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INCOME RISK MANAGEMENT OF CABBAGE FARMING WITHIN AGROFORESTRY ZONE IN KARANGKOBAR SUB DISTRICT, BANJARNEGARA REGENCY

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ABSTRACT

Cabbage is a suitable horticultural crop for cultivation in the Karangkobar Sub-District, Banjarnegara District. The income derived from cabbage farming can be influenced by various internal and external factors. This study has the following objectives: (1) to determine cabbage farm income, (2) to assess the risk associated with cabbage farm income, (3) to identify factors affecting the risk of cabbage farm income, and (4) to explore the strategies used by farmers to manage the risk of cabbage farm income. The research was conducted in Tamansari Hamlet, Leksana Village, Karangkobar Sub-District, and involved a sample of 30 cabbage farmers selected through a simple random sampling method. The analysis methods employed in this study include a one-way ANOVA test to determine cabbage farm income, the use of the coefficient of variation (CV) to evaluate farm income risk, multiple linear regression analysis to identify factors influencing income risk, and the examination of three risk management strategies: ex-ante, interactive, and ex-post. The findings revealed the following results: (1) The highest cabbage farm income was observed during the dry season, while the lowest income was recorded during the rainy season. (2) The rainy season presented the highest risk of cabbage farm income. (3) Factors such as age, farming experience, and land area were found to influence the risk associated with cabbage farm income. (4) Cabbage farmers have implemented three distinct risk management strategies, namely ex-ante, interactive, and ex-post strategies, to mitigate the risks associated with cabbage farm income.

Keywords: *cabbage, risk, income, farming, strategy*

INTRODUCTION

Based on the topography of Banjarnegara District, especially in Karangkobar Sub-District, which is characterized by hilly terrain, situated at an altitude of over 1,000 meters above sea level, and with low air temperatures around 15 - 18°C, farmers predominantly cultivate crops specific to this region, particularly horticultural crops like cabbage. In Karangkobar Sub-District, farmers practice land conservation through agroforestry systems to prevent erosion and landslides. Agroforestry is a land-use system that combines trees with agricultural crops to enhance income. However, there are internal and external factors that can influence cabbage farming activities, impacting farm income and giving rise to income risks.

Horticultural crops are widely cultivated due to their high demand. Data from the Pusat Penelitian dan Pengembangan Hortikultura (Center for Horticultural Research and Development) (2016) indicates that the demand for horticultural commodities increases by an average of 11 percent per year. Therefore, many farmers in Banjarnegara District engage in horticultural farming to meet market demands. Cabbage is cultivated in various regions, including Central Java, West Java, North Sumatra, and others. According to data from the Central Statistics Agency (BPS) of Central Java Province (2016), Banjarnegara District is the largest cabbage-producing district in Central Java, contributing 27.70% of the total production, followed by Magelang and Wonosobo Districts.

However, annual data from BPS Central Java Province (2018) shows fluctuations and a tendency of decreasing cabbage productivity based on harvested area and production quantity in Banjarnegara District. Cabbage productivity in 2016 was 234.66 quintals per hectare but decreased to 208.74 quintals per hectare in 2017. The fluctuating productivity poses an ongoing challenge for farmers. This condition is related to various internal factors, including limited land ownership, minimal farmer capital, suboptimal farming management, and low technology adoption among farmers. These factors contribute to low farming efficiency and higher production failure risks, ultimately resulting in low farm income.

Farmers always consider the level of risk they may face in agriculture, which could reduce their income or even lead to negative income. Besides productivity fluctuations, cabbage farming also faces external challenges such as climate change, pest and disease outbreaks, and uncontrollable price fluctuations. Nicholson (1998) mentioned that agricultural price fluctuations affect the value of agricultural commodities and the costs incurred to achieve optimum production, posing a unique risk to expected farmer income. Price fluctuations make it challenging to predict farm income accurately.

Cabbage farming in Karangkobar Sub-District typically follows a "tebasan" selling system, where farmers sell their harvest to middlemen before the harvest season without knowing the exact quantity and price of cabbage to be sold. Farmers also lack bargaining power in determining cabbage prices, as these are determined by middlemen based on market prices. If there is an oversupply of cabbage in the central market, cabbage prices will decrease significantly, leading to a decrease in farm income, even if cabbage production is substantial. Given these conditions, farmers are aware of the income risks associated with cabbage farming, not only in terms of production quantity and price.

Understanding cabbage farm income is essential for farmers to make informed decisions about adopting technologies to increase production and maximize farm income. Therefore, it's crucial to minimize income risks through the application of income risk management strategies. Determining the level of income risk is necessary to make appropriate decisions. Farmers' risk management behaviors can include ex-ante, interactive, or ex-post risk management strategies.

