Production Risk Analysis for Organic Cabbage Farming in Semarang District, Central Java

Nur Rahma*, Candra Yogatama, Wulansari Winahyu, Anisah Binti Kasim

1 Department of Agribusiness, Universitas Muhammadiyah Yogyakarta, Indonesia 55183
2 Department of Agribusiness, Universitas Papua Manukwari, Indonesia 98314
3 Universiti Teknikal Malaysia Melaka, Jalan Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

Abstract. There is some risk and uncertainty involved with purchasing organic cabbage. Farming is highly susceptible to natural phenomena such as high rainfall and pest infestations. It will have consequences for the development of the harvested area, and fluctuations in production can indicate a risk to agricultural production. This study aims to determine the factors that influence organic cabbage production and to determine the factors that affect the risk of organic cabbage production in Getasan District, Semarang Regency, where this study was conducted. A total of 73 farmers were selected using a census-based sample from four INOFICE-certified organic farmer groups: Batur Village, Wates Village, Tajuk Village, and Kopeng Village. The analysis method utilized the Just and Pope production risk function and the Cobb-Douglass type production function. The Cobb-Douglass production function analysis revealed that land area, seeds, manure, and cropping patterns all positively and substantially affected organic cabbage production, but only to a limited extent. According to the Just and Pope production risk function, the risk associated with farming organic cabbage could be mitigated by increasing land area and diversity in cropping patterns.

1 Introduction

Protein, vitamins A, C, B1, B2, and Niacin are just a few of the many nutrients in cabbage (Brassica oleracea L.). Cabbage needs a cool, damp environment to thrive, such as the highlands at 800–2000 meters above sea level. Soil with a pH between 6-7 rich in humus, loose, and porous is ideal for producing cabbage. Planting can be performed at the beginning of the rainy or dry seasons. With much extra work, cabbage can be grown year-round. Cabbage is generally ready to be harvested 55 days after transplanting [1].

Organic and conventional cabbage farming are the two most well-known methods. Farmers’ enthusiastic reception of organic farming practices bodes well for the industry’s future in Indonesia [2]. It is spurred on by the growing number of organic agricultural advocacy groups and organizations [3,4] and the general public’s acceptance of organic food consumption as part of a healthy, sustainable lifestyle. The environmental consciousness of...
Cabbage is one of the best vegetables for health due to its high nutritional value, including minerals, vitamins, and dietary fiber. It is a hardy crop that can tolerate cold temperatures, making it suitable for cultivation in regions with cooler climates. Farmers often ignore the rationality of using organic fertilizers, pesticides, and hybrid seeds capable of optimal output directly influence the results of mustard farming. Organic farming refers to the cultivation of agriculture that does not use synthetic chemicals or cultivation using natural components and applies more environmentally friendly techniques.

Organic farming can also provide a solution to dependence on chemical fertilizers and pesticides that directly influence the results of mustard farming. Organic farming refers to the cultivation of agriculture that does not use synthetic chemicals or cultivation using natural components and applies more environmentally friendly techniques. It is thought to be more effective in combating climate change, eutrophication in freshwater, and soil pollution. Some consumers are also fueling the expansion of organic farming methods. This strategy is expected to increase the quality and quantity of cabbage crop production.

Organic farming can also provide a solution to dependence on chemical fertilizers and pesticides that directly influence the results of mustard farming. Organic farming refers to the cultivation of agriculture that does not use synthetic chemicals or cultivation using natural components and applies more environmentally friendly techniques. It is thought to be more effective in combating climate change, eutrophication in freshwater, and soil pollution. Some consumers are also fueling the expansion of organic farming methods. This strategy is expected to increase the quality and quantity of cabbage crop production.

In this regard, the government has launched a program to develop organic agricultural technology through the Effective Use of Available Resources (INOFICE) certification. The implementation of INOFICE certification is expected to improve the quality and quantity of cabbage crop production. In Indonesia, organic farming has been under development with the support of the government to accelerate the implementation of organic farming. The government has also implemented a collaborative program to encourage the formation of farmers' groups engaged in organic farming.炜 They are expected to improve the quality and quantity of cabbage crop production.

