production risk. This research aims to (1) Analyze the magnitude of the risk of sugarcane production and (2) To know the variable that effect the production risk. The sample was taken purposively by selecting 50 sugarcane farmers in Malang Regency. Coefficient variations analysis was used to identify the risk scale and the just and pope model was used to identify the risk factor against the production risk. The result show that (1) the risk of the sugarcane production in Malang Regency is high, its about 0,428 and (2) the factors that affect the production risk is seeds, ZA, Phonska, and pesticide. The recommendation to policymakers is pay attention to the varieties that use by the farmers and improving the farmers managerial skills.

Keywords: Sugarcane Farming · Production risk · Production · Productivity

1 Introduction

Sugarcane is the main raw material for the sugar industry, which has a strategic role in the economy in Indonesia and a source of income for thousands of sugar cane farmers and workers in the sugar industry. Accordingn to the Central Bureau Of Statistic [1] area of sugar cane is currently around 419,000 ha in 2020. Herefore, the development of sugarcane farming needs to be done in looking for the raw material needs of the sugar industry. Sugarcane production is dominated by smallholder plantations, it is about 56 percent. Meanwhile, large private plantations produce about 32 percent of total sugarcane production in Indonesia and the rest is produced by large state plantations, its about 12 percent.

East Java Province is one of the centers of sugarcane production in Indonesia. There is 47.24 percent of sugarcane production is produced in East Java, followed by Lampung Province which has sugarcane production of 34.33 percent [1]. In general, sugarcane farmers cultivate on dry land, but there are also cultivate in irrigated rice fields with various varieties. So that, there are many varieties from region to region. Because of

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that, sugarcane varieties must be adapted to the climatic condition, soils and topography of each area. This condition causes the risk of sugarcane farming production.

In manage the sugarcane farming, farmers will face various risks, including production risk and product price risk. Production risk are indicated by the fluctuations in production obtained by farmers in every season. The risk of production will be decreasing the productivity. If we look at sugarcane production in the last five years in Picture 1, it tends decrease (Fig. 1).

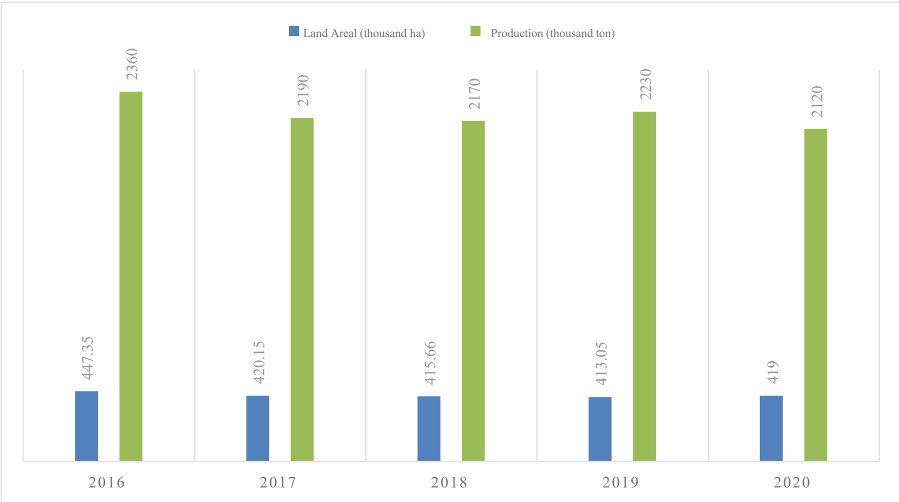

Fig. 1. Area and Sugar Production in Indonesia 2016–2020. Source: BPS, 2020 (processed)

Sources of risk that are generally perceived by farmers are including weather, product, and price uncertainty, and also plant pests and diseases. Production risks and the decreasing of productivity can be explained by the changes in weather and high levels of plant pests and diseases. Sugarcane requires the sufficient water during the vegetative formation, but requires dry conditions before the harvest season, so that the sugar formation process can run well.

Farmer activities always pose risks that must be faced by farmers, the high and low risks in sugarcane cultivation will affect farmers' decision making, especially in determining the scale of production, commodities to be cultivated. Therefore, this study aims to determine the level of production risk and identify factors that affect the level of risk in sugarcane farming.

2 Research and Analysis Method

The research was conducted in August 2022 in Malang Regency. The choice of location was determined by a purposive method because this Regency is one of the center of sugarcane production in East Java. Meanwhile, the method of determining the sample is purposive sampling with a sample of 50 respondents. Primary data collection with direct interview techniques in questionnaires and observation guidelines to obtain an overview of sugarcane farming in the research location. In addition to primary data, secondary data is also used to support this research.