Research by Falatehan and Ade (2008) on cabbage cultivation during the rainy season revealed several challenges, primarily related to production timing. When production occurs from September to February, cabbage yields are generally good, but cabbage prices are very low. A study by Aini et al. (2015) showed that income from rainfed fields was higher than income from dryland farming. This difference was due to higher production in rainfed fields compared to cabbage production in dryland areas. Cabbage plants in dryland areas have broader leaves but less perfect head formation, while cabbage plants in rainfed fields have better head formation, resulting in different weights per plant. Aini et al. (2015) stated that the productivity and income of rainfed cabbage farming are higher than those of dryland farming, with a higher risk associated with dryland farming due to weather and pest-related factors. To assess farming risks on a particular plot of land, quantitative analysis using the coefficient of variation (CV) is employed. The fluctuation in production and prices over the last five growing seasons has contributed to income risks that affect farmer income.

According to research by Imelda et al. (2007) on income risk in aloe vera farming, both monoculture and polyculture farming systems, monotonous farming poses a higher income risk compared to polyculture farming. Rifki (2014) noted that risk and uncertainty impact farmer losses, which are then used for the sustainability of their farming activities. Therefore, it is better for farmers to adopt integrated farming systems (IFS) as an effort to reduce income risks. Fauzan (2016) suggested that a higher coefficient of variation indicates greater risk for farmers. Conversely, a smaller coefficient of variation implies lower farming risks.

Suharyanto et al. (2015) found that disease incidence is higher during the rainy season than the dry season, with lower solar radiation during the rainy season affecting photosynthesis and an increase in rainfall potentially raising risks. Farming risks can arise due to various factors. According to Mishra and Barry (1997) cited in Hariyani (2018), if farmers wish to reduce farming risks, they must be able to control the supply of external labor. They argue that farming income and farming risks can be influenced by farming experience, land area, and farmers' education related to agriculture. Hariyani (2018) states that factors influencing income farming risks include farming experience, labor costs, and age of farmers. Based on research by Astuti (2015), factors affecting risks include land and seed use, meaning that additional land and seed usage can reduce production risks.

Research by Lawalata (2013) indicates that factors affecting income risk include the age of farmers, farming experience, organic fertilizer prices, phonska fertilizer prices, fungicide prices, and labor wages. Based on Muzdalifah et al.'s (2012) research, factors affecting income risks in rice farming include land area, seed prices, ponskha fertilizer prices, and pesticide prices. A larger land area leads to greater income risks. Higher seed prices, ponskha fertilizer prices, and pesticide prices result in higher income risks in rice farming. Imelda et al.'s (2007) research shows that several variables influence income risks, including farmer age and farming experience. Additionally, Kumbhakar and Tsionas (2010) used parametric function analysis with several variables assumed as causes of farming risks. Based on their analysis, fertilizer, land area, and other production facilities can cause an

increase in farming risks, including production, price, or income risks.

According to McNamara and Christoph (2005) as cited in Sholihah (2018), agriculture is an economic activity that involves risks. Agriculture can be subject to various uncertain factors, including weather conditions and market dynamics, which can influence household income risks. High income risks can be mitigated by diversifying into non-agricultural activities, with agriculture as the primary motivation. The research conducted by Fauziyah (2011) indicates that the level of production risk, price risk, and income risk in rice farming falls into the low category. Some farmers perceive risks as burdensome consequences of engaging in rice farming. The main factors causing this burden are attacks from PTOs (plant-threatening organisms), high input costs, and low output prices. Ex-ante risk management strategies employed include using different rice varieties, purchasing certified seeds, and implementing intercropping systems. Interactive strategies involve proper planting distances, combining the use of single, compound, and organic fertilizers, pest control using chemical pesticides or IPM (Integrated Pest Management), hiring labor from outside the village, and addressing capital shortages through loans from relatives and farmer groups. Meanwhile, ex-post strategies, in case of farming failures, include using income from secondary jobs to meet family needs, continuing rice farming while studying the causes of failure, and obtaining capital by withdrawing from savings or borrowing from farmer groups.

Lien et al. (2003) as cited in Sholihah (2018) conducted research in Norway on the risk and risk management strategies in organic and conventional dairy farming. The objective of the research was to analyze dairy farmers' attitudes toward risks, the sources of risks, and their risk management strategies. The results showed that organic farmers are less risk-averse. Institutional risk was considered the most significant source of risk, irrespective of whether it was conventional or organic production. However, organic farmers had greater concerns about crop yield risks. The most important risk management strategy for all dairy farmers was maintaining cash in hand. On the other hand, organic dairy farmers considered diversification as a more crucial risk management strategy.

