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Analysis Model And Strategy For Handling Banana Production Risks In Central Sebatik Border Area

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ABSTRACT

Sebatik Tengah is one of the sub-districts with the lowest production when compared to other sub-districts, namely only 0.004% of the total production of the entire Nunukan Regency. The cause of low production in this region is because farmers are faced with various production risks such as pest and disease attacks, weather, uncertain harvest times, price risks and human errors. For this reason, this study aims to analyze the risk level of kepok banana production, and recommend alternative strategies that can be done to minimize the risk. Respondents in this study were 30 farmers who were determined through the census sampling method. The data used in this study are primary data obtained from survey results and direct interviews with respondents and secondary data obtained from the literature and agencies related to research. To answer the first objective, the data analysis used is risk analysis by calculating the standard deviation and variance while the second objective is analyzed using Failure Mode and Effect Analysis (FMEA). The results showed that the highest average production risk level in the first period was 893.67 kg, the highest variance in the second period was 41,739 kg, the highest standard deviation in the second period was 204.30 kg, the highest coefficient was in the second period of 0.24 kg with the lowest production lower limit in the second period of 454.33 kg. The highest coefficient price risk level in the third period is Rp.0.08 with the lowest lower limit in the third period of Rp.1,342.05. Sources of risk that have the highest to lowest Risk Score Value (RSV), namely the highest value found in pests and diseases of 59.43, the second highest selling price decreased by 53.66, weather by 46.13, demand decreased by 43.60, harvest time 38.83, and the lowest there is human errors of 14.88. Based on the results of the Failure Mode And Effect Analysis (FMEA) there are preventive and mitigation strategies. For prevention, namely monkey pests are handled by clearing the land, harvest time by increasing the search for

Keywords :

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information, human resource errors by maintaining the land. As for mitigation, namely caterpillars and ladybugs are handled by mechanical, chemical and cultural techniques, fusarium wilt and leaf spot are handled by cleaning damaged leaves and burning them, for the price risk the handling is by means of a contract system and setting cropping patterns.

INTRODUCTION

The cultivation of horticulture crops like bananas helps to support one of Nunukan's economic axes. One of North Kalimantan's most productive regions, Nunukan Regency will produce 75,443 quintals of bananas in 2021 (1). There are a lot of potential banana business options in the Sebatik Tengah border region. The soil and environment in this area are ideal for the growth of bananas. This potential can be used to create a banana agribusiness that will benefit people on both sides of the border economically.

A significant agricultural product, bananas are in high demand both domestically and abroad. The expansion of banana farming in Central Sebatik's border region may present prospects for local farmers and business owners to boost their revenue. It can also boost the local economy and generate new jobs. Additionally, there is a chance that bananas from the Central Sebatik border region will be shipped to nearby nations. The high quality and diversity of banana types that are offered in this area can give this region a competitive edge on the global market (2). The potential for exporting bananas can help the nation's foreign exchange revenues and promote economic development in border regions.

The expansion of banana farming in the Central Sebatik border region may have economic worth in addition to environmental advantages. Fast-growing plants like bananas can contribute to preserving the ecosystem's balance, preventing soil erosion, and promoting environmental sustainability (3). The government and associated parties must promote the growth of the banana agribusiness in the Central Sebatik border region by granting farmers access to markets, educating them, and creating the necessary infrastructure. This assistance can boost capacity for production, raise the quality and competitiveness of the region's bananas, and provide value to the banana industry. Exploiting the potential banana markets in the Central Sebatik border region can lead to sustainable agricultural development, which benefits population welfare and economic growth on both sides of the border with adjacent nations. With only 0.004% of the overall production of the entire Nunukan Regency, Sebatik Tengah is one of the sub-districts with the lowest production when compared to other sub-districts. Farmers in this area confront a variety of production risks, including insect and disease attacks, weather, erratic harvest dates, price risks, and human error, which contributes to the region's poor production levels. Previous studies revealed that several risk factors, including pest attacks, which had a fairly high probability level (51%), disease, which had a high probability level (28%), and harvest time, which had a high probability level, were to blame for the decline in banana production (4). In order

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to reduce this danger, this study will examine the amount of risk associated with the manufacturing of kepok bananas and suggest alternate methods.