The production risk analysis proposed by Just and Pope is to develop a general model for handling econometric production risk and is used to analyze production factors but does not ignore the level of risk that may occur in the production which can cause errors in calculations. So that the Just and Pope models include an error element so that the risk element can be taken into account in the production analysis. So, the error rate in the calculation is small. The basic concept introduced by Just and Pope is to construct the production function as the sum of two components, one with respect to the level of output, and one with respect to the variability of output. So that the use of the Just and Pope models is the mean production function and the variance production function, each of which is influenced by the use of these production variables so that the variance and production functions are known. The equation of the Just and Pope production risk function model can be written mathematically as follows:

$$Y = (X, \beta) + h(X, \theta)e \tag{1}$$

Description:

Y : Amount of production produced (Q)
f, h : Transforming factors of production into production results
X : Production factors used in the production process
B, θ : Quantity/coefficient to be estimated
E : Error element

The production function above consists of two combined functions, namely the output production function (means production function) which transforms the input variables into a production function and another is the production function which has added the element of risk, namely by paying attention to the variance element of the production function. To complete the calculation of the production function and the variance of the production in the form of a Cobb Douglass function. The production function model of Just and Pope can be written mathematically as follows:

Production Function

$$\mathrm{Y} = \mathrm{f(X)} \tag{2}$$

$$\mathrm{LnY} = \mathrm{Ln}\beta_0 + \beta_1\mathrm{LnX}_1 + \beta_2\mathrm{LnX}_2 + \beta_3\mathrm{LnX}_3 + \beta_4\mathrm{LnX}_4 + \beta_5\mathrm{LnX}_5 + \beta_6\mathrm{LnX}_6 + \mathrm{e} \tag{3}$$

Production Variance

$$\sigma^2 = \mathrm{f(X)} \tag{4}$$

$$\mathrm{Ln}\,\sigma^2\mathrm{Y} = \mathrm{Ln}\theta_0 + \theta_1\mathrm{LnX}_1 + \theta_2\mathrm{LnX}_2 + \theta_3\mathrm{LnX}_3 + \theta_4\mathrm{LnX}_4 + \theta_5\mathrm{LnX}_5 + \theta_6\mathrm{LnX}_6 + \mathrm{e} \tag{5}$$

Description:

Y	= Sugarcane Production (Q)
X1	= Land Area (ha)
X2	= Seeds (Q/ha)
X3	= ZA (Q/ha)
X4	= Ponska (Q/ha)
X5	= Pesticide (liter/ha)
X6	= Labor (HOK/ha)
β	= *Mean intercept*
θ	= *variance intercept*
β1, β2, β3... β6	= Estimated parameter coefficient X1, X2, X3...6
$\theta1$, $\theta2$, $\theta3$... $\theta6$	= Estimated parameter coefficient X1, X2, X3...6
e	= Error Element

3 Results and Discussion

3.1 Overview of Research Area

The descriptive statistical analysis as shown in Table 1 shows the minimum, maximum, mean, and standard deviation values for each variable. The maximum value is the highest value for each variable, while the minimum value is the lowest value for each variable. Then, the mean value is the average value of each variable studied and the standard deviation is the distribution of the data used in the study that reflects the heterogeneous or homogeneous data that is fluctuating.

From Table 1, it is known that the value of the standard deviation for all variables is smaller than the average value. This explains that the data used has been spread evenly and is homogeneous. Based on the Table 1, the lowest number of members is 1 and the

Table 1. Descriptive Statistical Analysis of Variables in Malang Regency

No	Characteristics		Malang Regencys		Standard Deviation
		Minimum	Maximum	Mean	
1	Size of Family (People)	1	7	4	1
2	Farming Experiences (Years)	1	64	27,92	15,68
3	Land Area (Ha)	0,5	5	1,80	0,95
4	Age Of Farmer (years)	27	83	53,58	13,14
5	Productivity (Q/ha)	440	3000	1363,17	412,86
6	Education	Elementary School	Bachelor	Senior High School	-

Source: Primary Data, 2022 (processed)

highest is 7. The greater the number of dependents in the family, the greater the burden on farmers to meet their economic needs. Furthermore, for the variable land area, the lowest area is 0.5 ha and the highest is 5 ha. According to Moscardi and Alain [2] land area will have an influence on the level of risk faced by producers. The larger the area of land, it will increase production and also the level of courage of farmers in facing risks. Then, the variable of farmer education. The lowest education in farmers is elementary school and the highest is bachelor. The higher the level of education possessed by an individual, it will make the individual more courageous in facing risks. This is in line with what was stated by Olarinde, *et al.,* [3], that the high education of an individual, will have an impact on the individual's courage in facing risks compared to individuals with low levels of education. As for the variable age of farmers, the youngest age is 27 years and the oldest is 83 years. Younger farmers will have risk averse behavior compared to older farmers. Furthermore, for the variable of farming experience, the individual farmer with the longest farming experience is 64 years and the minimum are 1 year. The farming experience possessed by farmers will affect farming behavior. The longer the farming experience, the more reluctant farmers are to face risks.