METHOD

This research was conducted in the Karangkobar Sub-District of Banjarnegara District. The basic method employed was descriptive analysis. Descriptive analysis involved data collection, organization, followed by the analysis and interpretation of the research findings. The sampling method used for this research was simple random sampling. The criteria for selecting farmers as samples were those engaged in cabbage farming. The total number of samples in this study was 30 farmers.

a. One way ANOVA Analysis

The analysis of variance used in this study is One-way ANOVA, which aims to determine whether there is a difference in means among more than two sample groups. It is suspected that there is a difference in the average income of cabbage farming in various planting seasons.

$H_0 : \mu_1 = \mu_2 = \mu_3$

$H_a : \mu_1 \neq \mu_2 \neq \mu_3$

The statistical test used to test the null hypothesis that all groups have the same population mean is by using the F-table. The calculated F-value is obtained from the average sum of squares between groups divided by the average sum of squares within groups with the formula:

$$F = \frac{S_B^2}{S_w^2} \text{ ……..…. (1)}$$

In which:

S_B^2= between-treatment variance

S_w^2= within-treatment variance

Then, if the F-value indicates a difference, a Post Hoc test is conducted.

b. Risk Analysis

The types of agricultural risks can be determined through descriptive analysis. This analysis describes the various risks faced by farmers, while quantitative analysis is used to measure production, price, and income risks using the coefficient of variation. Determining standard deviation and coefficient of variation is formulated as follows (Salvatore, 2004):

$$S^2 = \sum \frac{Y_k - \bar{Y}}{n-1} \text{……..…. (2)}$$

In which:

S^2 = Variance

Y_k = Farm income

$\bar{Y}$ = average of farm income

n = sample

Then the standard deviation can be calculated using the formula (Salvatore, 2004):

$$S = \sqrt{S^2} \text{……..…. (3)}$$

The vulnerability of risk can be measured using the coefficient of variation. A smaller standard deviation indicates that the farming activity has lower farming risk. Mathematically, the coefficient of variation can be expressed as

follows (Salvatore, 2004):

$$CV = \frac{S}{\bar{Y}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:
CV = Coefficient variation
S = Standard deviation
$\bar{Y}$ = average of farm income

c. Factors affecting the cabbage farm income analysis

The analysis of factors influencing income risk is conducted using residual squares obtained from the income function model. The square of residuals becomes the dependent variable, while the factors suspected of affecting farm income risk serve as independent variables. The regression model for income risk function is as follows:

$$\text{Ln } s1^2 = \alpha 2.0 + \alpha 2.1 \ln X2.1 + \alpha 2.2 \ln X2.2 + \alpha 2.3 \ln X2.3 + \alpha 2.4 \ln X2.4 + \alpha 2.5 \ln X2.5 + \alpha 2.6 \ln X2.6 + s_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

In which:
s_1^2 = Risk of cabbage farm income
s_2 = Residual
$\alpha_{2.0}$ = Intercept
$\alpha_{2.i}$ = Coefficient regression (i= 1s/d 6)
$X_{2.1}$ = Farmer age (year)
$X_{2.2}$ = Farming experience (year)
$X_{2.3}$ = Land area (m^2)
$X_{2.4}$ = Normalized seed price with output price (Rp/gram)
$X_{2.5}$ = Normalized inorganic fertilizer price with output price (Rp/kg)
$X_{2.6}$ = Normalized liquid pesticide price with output price (Rp/ml)

d. Risk Management Strategies for Cabbage Farming Analysis

Risk management strategies in cabbage farming are efforts that farmers must undertake to minimize the risks they face. These risk management strategies for farmers can be grouped into three categories: (1) Ex-ante strategies, which farmers implement before shocks occur. The goal is to prepare the farming operation so that it is not in a highly vulnerable position when shocks happen. (2) Interactive strategies, which farmers employ when shocks occur. These strategies involve reallocating resources to minimize the impact of risks on production. (3) Ex-post strategies, which are implemented after shocks have occurred. These strategies aim to minimize the potential impact of future shocks.

RESULTS AND DISCUSSION

a. Cabbage farm income

Based on Table 1, it can be observed that the total costs during the first dry season are the highest among the two other planting seasons. This can be explained by the greater use of production facilities during the first dry season, which subsequently increases variable costs. Fixed costs such as taxes and miscellaneous expenses also have the highest values during the first dry season, resulting in the highest total costs during this season. Despite the highest total costs occurring during the first dry season, the selling price of cabbage obtained during this season is significantly higher than the selling price in the other two planting seasons. As a result, the highest cabbage farming income remains during the first dry season. Therefore, it can be said that the difference in income between the rainy season, the first dry season, and the second dry season is due to variations in the total farming costs and the selling price of cabbage obtained in each planting season, considering that cabbage prices always fluctuate depending on the market price determination in the Jakarta wholesale market.