In this context, the government has launched a program to develop organic agricultural technology through the Effective Use of Available Resources (INOFICE) certification. The implementation of INOFICE certification is expected to improve the quality and quantity of cabbage crop production. In Indonesia, organic farming has been under development with the support of the government to accelerate the implementation of organic farming. The government has also implemented a collaborative program to encourage the formation of farmers' groups engaged in organic farming. They are expected to improve the quality and quantity of cabbage crop production.
Risks and unknowns are involved in farming organic cabbage in Getasan District. A farming enterprise relies heavily on natural factors like abundant rainfall and the threat of pest and disease infestations. Further, changes in output can signify a production risk in farming, and the use of insufficient or excessive production inputs will ultimately affect the growth of the harvested area. In light of this background information, a question emerged. In the Getasan District, where organic cabbage is grown, what factors influence production and affect the production risk?

This study aims to determine the factors that influence organic cabbage production and to determine the factors that affect the risk of organic cabbage production in Getasan District.

2 Research Method

This research was conducted on organic cabbage farmers in Getasan District, Semarang Regency, Central Java, considering the largest level of cabbage production in this regency. Another reason was that several farmer groups cultivate cabbage organically and have organic vegetable certification from INOFICE. The respondents were 73 farmers from four farmer groups with INOFICE organic vegetable certification.

This study utilized the analysis of the Cobb-Douglass type production function and the risk function of the Just and Pope model, tested statistically by testing the coefficient of determination ($R^2$), F test, and $t$-test. The model was formulated as follows.

Cobb-Douglass type production function:

$$Y = \beta_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} D^d \varepsilon$$

Production risk function:

$$\sigma^2 = \theta_0 X_1^{\theta_1} X_2^{\theta_2} X_3^{\theta_3} X_4^{\theta_4} X_5^{\theta_5} D^d \varepsilon$$

Equations 1 and 2 were converted into multiple linear forms to make estimating them easier.

Production Function:

$$\ln Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + \ldots + b_5 \ln X_5 + dD + \varepsilon$$

Production risk function:

$$\ln \sigma^2 = \ln \theta_0 + \theta_1 \ln X_1 + \theta_2 \ln X_2 + \ldots + \theta_5 \ln X_5 + dD + \varepsilon$$

Description:

$Y$ = Organic cabbage production output

$\sigma^2$ = Risks of organic cabbage production

$bi$ = Regression coefficient of the production function

$\theta i$ = Regression coefficient of the risk function

$d$ = Dummy variable regression coefficient

$X1$ = Land (M$^2$)

$X2$ = Seed (stem)

$X3$ = Manure (Kg)

$X4$ = Botanical pesticide (L)

$X5$ = Labor (daily work equivalent to men)

$D$ = Dummy cropping pattern (1: Intercropping; 0: Monoculture)

$\varepsilon$ = Element of error.
3 Research Results and Discussion

3.1 Farmer Identity

Farmer identity refers to their inner characteristic, a benchmark for managing farming and accepting innovation. The identity of the farmers in this study described 73 respondents who were organic cabbage farmers in Getasan District, including the age, gender, education level, farming experience, and land ownership area.

Table 1. Identity of Organic Cabbage Farmers in Getasan District

<table>
<thead>
<tr>
<th>Profile</th>
<th>Total</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39-51</td>
<td>31</td>
<td>42.46</td>
</tr>
<tr>
<td>52-64</td>
<td>21</td>
<td>28.77</td>
</tr>
<tr>
<td>65-77</td>
<td>13</td>
<td>17.81</td>
</tr>
<tr>
<td>78-90</td>
<td>1</td>
<td>1.37</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>50</td>
<td>68.49</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>31.51</td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No School</td>
<td>4</td>
<td>5.48</td>
</tr>
<tr>
<td>Elementary School</td>
<td>37</td>
<td>50.68</td>
</tr>
<tr>
<td>Junior High School</td>
<td>19</td>
<td>26.03</td>
</tr>
<tr>
<td>Senior High School</td>
<td>10</td>
<td>13.70</td>
</tr>
<tr>
<td>Higher Education</td>
<td>3</td>
<td>4.11</td>
</tr>
</tbody>
</table>

Table 1 continued:

<table>
<thead>
<tr>
<th>Profile</th>
<th>Total</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Farming Experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-18</td>
<td>25</td>
<td>34.25</td>
</tr>
<tr>
<td>19-27</td>
<td>17</td>
<td>23.29</td>
</tr>
<tr>
<td>28-36</td>
<td>7</td>
<td>9.59</td>
</tr>
<tr>
<td>37-45</td>
<td>1</td>
<td>1.37</td>
</tr>
<tr>
<td><strong>Land Area (m²)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-2060</td>
<td>48</td>
<td>66.23</td>
</tr>
<tr>
<td>2061-3042</td>
<td>12</td>
<td>16.35</td>
</tr>
<tr>
<td>3043-4023</td>
<td>13</td>
<td>17.81</td>
</tr>
<tr>
<td>4024-5000</td>
<td>2</td>
<td>2.74</td>
</tr>
</tbody>
</table>

Most organic cabbage farmers in Getasan District were between 39-51 (42.72%), meaning they were of mature, productive age, with physical and mental abilities and a good capacity to receive information and innovation. It enabled them to manage production factors and implement organic farming to boost production [24].

Male farmers dominated organic cabbage farming in Getasan District because organic cabbage farming involved heavy physical activity. Women's labor was only employed to assist in seeding, planting, and harvesting. However, the research results unveiled that women played a role in organic cabbage farming because the husband, as head of the family, had a main job other than farming.

The educational level of organic cabbage farmers in Getasan District was mostly elementary school, reaching 50.68%. It implies that the education level of organic cabbage farmers in Getasan District still needs to be higher. However, a low level of education does not mean that farmers have less knowledge. These farmers learned much about organic farming through farmer group activities or extension programs.

Only between 10 and 18 years of farming experience have been devoted to organic cabbage. Batur Village’s farmers, who were among the movement’s earliest pioneers, have been at it the longest; farmers in Wates Village, Tajuk Village, and Kopeng Village, on average, only began organic farming in the 2010s. This finding suggests that organic cabbage farmers in Batur Village had a more refined understanding of managing production parameters and assessing the risks associated with their enterprise than their counterparts in other villages. Longer experience implies means better farmer managerial skills [25].
3.2 Analysis of Production Function and Production Risk Function

The production function of organic cabbage was analyzed using the Cobb-Douglas type production function model, while the production risk analysis employed the Just and Pop approach. Factors influencing the production and production risk of organic cabbage farming encompassed land area (X1), seeds (X2), manure (X3), botanical pesticides (X4), labor (X5), and cropping patterns (Dummy) on organic cabbage production (Y). Table 2 depicts the regression coefficient value of the Cobb-Douglas type production function and production risk function.

Table 2. Regression Coefficient of Production Function and Risk Function of Organic Cabbage Production in Getasan District

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression Coefficients</th>
<th>Production Function</th>
<th>Risk Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td></td>
<td>6,242 ***</td>
<td>1,431 ***</td>
</tr>
<tr>
<td>Land Area (X1)</td>
<td></td>
<td>0.097 **</td>
<td>-0.039 ***</td>
</tr>
<tr>
<td>Seed (X2)</td>
<td></td>
<td>0.592 ***</td>
<td>-0.005 NS</td>
</tr>
<tr>
<td>Manure (X3)</td>
<td></td>
<td>0.115 *</td>
<td>0.007 NS</td>
</tr>
<tr>
<td>Botanical Pesticides (X4)</td>
<td></td>
<td>0.034 NS</td>
<td>-0.029 NS</td>
</tr>
<tr>
<td>Labor (X5)</td>
<td></td>
<td>-0.048 NS</td>
<td>0.001 NS</td>
</tr>
<tr>
<td>Planting System (Dummy)</td>
<td></td>
<td>0.552 ***</td>
<td>-0.044 *</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>0.890</td>
<td>0.273</td>
</tr>
<tr>
<td>F-Count</td>
<td></td>
<td>89.141 ***</td>
<td>4.130 ***</td>
</tr>
</tbody>
</table>

Description: **: Significant α= 1%; ***: Significant α= 5%; *: Significant α=10%; and NS: Non significant

The regression analysis results obtained an R² (Coefficient of Determination) of the production function of 0.890, meaning that the ability of the independent variable land area (X1), seeds (X2), manure (X3), pesticides (X4), labor (X5) and planting systems (Dummy) could explain the dependent variable organic cabbage production (Y) of 89.0%. In contrast, the remaining 11% was explained by other factors excluded in the model. Conversely, the regression coefficient of the risk function was only 27%, indicating that production risk was not only influenced by production factors but also other factors not explained by the model, such as rainfall, cultivation techniques, input prices, cabbage prices, and others.

The F test revealed that the independent variables significantly affected the dependent variable in the production and risk functions. Thus, this model could be continued with the t-test.