3.2 Sugarcane Risk Function in Malang Regency

According to Table 2, the productivity risk faced by sugarcane farmers in the Malang area is 0.428. The coefficient of variation value indicates that for every Q of expected sugarcane productivity, there is a productivity risk of 0.428 Q/ha, or a risk of 42.8 percent of total expected productivity. Because of factors such as the variety of varieties used, the availability of water on the land, and the presence of unpredictable weather and climate, the magnitude of the risk is relatively high. Based on Prain [4], and IPCC [5] soil, technology, crop variety, and geography all have an impact on the role of climate in driving inter-annual variations in sugarcane yields. According to the Margin, *et al.,* [6], rainfall changes are predictable, but highly uncertain, and vary by region. As a result of rising CO2, several studies have also documented a decline in C4 crop yields under climate change, whic stated by Marin, *et al.,* [7], and Walker, *et al.,* [8].

Table 2. Sugarcane Productivity Risk Magnitude in Malang Regency

Magnitude	Score
Variance $(Q/ha)^2$)	163626,3
Std. Deviation (Q/ha)	404,50
Coefficient variation	0,428

Source: Primary Data, 2022 (processed)

Based on Table 3, six factors, including land area, seeds, ZA, Phonska, pesticides, and labor, are included in the risk function. Land area has a positive effect on risk. This means that each additional acre of land increases the risk of production for farmers. This outcome is consistent with studies by Fariyanti et al [9], that demonstrates the risky

Table 3. Sugarcane Production Function in Malang Regency

Variable	Malang Regency		
	Coefficient	Sd. Error	T-test
Constanta	5,412031	0,5867982	9,22
Land Area (Ha)	0,8368	0,0452654	18,49
Seeds (Q/Ha)	0,0180227	0,0210709	0,86
ZA (Q/Ha)	0,0370959	0,0693752	0,53
Phonska (Q/Ha)	0,0019394	0,0164215	0,12
Pesticide (Liter/Ha)	-0,0061878	0,0080097	-0,77
Labor (HOK/Ha)	0,2370101	0,0989861	2,39

Source: Primary Data, 2022 (processed)

nature of land acreage as a production component. The production expectation function is increased by the amount of land allotted to each crop.

Sugarcane production may be influenced by the element of seed production. This is demonstrated by the positive correlation between seed consumption and production risk of 0.081, which suggests that increased seed use will result in higher production risk. For maximum yield in sugarcane farming, seeds must be used in accordance with GAP (Good Agricultural Practices) of sugarcane agriculture. Increasing sugarcane productivity is more important in seed variety selection than increasing seed population. Sugarcane yields can be predicted based on seed family diversity, which stated by James [10]. Sugarcane breeders should compare effective sizes rather than seedling population sizes. This study supports previous findings by Ali et al [11] and Singh et al [12] that seeds have a positive effect on production.

ZA and Phonska, two inorganic fertilizer variables that farmers utilize, have positive values of 0.037 and 0.00193, respectively, and these factors enhance production risk. Because inorganic fertilizers have a positive effect, increasing the amount of inorganic fertilizer increases the risk. The findings of this study contradict those of Zainuddin et al [13], Fariyanti et al [9], and Fanani et al [14], who reported that the inorganic fertilizer variable could reduce the risk of sugarcane production. The pesticide factor has a negative value of 0.0061, indicating that pesticide use can reduce the risk of sugarcane production. This is consistent with the study of Fariyanti et al [9], which claims that one of the factors that is believed to be able to maintain production in order to avoid variances or production gaps is the use of pesticides. In order to reduce pests like rats and to lessen competition between grass and sugar cane, sugarcane producers frequently employ herbicide chemicals to clear the grass. The labor factor has a positive impact of 0.237, which increases the production risk of sugarcane. The findings of this study are consistent with studies by Dlamini et al [15], Ali and Jan [16], and Ali et al [11] that demonstrated the beneficial impact of labor on sugarcane yield. The t-test results, however, revealed that labor had no appreciable impact on the risk associated with sugarcane output.

4 Conclusion

The magnitude of the risk production in Malang Regency is high, its about 0,428. It caused by the weather and climate, soil, technology, crop variety and rising CO2. And for the variable, there are seeds, ZA, Phonska and labor can affect the risk of production. Based on this conclusion, so the recommendation that can be given to the policymakers is policymakers is pay attention to the varieties that use by the farmers and improving the farmers managerial skills.

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