Table 1. Average Income of Cabbage Farming per Hectare

	MH (Rp)	MK I (Rp)	MK II (Rp)
Farm revenue	8.998.253,93	19.571.137,65	8.383.375,89
Variable cost:			
Seed	426.277,65	861.406,32	437.712,39
Fertilizer	5.184.740,00	6.360.332,63	3.245.322,36
Persticide	1.094.816,69	1.665.309,73	944.549,61
Workers outside the family	1.420.208,33	1.326.677,79	1.116.666,67
Fix cost:			
Tax cost	52.801,21	83.342,00	53.756,94
Another cost:			
Equipment Repair Costs	105.386,00	128.141,00	57.605,00
Festivity cost	207.056,00	274.279,00	248.452,00
Total Cost	8.491.285,88	10.699.486,79	6.104.064,27
Farm income	506.968,16	8.871.650,86	2.279.311,62

Source : Primary Data Analysis (2019)

Next, to determine whether there is a difference in income between planting seasons, a mean difference test will be conducted using One-Way ANOVA. Based on the data in Table 6.10, it can be seen that the value of F calculated at 9.737 is greater than the F-table value of 3.120, which means that H0 is rejected. This indicates that there is a difference in the average income of cabbage farming using different planting seasons, so it can be said that the planting season has an influence on cabbage farming income.

After obtaining the results of the Anova test, which indicated that there is a difference in the average income of cabbage farming, the next step is to determine which planting season differs. The results of the post hoc test can be seen in Table 3 as follows. Based on Table 3, it can be observed that the difference in mean between MH and MK I is -1.16054 (MH is smaller by 1.16054 points compared to MK I). The difference in mean between MH and MK II is -0.20257 (MH is smaller by 0.20257 points compared to MK II). The difference in mean between MK I and MH is 1.16054 (MK I is larger by 1.16054 than MH). The difference in mean between MK I and MK II is 0.95798 (MK I is larger by 0.95798 points compared to MK II). The difference in mean between MK II and MH is 0.20257 (MK II is larger by 0.20257 points than MH). Meanwhile, the difference in mean between MK II and MK I is -0.95798 (MK II is smaller by 0.95798 points compared to MK I).

Based on Table 6.11, it can be concluded that the rainy season is different from the first dry season (MH ≠ MK I), the rainy season is different from the second dry season (MH ≠ MK II), and the first dry season is different from the second dry season (MK I ≠ MK II). Based on this, it can be stated that the best planting season to increase cabbage farming income is during the first dry season. This can be seen from the highest average in the MK I group, while the less favorable planting season for increasing cabbage farming income is the rainy season. Furthermore, it can also be noted that there is a significant influence between the rainy season, the first dry season, and the second dry season on cabbage farming income.

Table 2. Results of the Cabbage Farming Income Difference Test

Description	Sum of square	df	Mean square	Fcalculated	Ftable	Sig. F
Between groups	19,078	2	9,722			
Within groups	77,973	72	0,998	9,737	3,120	0,000
Total	97,041	74				

Source: Primary Data Analysis (2019)

Table 3. The results of the Post Hoc Test

(I) Musim tanam	(J) Musim tanam	Mean Difference (I – J)	Std. Error
MH	MK I	-1,16054*	0,26978
	MK II	-0,20257	0,29127
MK I	MH	1,16054*	0,26978
	MK II	0,95798*	0,31446
MK II	MH	0,20257	0,29127
	MK I	-0,95798*	0,31446

Source: Primary Data Analysis (2019)

b. The Risk of Cabbage Farm Income

Based on Table 4, it can be observed that the average income of cabbage farming during the rainy season is lower compared to the dry season one and two. This is in line with the risk value of cabbage farming income during the rainy season, which is the highest at 0.8470 compared to the dry season one and two. This indicates that the researcher's hypothesis aligns with the research findings, which state that the highest risk of cabbage farming income occurs during the rainy season because most farmers plant cabbage during this planting season. During the rainy season, crops have sufficient water supply, which encourages farmers to engage in cabbage farming. However, cabbage farming during the rainy season faces various challenges, especially in determining the production period. When the majority of farmers choose to plant cabbage during the rainy season, it results in oversupply, causing a sharp drop in cabbage prices at the farmer level. According to the research data, the lowest price obtained by farmers occurs during the rainy season, which is around Rp 300 to Rp 500 per kilogram.