METHOD

The challenges associated with the research theme were taken into consideration when choosing the research venue. 30 farmers who participated in the study were chosen as respondents using the census sample technique. Data from survey findings and in-person interviews with respondents, or "primary data" as well as secondary data from literature and organizations engaged in related research by computing the standard deviation and variance, the data analysis method utilized to address the first aim is risk analysis. Statistics tools like the standard deviation and variance are used to quantify how much data or outcomes can deviate from the mean. On the other hand, the standard deviation is the variance's square root. A summary of the data distribution in the same units as the data is provided by the standard deviation. The data tends to vary greatly when the standard deviation is high, but the data tends to be more consistent when the standard deviation is low. Calculations of standard deviation and variance are used in risk analysis to assess the level of unpredictability or uncertainty of anticipated outcomes or returns (5). The danger involved increases as the standard deviation or variation rises. Decision-makers can compare and assess the degree of risk associated with various options or alternatives using the standard deviation and variance. Based on this calculation, they can determine whether assets or projects have a lower or higher level of risk and take the necessary risk management steps. The deviation can be expressed mathematically as follows (6) : Va = $\sqrt{Va^2}$

The variance is calculated by squaring the difference between each piece of data and the average value, adding up the squared results, and dividing by the amount of data, or it can be written as follows : $va^2 = \frac{\sum(p-pi)^2}{n-1}$

va = Variance
p = Production and price
pi = Average of production and price
n = Number of sample farmers

Then calculate the coefficient of variation with the formula : CV = $\frac{(va)}{pi}$

CV = Coefficient of Variation
$V\alpha^2$ = Standard deviation
pi = Average of production and price

Lastly, it is important to calculate the lower bound to find out the lowest number of results from the expected return level. The lower limit of profit (L) shows the lowest nominal value of profit that farmers may receive, which can be calculated as follows (7) : L = pi – 2vα

L = Lower bounds of production and prices
pi = Average of production and price
$v\alpha$ = Standard deviation

While the second objective was analyzed using Failure Mode and Effect Analysis (FMEA), a method for identifying and assessing risks in a simple and systematic way (8). Every possible failure that occurs is quantified to prioritize handling, and the quantification of priority is carried out based on the multiplication of the

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frequency rating, the level of damage, and the level of detection of risk. The stages of analysis in this study are field data collection, analyze all data and then assessment or measurement of risk sources from identification results in the early stages (9).

Table 1. Severity Scale

Scale	Description
10	The effect of the hazard is very high
9	The effect is very high
8	The effect is very high
7	The effect is high
6	The effect is moderate
5	The effect is low
4	The effect is very low
3	The effect is small
2	The effect is caused very small
1	Has no effect resulting from the cause of the failure

Severity (S), namely the impact that arises when an error (failure). The highest scale is worth 10, which means the effect is very high, while the lowest is worth 1, which means there is no effect caused by the cause of the failure.

Table 2. Occurance Scale

Scale	Description
10	Occurs more than once a day
9	Occurs every 3 - 4 days
8	Occurs weekly
7	Occurs monthly
6	Occurs every 3 months
5	Occurs every 6 months
4	Occurs annually Occurs 1 - 3 years
3	Occurs 1 - 3 years
2	Occurs 3 - 4 years
1	Happened more than 4 years

Occurrance namely the possibility, probability, or frequency of errors. The highest scale is worth 10 which means it occurs more than once a day while the lowest is worth 1 which means it occurs more than 4 years.

Table 3. Detection Scale

Scale	Description
10	Absolute uncertainty
9	The causes of failure are very difficult to detect
8	The causes of failure are difficult to detect
7	The causes of failure are detectable very low
6	The causes of failure are detectable low
5	The causes of failure are detectable moderate
4	The causes of failure are sufficiently detectable
3	The causes of failure are detected high
2	Cause of failure detected very high
1	Cause of failure almost certainly detected

Detection (D), the possibility of detecting an error before the impact of the error occurs. The highest scale is worth 10, which means the cause of failure is not detected, while the lowest is worth 1, which means failure is almost certain to be detected.

For each identified risk source, the severity (S) value is calculated. the value of the frequency of occurrence (O) and the value of detection (D) with a scale assessment above. Risk Score Value : the number of events (occurence) x the number of severity (RSV) (severity). The calculation of the value of the risk priority number and the value of the risk score value refers to the rule of the scale that looks at the severity, the effect of failure that is likely to occur from a cause of failure, the frequency of events that cause a failure to occur, and the scale of capability to detect a cause of failure. When the results of the Risk Priority Number (RPN) and Risk Score Value (RSV) are validated and grouped using a scatter diagram, a profile will be obtained indicating which risks will be prioritized to be addressed immediately. The

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risk priority obtained is used to develop a risk mitigation plan for every event plotted in a pareto chart. Sometimes, in extreme cases, risks are unavoidable, so a detection plan and a contingency plan are required (10).