Based on the regression analysis results, the factors that significantly influenced the production of organic cabbage comprised land area, manure, seeds, and cropping pattern dummy variables. The only significant effect on the risk of cabbage production was land area and the dummy variable.

The effect of the dummy variable on the cropping system, both on the production function and the risk function, as well showing a significant regression coefficient, signifies a difference in the effect of the use of production factors on organic cabbage production and the risk of organic production between organic cabbage grown in intercropping and monoculture. However, the dummy variable of the cropping system in the production function was positive. Hence, production factors of organic cabbage grown in intercropping gained higher production than that of organic cabbage grown in monoculture.

The finding was in accordance with Li et al. [26] that stated the intercropping system showed an increase in yield. Conversely, the dummy variable in the risk function had a negative value, meaning that the use of production factors of organic cabbage grown in intercropping possessed a lower production risk than production of organic cabbage grown in monoculture.
It must be appropriate, timely, and targeted, requiring patience—another factor to consider in land area production. Adding organic pesticides function, adding plant production risk because not 50% of farmers employ them. Fungal diseases are slightly contradictory in that the use of organic cabbage could boost production and reduce the risk of organic cabbage production. The regression coefficient value, adding vegetable pesticides, and able to adapt without the additional use of manure significantly reduced production risk. cabbage farmers in Getasan District, East Lombok, that the regression coefficient of large chili seedlings would enhance production and reduce the risk of organic cabbage production. The results of this study are in contrast to research in Chhattisgarh, India, where the seed production factor had a negative coefficient and tended to increase organic cabbage production. The results of this study are in contrast to research in Sikur, Indonesia, where seeds were added significantly and harm production. In that case, it would be better if farmers in these two countries mostly still have adequate technical knowledge, so when the land is expanded, they will encounter difficulties in management. Organic cabbage farmers in Getasan District reduce production risk even though it suffered from low quality seeds according to the area of land managed. The seeds used must also be resistant, able to adapt, and able to survive and recover from damage caused by pests. The use of seeds has served as an alternative to integrated pest control, and the results align with research on water spinach in Mranggen, Demak; adding organic cabbage with commodities such as chicory, bok choy, carrots, radishes, and beetroot. Pest and disease attacks often found on organic cabbage include whiteflies, stem flies, aphids, thrips, caterpillars, whiteflies, clubroot, and water rot. The application of intercropping intercrop which has served as an alternative to integrated pest control, natural enemies to suppress and control pest populations. Farmers could boost production and reduce the risk of organic cabbage production. The results of this study were still available, dominant in absorbing nutrients, and raised the risk of production. Sufficient manure could boost the production of organic vegetables, but ha is inadequate technical knowledge, so when the land is expanded, they will encounter difficulties in management. Inadequate technical knowledge, so when the land is expanded, they will encounter difficulties in management.
and tenacity. This study's results of estimating plant pesticide production factors contrast the use of liquid pesticides in shallot farming in Bagor District, Nganjuk Regency. Liquid pesticides are inorganic. If used excessively, they will significantly raise production risks.

The use of labor was seen from the production and risk functions; statistically, these production factors had no effect. The regression coefficient for organic cabbage production depicted a negative result, meaning that adding labor while other production factors remain the same will still reduce organic cabbage production. The use of labor for organic cabbage farming in Getasan District mostly employed large amounts of family labor even though the land owned was relatively small. Hence, this excessive labor decreased production and increased the risk of organic cabbage production, as demonstrated in the regression coefficient, where risk functions have a positive value. This excessive and non-optimal use of labor was carried out by farmers when transporting the harvest, lacking supervision and causing shrinkage or damage to the harvest. These findings are in contrast to research in Manikganj, revealing that labor production factors had a significant and positive influence on mustard production. Meanwhile, the increase in risk due to additional labor is in line with research on spinach farming in Siantan Hilir and beans farming in Bangladesh, disclosing that additional labor increase production risk and was significant to production risk.

4 Conclusion

- Land area, seeds, manure, and dummy planting system positively and significantly influence organic cabbage production in Getasan District. There were production differences between organic cabbage grown in intercropping and monoculture.
- Land area, seeds, vegetable pesticides, and dummy planting systems affect the risk of organic cabbage production. Differences existed in the risk of organic cabbage production with intercropping and monoculture cropping systems. Adding land production factors declined risks, while adding manure and labor production factors raised risks.

References