The average income of cabbage farming during the first dry season is Rp 8,871,650.86,

which is higher than during the second dry season. However, the risk value of cabbage farming income during the first dry season is actually higher than that during the second dry season. This suggests that higher average income does not necessarily correspond to lower income risk in cabbage farming. Agriculture is influenced by many internal and external factors that can affect the risk of cabbage farming income. The equation for all three CV values is that they indicate a high risk of cabbage farming income. This is based on the risk categories established by Hermanto (1993), which state that if the CV value is greater than 0.50 (CV > 0.50), then it can be considered a high-risk situation. Farmers have implemented agroforestry systems as an effort to increase cabbage farming income and conserve land. However, land conservation efforts have not been maximized because cabbage farmers in Karangkobar District still prefer to use inorganic fertilizers and pesticides in their farming. Additionally, farmers practice planting along the slope direction to prevent cabbage from rotting during rainfall. Soil cultivation of this kind can lead to a decrease in topsoil quality, resulting in nutrient-poor soil. Therefore, there is a need to improve soil fertility through organic and inorganic fertilizers, which means that production costs will increase. Increased production costs in cabbage farming will reduce income and increase the risk of cabbage farming income. Another approach to address this issue is using mulch in cabbage farming to prevent excessive soil erosion and nutrient loss due to heavy rainfall. Mulch not only reduces production costs but also enhances cabbage production since nutrients in the soil are less prone to being washed away by rainwater and are more effectively absorbed by the plants.

Table 4. Average Income of Cabbage Farming and Income Risk of Cabbage Farming per Hectare

Description	MH	MK I	MK II
Income average (Rp/Ha)	506.968,16	8.871.650,86	2.279.311,62
Standard Deviation	429.402,03	7.326.209,28	1.458.987,37
Coefficient Variation (CV)	0,8470	0,8258	0,6401

Source: Primary Data Analysis (2019)

Farmers' Perceptions of Risk in Cabbage Farming in Karangkobar District

Based on Table 5, it is known that 3.33 percent of farmers consider risk as a measure of the causes of deviations from expected cabbage production. Meanwhile, 6.67 percent of farmers perceive risk as anything that can endanger cabbage farming but can be prevented or reduced in its impact if it is anticipated from the beginning. As many as 13.33 percent consider risk as a consequence that must be accepted when they engage in farming activities. The remaining 76.67 percent of farmers perceive risk as everything that tends to lead to losses in cabbage farming, so the cabbage farmers in Karangkobar Subdistrict have an understanding that anything that can harm cabbage farming is a farming risk that must be prepared for. This understanding of risk should encourage farmers to equip themselves with various strategic plans that can be implemented to deal with risks, whether before, during, or after the farming activities are carried out.

Most farmers in Karangkobar Subdistrict perceive that the failure of cabbage farming can be described by the low production and selling prices of cabbage. However, there are also 3.33 percent of farmers who consider cabbage farming to have failed if the cabbage production is relatively low, and 30 percent of farmers have the perception that farming is considered to have failed if the cabbage prices received are relatively low. So, even though cabbage prices are considered by farmers as an external factor that cannot be controlled, they also have the perception that low production will affect the low income of cabbage farming, so farmers also strive for maximum production because production is an internal factor that can be controlled by farmers.

As many as 60 percent of farmers believe that cabbage farming has experienced productivity risks with only 25 percent of cabbage experiencing crop failure. This indicates that farmers are aware that cabbage farming has risks, so there is a need for several strategies to minimize potential risks. Almost all cabbage farmers perceive that price risk occurs when cabbage prices fall by more than 50 percent from the average. Meanwhile, another 20 percent of farmers consider that price risk occurs when cabbage prices fall between 25 to 50 percent from the average. There are no farmers who consider that risk occurs when cabbage prices fall less than 25 percent. This shows that for farmers, if cabbage prices only drop by 25 percent from the average, it is not considered a risk, but if it is more than 25 percent or more than 50 percent, it can be considered a risk.

Table 5. Farmers' Perceptions of Risk in Cabbage Farming in Karangkobar District

No.	Farmers' Perceptions	Cabbage Farming	
		Frequency(n = 30)	(%)
1.	Perceived Risks According to Farmers:		
	a. A measure of the causes of deviations from the expected cabbage production.	1	3,33
	b. Everything that tends to lead to losses in cabbage farming.	23	76,67
	c. Anything that can jeopardize cabbage farming but can be prevented or mitigated if anticipated from the beginning.	2	6,67
	d. Consequences that burden farmers if they want to engage in cabbage farming, such as providing capital and production facilities.	4	13,33
2.	Farming Categorized as Failures According to Farmers' Perceptions		
	a. The cabbage production generated is relatively low (<50% of the usual production).	1	3,33
	b. The cabbage prices received are relatively low (approaching the cost price).	9	30,00
	a. c. Both cabbage production and prices are relatively low.	20	66,67
3.	The perceived level of risk for cabbage farming productivity according to farmers:		
	a. High (>50% crop failure)	0	0
	b. Moderate (25% - 50% crop failure)	12	40,00
	c. Low (<25% crop failure)	18	60,00
4.	The perceived level of risk for cabbage prices according to farmers:		
	a. High (prices fall >50% below average)	24	80,00
	b. Moderate (prices fall 25% - 50% below average)	6	20,00
	c. Low (prices fall <25% below average)	0	0

Source: Primary Data Analysis (2019)

c. Factors affecting the cabbage farm income

Based on Table 6, several pieces of information regarding the income risk function of cabbage farming can be identified, which will be used to determine the factors influencing income risk in cabbage farming in the Karangkobar District.