RESULT AND DISCUSSION

1. Production and Price Risk Analysis

1.1 *There are several sources of production risk that often occur, as follows :*

a. Weather. The weather or rain factor that often occurs during the harvest season affects the production process of kepok bananas, where when it rains it will be difficult for farmers to get the produce out of the land, causing the banana to be damaged and resulting in the price of bananas decreasing.
b. Harvest Time. The age of harvesting kepok bananas is determined based on the amount of time needed to transport bananas to the sales area so that the fruit does not overripe when it reaches the buyer or consumer.
c. Pest attack. Pests are something that is considered harmful and undesirable for pest farmers, whether they are kepok banana farmers or cultivation farmersation farmers. Pests found in kepok bananas are monkeys, caterpillars, ladybugs, and leaf roller pests.
d. Disease. One of the sources of risk that can attack the kepok banana plant is that it can affect the amount of production that will be produced by farmers. Diseases that usually attack kepok banana plants are leaf spot and Panama disease (*Fusarium wilt*). Banana leaf spot leaf spot disease usually takes the form of black and brownish spots like stains on the leaves, and if left unchecked, the disease will become more numerous and get bigger, so the leaves are yellow and also dry. This disease is usually caused by a fungus called *Mycosphaerella musicola* (11).

1.2 *Value of Production Risk*

This production risk is divided into three periods, where each period has a different value.

Table 4. Production Risk

Production Risk (Kg)			
Description	1st Period	2nd period	3rd period
Average (pi)	893,67	862,93	592,33
Variance (va)	37.673	41.739	4.319
Standard Deviation ($v\alpha$)	194,09	204,30	65,72
Coefficient of Variation (CV)	0,22	0,24	0,11
Lower bounds of production and prices (L)	505,48	454,33	460,89

Source : Primary Data

Based on table 4, it can be seen that the results of the standard deviation or standard deviation the highest was in the second period of 204.30 kg. This illustrates deviations from the observations of the results of the highest average value, namely 893.67 kg. This means production could deviate 204.30 kg from the value of the average so that farmers bear the risk of production and each value period. From the results obtained for the highest coefficient of variation in the second period, namely 0.24 kg, this shows that farmers are likely to experience production risk in each period and will experience

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different coefficient values. The lower limit value of L production is to find out the lowest number of results for the expected return rate, it shows that the minimum value of the lowest production produced by kepok banana farmers, the limit value under production in the second period shows the possibility of the lowest production risk or the lowest loss in three periods that will be faced by kepok banana farmers. It can be seen from table that the lowest average value of production in the three periods is seen in the third period, which exceeded the results of the lower limit of production L, so that it can be said that banana farmers kepok will make a profit, but if the lower limit value of L production is 0, then production will experience a loss or be unprofitable.

Table 5. Price Risk

Production Risk (Kg)			
Description	1st Period	2nd period	3rd period
Average (pi)	1.683,33	1.603.33	1.586,67
Variance (va)	13.194	14.164	14.960
Standard Deviation ($v\alpha$)	114,87	119,01	122,31
Coefficient of Variation (CV)	0,07	0,07	0,08
Lower bounds of production and prices (L)	1.453,60	1.365,31	1.342,05

Source : Primary Data

Based on the results, that the highest average selling price of kepok bananas was in the first period at Rp. 1,683.33. The lowest price received by Kepok banana farmers is in the first period of IDR 13,194, as can be seen from the results of the variance value. The highest variation coefficient is found in the third period, which is Rp. 0.08, which means that for every Rp. 1/kg received by Kepok banana farmers, there is a risk of IDR 0.08. In this study, CV (0.08) and the value of L (1,453.60) > 0, therefore kepok banana farmers who are in Sebatik Tengah sub-district are likely to still experience profits (12).

2. Alternative Risk Handling Strategies

2.1 *Failure Mode And Effect Analysis (FMEA)*

Sources of production risk that have been identified include weather, pests and diseases, human error, and harvest time. As for the source of price risk that has been identified, namely, the selling price decreased and the demand for kepok bananas decreased.

Table 6. Measurement of the risk source level of banana production

Risk Source	Saverity	Occurance	Detection
Weather	6,6	7,0	7,4
Pest and Disease	7,2	8,2	8,3
Human error	3,3	4,4	6,5
Harvest Time	5,4	7,2	2,5

Source : Primary Data

Source of production risk has the highest level of severity (severity), namely pests and diseases, with a value of 7.2, which means that the effect is very high on production produced by farmers in Kepok banana farming. Whereas the lowest value of severity (severity) is human resource error, namely 3.3, the source of production risk with the highest occurance value is pests and diseases, with a score of 8.2. The lowest occurrence value on the

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source of the risk of kepok banana production, namely on resource errors, is 4.4, which means that human resources have errors with relatively low frequency when compared to the severity of the risk of another production. The highest value of detectability is found in the source of risk production of pests and diseases, which is 8.3, which means it will be difficult for farmers to detect pests and diseases in banana kepok. This is because farmers will find out if the banana is exposed to pests or banana leaf diseases, turns brown and has black spots, or ripe bananas start to get damaged by monkeys or squirrels and the weevils or banana stems start to rot. As for the value of the lowest detectability there is at harvest time, that is equal to 2.5, which means farmers can detect banana kepok faster by paying attention to enough bananas good for harvesting so they don't get eaten by monkeys or squirrels, pests, or other diseases. The source of price risk that has been identified is the declining selling price and decreased demand for kepok bananas.