1. Constant

Based on the regression analysis results shown in Table 6, it can be observed that the constant has an impact on income risk in farming (probability value of t-statistic < 0.01). The regression coefficient has a value of 48.8749, which means that the minimum income from cabbage farming is 48.8749 (exponential).

2. Age

Based on the regression results, it can be determined that the age of cabbage farmers significantly influences income risk (probability value of t-statistic < 0.01). The regression coefficient for age is -18.3937, which means that each 1% increase in farming experience results in a decrease in income risk by 18.3937% compared to the previous income risk.

3. Farming Experience

Based on the regression results, it can be determined that the farming experience of cabbage farmers significantly affects income risk (probability value of t-statistic < 0.05). The regression coefficient for farming experience is 11.3052, indicating that each 1% increase in farming experience leads to an increase in income risk by 11.3052% compared to the previous income risk. This contradicts the expected sign, which suggests that longer farming experience should lead to a decrease in income risk. This discrepancy is due to cabbage farmers in the Karangkobar District having long farming experience but not implementing innovation and technological development in their farming practices. Therefore, the increase in age and farming experience, without corresponding technological innovations, leads to an increase in income risk.

4. Land Size

Based on Table 6, it can be observed that land size significantly influences income risk (probability value of t-statistic < 0.01). The regression coefficient for land size is -2.2189, which means that each 1% increase in land size results in a decrease in income risk by 2.2189% compared to the previous income risk. This contradicts the expected sign, which suggests that larger land sizes should lead to higher income risk in farming. This occurs because farmers with smaller land sizes often abandon farming to seek additional work, such as construction labor or trading, while passing on farming responsibilities

to family members. Farmers with larger land sizes choose to remain and farm more diligently and seriously, as they believe that the capital investment is substantial and they cannot afford farming failures.

5. Seed Price

The independent variable of cabbage seed price does not significantly influence income risk (probability value of t-statistic > 0.1). This is because most farmers use the same type of cabbage seed, Hybrid F1 Grand 11, which is priced at approximately Rp 60,000 to Rp 65,000. This indicates that there is little variation in seed prices among farmers, and therefore, it does not affect income risk in cabbage farming.

6. Inorganic Fertilizer Price

The regression results in Table 6 show that the price of inorganic fertilizer does not significantly affect income risk (probability value of t-statistic > 0.1). This is because the majority of cabbage farmers use the same types of inorganic fertilizers, such as urea, ponskha, and TSP. The quantity of fertilizer purchased by farmers is also similar, resulting in relatively consistent fertilizer prices. This lack of variation in inorganic fertilizer prices among cabbage farmers means that it does not impact income risk.

7. Liquid Pesticide Price

The analysis in Table 6 indicates that the price of liquid pesticide used by cabbage farmers does not significantly affect income risk (probability value of t-statistic > 0.1). This is due to the fact that most cabbage farmers use the same brand of liquid pesticide, uracron, resulting in relatively uniform pesticide prices. Therefore, the price of liquid pesticide does not influence income risk in cabbage farming.

Table 6. Results of Regression Analysis of Factors Affecting Cabbage Farming Income Risk

Variable	*Expected sign*	Koefisien	t-sig
Constant	-	48,8749***	0,0000
Ln Farmer age (X1)	-	-18,3937***	0,0026
Ln Farming experience (X2)	-	11,3052**	0,0109
Ln Land area (X3)	+	-2,2189***	0,0007
Ln Seed price per output price (X4)	+	-0,3064^{ns}	0,4396
Ln Inorganic frtilizer price per output price (X5)	+	-0,0543^{ns}	0,8911
Ln Liquid pesticide price per output price (X6)	+	0,2326^{ns}	0,4134
Adjusted R^2		0,5458	
F-stat		6,6086	
F-sig		0,0004	

Source: Primary Data Analysis (2019)

d. Risk Management Strategies for Cabbage Farming

Income earned by farmers will influence their behavior in managing the risks they face. If the income obtained is substantial, farmers have the ability to employ various strategies to reduce the risks they face. Conversely, limited income can be an impediment for farmers in minimizing farming risks (Saptana, 2011). Cabbage farmers in the Karangkobar District consider farming their primary occupation. Part-time work is done to supplement the household income, such as working as construction laborers or in the timber industry. According to some respondents, most of the income from part-time work is also used to increase the capital for farming.

Ex-ante Risk Management Strategies

This is one of the strategies employed by farmers to anticipate farming risks. Ex-ante risk management strategies implemented by cabbage farmers in the Karangkobar District can be seen in Table 7. Table 7 describes the efforts made by cabbage farmers in the Karangkobar District to manage risks before initiating farming activities. Cabbage farming is the most favored commodity among farmers in the Karangkobar District. This can be seen in the planting patterns, where despite the highly fluctuating cabbage prices, farmers choose to grow cabbage once or twice a year, alternating with other commodities like chili and corn to generate additional income. In fact, 13.33% of farmers adopt a continuous cabbage planting pattern because they find cabbage maintenance relatively easy and can tend to part-time work as construction laborers. However, the continuous cabbage planting pattern is considered unfavorable for soil health due to the absence of crop rotation. Furthermore, the planting patterns employed are not entirely suitable as research findings suggest that the best time to cultivate

cabbage is during the first dry season, yet most farmers grow cabbage during the rainy season.

Among all the planting patterns used by cabbage farmers, they have reasons for adopting the patterns they consider most profitable, considering climate conditions and land fertility preservation. Farmers' awareness of fluctuating cabbage prices has prompted them to implement agroforestry systems in their farming practices. Agroforestry is employed to increase income and conserve land. Another Ex-ante risk reduction strategy is the use of monoculture planting. All farmers (100%) apply monoculture planting. This is because cabbage farming in the Karangkobar District has been mixed with perennial crops like taro in an agroforestry system. When farmers adopt intercropping, it can negatively affect plant growth performance due to root competition for nutrients in the soil. However, if cabbage farming uses monoculture planting, plant growth performance will be better.

Based on the number of locations used by farmers to grow cabbage in a year, it can be observed that 56.57% of farmers only plant cabbage in one location. Meanwhile, 43.33% of farmers plant cabbage in several or more than one location. To better reduce Ex-ante risk, farmers should consider planting cabbage in several or even all of their locations, even if the planting area is only a portion of the total land area. By planting cabbage in only one location, if there is a crop failure or a sharp drop in cabbage prices, farmers will not have an alternative source of income during that planting season.

Table 7. Ex-ante Risk Management Strategies in Cabbage Farming

No.	Description	Cabbage Farming	
		Frequency(n = 30)	(%)
1.	Crop rotation in a year:		
	a. Cabbage – Cabbage – Cabbage	4	13,33
	b. Cabbage – Cabbage – tanaman semusim lainnya	12	40,00
	c. kubis – other annual crops – other annual crops	14	46,67
2.	The reasons for following the crop rotation:		
	a. The crop planting/crop rotation pattern is considered the most advantageous	21	70,00
	b. In accordance with the local climate conditions.	5	16,67
	c. c. In accordance with the land conditions (topography, fertility).	1	3,33
	d. If different, the possibility of pest attacks (OPT) may occur.	0	0
	e. Maintaining land fertility and sustainability.	3	10,00
3.	Reasons for Implementing Agrforestry		
	a. Land conservation	7	23,33
	b. Increasing income	23	76,67
	c. Following other farmers.	0	0
4.	The cabbage planting system that is used:		
	a. Monoculture	30	100,00
	b. Intercropping	0	0
5.	The reasons for choosing that planting system:		
	a. Easier farm management	7	23,33
	b. Good plant growth performance	16	53,33
	c. Providing additional income	7	23,33
6.	The number of cabbage planting locations in a year:		
	a. Only planted in one location	17	56,67
	b. In several or more than one location	3	43,33
	c. All location	0	0

Source: Primary Data Analysis (2019)

Interactive Risk Management Strategies

Interactive risk management strategies emphasized the use of farming technology that aligns with recommendations, including: (1) Farmers use medium or recommended planting spacing, although 6.67% of farmers still employ close planting spacing, (2) All cabbage farmers combine the use of organic and inorganic fertilizers to complement each other. Organic fertilizer is used as a basal fertilizer, while inorganic fertilizer is utilized as a supplementary fertilizer during crop maintenance. There are 53.33% of farmers who do not differentiate between types and volumes of fertilizer usage, and 40% of farmers who do not differentiate types but use varying volumes, (3) 70% of farmers use

a combination of liquid and solid pesticides to manage pests and diseases. Liquid pesticides are the preferred choice of cabbage farmers because they are considered more effective in eradicating pests and diseases compared to solid pesticide products. Cabbage farmers primarily use a single type of solid pesticide, which is antracol, while they use various types of liquid pesticides, despite the relatively higher cost of liquid pesticides compared to solid pesticides. 80% of farmers use pesticides both for preventive and curative purposes, (4) Farmers rely more on family labor than external labor to save on labor costs, and (5) In case of capital shortage, farmers borrow from relatives, neighbors, acquaintances, or farmer groups. Borrowing and lending among neighbors are common practices among cabbage farmers in Karangkobar Sub-District. Interactive risk management strategies employed by cabbage farmers can be seen in Table 8.