Table 7. Measurement of the risk source level of banana price

Risk Source	Saverity	Occurance	Detection
Decreased Price	7,14	7,52	2,52
Decreased demand	6,55	6,66	3,14

Source : Primary Data

It can be seen in the table above that the source of the risk of declining selling prices has a severity value (severity) that is equal to 7.14, a number of events (occurrence) of 7.52, and a detect value (detection) of 2.52, meaning that the effect of the number of events is greater than the effect of the value. The severity of this means that farmers will experience selling price events more frequently. Kepok bananas are decreasing but erratic. As for farmers' abilities to be able to detect high declining price events, The demand for kepok bananas has decreased erratically and can change. It has a severity level of 6.55, a value incident (detection) of 6.66, and the ability to detect 3.14. More event value than severity value means decreased demand events will be more often experienced by farmers, and for the ability to detect them, it will be difficult to know due to demand that can be fickle and erratic.

Table 8. Risk Priority Number (RPN)

Risk Source	RPN
Pest and disease	504,90
Weather	335,03
Human Error	102,45
Harvest Time	96,931
Decreased demand	137,31
Decreased price	134,90

Source : Primary Data

Based on the table of risk sources that have priority values or Risk Priority Number (RPN), there is the highest risk source up to the lowest, namely the first highest risk of pests and diseases at 504.90, the second highest was the weather at 335.03, demand decreased by 137.31, the price decreased by 134.90, human resource error at 102.45, and harvest time at 96,931. Source of risk that has the highest value, so prevention is immediately taken first so that farmers can avoid it. The source of risk that has the highest priority value is the risk of production, namely pests and diseases at 504.90 and weather at 335.03. These sources are caused by natural factors, and the highest risk detected can be of particular concern.

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Table 9. Risk Score Value (RSV)

Risk Source	RPN
Pest and disease	59,43
Weather	46,13
Harvest Time	38,83
Human error	14,88
Decreased price	53,66
Decreased demand	43,60

Source : Primary Data

The source of pest and disease risk has the highest priority value of 59.43 for production risk, and the risk of declining selling prices has the second highest priority value of 53.66. All of this is caused by natural factors that are interrelated, so if pests and diseases continue to attack kepok bananas, production will be damaged, banana prices will fall, and the highest risks will be of particular concern. Kepok banana farming must apply the necessary risk strategies to increase production and quality in the next period.

2.2 *Handling Efforts Against Risk*

a. Preventive

Alternative recommendations that can be made consist of two, namely prevention and mitigation. The source of the risk of monkey pests that can be handled by farmers is to pay more attention to the situation and clear the land (13). Sources of risk during harvest time can be handled by seeking information regarding good harvest times and ages (14). Human resource errors can be handled by paying more attention to and clearing the land, fertilizing it regularly, and paying attention to harvest time.

b. Mitigation

Caterpillar pests can be handled with efforts to eradicate them by mechanical and chemical means (15). Treatment of banana leaf spot disease can be done in a number of ways. Cleaning and burning diseased plants and watering them with fungicide, a source of weather risks, can be prevented by applying disaster risk management, namely paying attention to stagnant water and making ditches so that during the rainy season the water is not accommodated, which can damage banana stems. The handling strategy for price risk can be handled properly using a contract system and setting cropping patterns on banana plants so that farmers can adjust the amount of production produced in accordance with market demand.

CONCLUSION

Sources of risk that have the highest to lowest Risk Score Value (RSV), i.e., the highest value is found in pests and diseases at 59.43, the second highest selling price decreases by 53.66, the weather decreases by 46.13, demand decreases by 43.60, harvest time decreases by 38.83, and the lowest value is found in human error at 14.88. Based on the results of failure mode and effect analysis (FMEA), there are preventive and mitigation strategies. For prevention, namely handling monkey pests by clearing land, harvest time by increasing information searches, and human resource errors by guarding the land. As for the countermeasures, caterpillars and ladybugs are handled with mechanical, chemical, and cultural techniques; fusarium wilt and leaf spot are treated by removing damaged leaves and burning them; and price risk is handled through a contract system and cropping pattern arrangements.

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