Table 8. Interactive Risk Management Strategies in Cabbage Farming

No.	Description	Cabbage Farming	
		Frequency (n = 30)	(%)
1.	The planting spacing used:		
	a. Close planting spacing	2	6,67
	b. Medium planting spacing / as recommended	28	93,33
	c. Wide planting spacing	0	0
2.	The types of fertilizer used in cabbage cultivation:		
	a. Organic fertilizer only	0	0
	b. Inorganic fertilizer only	0	0
	c. Organic and inorganic fertilizer	30	100,00
3.	The use of fertilizer from one planting season to another:		
	a. No difference in type or volume	16	53,33
	b. No difference in type, but different in volume	12	40,00
	c. Different in type and volume	2	6,67
4.	The farmers' tendency in controlling Pests and Diseases (OPT) conducted:		
	a. Tend to use liquid pesticides	9	30,00
	b. Tend to use solid pesticides	0	0
	c. Tend to use both liquid and solid pesticides	21	70,00
5.	The methods of pest and disease control employed:		
	a. As a preventive measure	5	16,67
	b. As a curative measure	1	3,33
	c. As both a preventive and curative measure	24	80,00
6.	The majority of the labor employed		
	a. Inside family	27	90,00
	b. Outside family	3	10,00
7.	Actions taken when facing a shortage of external family labor:		
	a. Utilizing family labor to the maximum extent possible.	28	93,33
	b. Seeking wage labor from outside the village/outside the area.	2	6,67
8.	Actions taken in case of a shortage or difficulty in obtaining capital:		
	a. Borrowing from farmer groups/cooperatives.	4	13,33
	b. Borrowing from partner companies.	0	00,00
	c. Borrowing from relatives/neighbors/kin.	24	80,00
	d. Not borrowing.	2	6,67

Source: Primary Data Analysis (2019)

Ex-post risk management strategies

Based on Table 9, it can be observed that post-farming risk management strategies include: (1) not relying solely on cabbage farming as their primary livelihood, meaning that most farmers have other farming activities and engage in additional work such as construction labor or woodwork, (2) farmers take additional employment if cabbage farming fails to meet their needs, (3) if there is a shortage of capital for the next farming season, farmers take the step of selling their livestock to increase their farming

capital, and (4) the failure of cabbage farming does not lead most farmers to quit or switch to other commodities. Instead, 16.67% of farmers choose to continue planting while waiting for a safer time, 23.33% choose to continue planting while looking for a time when prices are high, 16.67% opt to continue planting cabbage while studying the causes of failure in the previous season, and 40% of farmers choose to continue cabbage farming regardless of the risks involved.

Table 9. Ex-post risk management strategies in cabbage farming

No.	Description	Cabbage Farming	
		Frequency(n = 30)	(%)
1.	The status of cabbage farming in supporting their family:		
	a. Fully dependent on cabbage farming.	0	0
	b. Mostly dependent on cabbage farming.	9	30,00
	c. Partially dependent on cabbage farming.	20	66,67
	d. Not dependent on cabbage farming at all.	1	3,33
2.	If cabbage farming experiences a failure, efforts to cover the failure in supporting the family:		
	a. Income from other farming activities.	7	23,33
	b. Withdrawal from savings.	0	0
	c. Borrowing from other farmers/family/relatives.	0	0
	d. Seeking additional employment.	17	56,67
	e. Selling owned livestock.	6	20,00
3.	If experiencing losses, what actions or sources of capital are chosen for the next farming season:		
	a. Adjusting the planting area in the next season according to available capital.	9	30,00
	b. Cultivating crops with low risk.	1	3,33
	c. Increasing capital by using savings.	1	3,33
	d. Increasing capital by borrowing money.	2	6,67
	e. Increasing capital by selling livestock.	6	20,00
	f. Borrowing production facilities from agricultural stores/kiosks.	11	36,67
4.	Actions taken if cabbage cultivation is considered a failure:		
	a. Not planting cabbage again because of the fear of a repeat failure.	1	3,33
	b. Only planting during safe planting times or seasons.	5	16,67
	c. Only planting during times or seasons when good prices are expected.	7	23,33
	d. Will still plant cabbage again and investigate the causes of the failure.	5	16,67
	e. Will still plant cabbage again regardless of the risks involved.	12	40,00

Source: Primary Data Analysis (2019)

CONCLUSIONS

1. The planting season has an impact on cabbage farming income, with the highest income occurring during the first dry season and the lowest income during the rainy season.
2. The highest income risk for cabbage farming is during the rainy season.
3. Factors influencing the risk of cabbage farming income include age, farming experience, and land area.
4. Farmers have implemented three risk management strategies, namely Ex-ante, Interactive, and Ex-post strategies, to mitigate the risk of cabbage farming income.

SUGGESTIONS

1. Farmers are advised to plant cabbage during the first dry season to achieve better cabbage farming income compared to the other two planting seasons.
2. Farmers should improve land conservation by enhancing terrace maintenance and slope management.

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