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PRODUCTION RISK OF MORINGA (*Moringa oleifera L.*) IN THE RAINY AND DRY SEASONS

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ABSTRACT

This study aimed to determine and analyze the risk of moringa (Moringa oleifera L.) production in rainy and dry seasons at PT Moringa Organic Indonesia, Blora. The research method used is a case study method, using secondary data and time-series data and interviews with the company. The analytical tools used are coefficient variation (CV) and lower limit (L). The results show that the sources of production risk at PT Moringa Organic Indonesia consist of external and internal production risks, external production risks consist of weeds, disease, and seasons, while internal production risks are human resource risks. The calculation result of risk level of Moringa production for rainy season and dry season show the risk level of production in dry season has a high risk because it has a coefficient variation value greater than the rainy season. The lower limit of production (L) was obtained in the dry season, based on the lower limit values of the two seasons, indicating that the losses were lower than dry season during the rainy season.

INTRODUCTION

One of the plantation crops found in Indonesia is Moringa. Moringa (Moringa oleifera) is a herbaceous plant generally used as a source of forage for ruminants. Currently, moringa is known as a miracle tree with many uses not only as a forage plant but also as a plant with many benefits in treating various diseases. Program

support to optimize the wealth of indigenous forages as a basis for overcoming hunger and making moringa a priority. The community follows up on the program. Currently, moringa is cultivated on a household scale, on small plantations, and on large plantations integrated with the processing industry with export facilities. This shows that moringa can be used as a profitable agribusiness activity.

One of the companies engaged in Moringa plantations in Central Java Province is PT Moringa Organic Indonesia. PT Moringa Organic Indonesia is a privately owned company engaged in the Moringa plantation sector. This company has been established since 2015 and has a plantation area of 6 ha located in Kunduran District, Blora Regency, Central Java Province. To produce moringa, PT. Moringan Organik Indonesia collaborates with farmers who join the Indonesian Moringa Farmers Association (APMI). In the management of Moringa plantations, PT. MOI applies very strict SOPs, starting with site selection, minimal tillage, fertilizing with organic fertilizers made independently, seed selection, cropping patterns, and maintenance free from chemical residues. This is an effort made by PT Moringa Organic Indonesia to manage and control the risks.

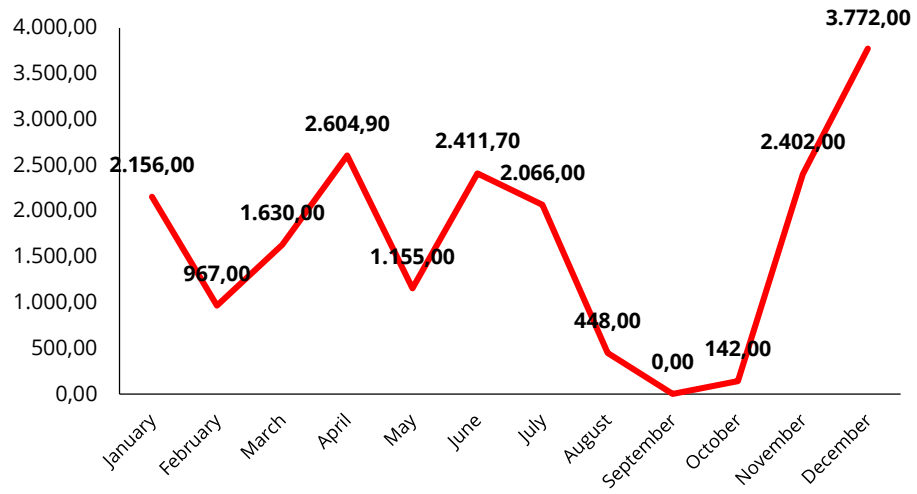

Figure 1.
Graph of Moringa Production PT Moringa Organic Indonesia in 2020
(Note: Land area 6 ha Production 1 year 19,754.6 kgs)

Figure 1 shows the fluctuation of Moringa production PT Moringa Organic Indonesia in 2020. This is due to the high mortality rate. fluctuates every month, indicating there will be production risks that affect production results. The cultivation of Moringa certainly faces various beneficial and detrimental situations, which are commonly referred to as risks. Some problems in the cultivation of moringa in general are seasonal conditions, besides that there is often a disease, one of the

diseases that often occurs is leaf spot disease, leaf spot disease can attack up to 40 percent of the Moringa leaf area. This can cause a decrease in production so that the moringa fluctuates in total production (Krisnadi 2012). PT Moringa Organic Indonesia stated that the rainy season and dry season are factors that affect the production of moringa. During the rainy season, there will be puddles of water in the soil which causes the roots of moringa to rot. On the other hand, in the dry season, water and nutrients in the soil are reduced, resulting in the growth of Moringa and Moringa leaves falling and the leaves turning yellow because high temperatures can inhibit the development of chlorophyll moringa leaves. Apart from changing seasons, moringa is also susceptible to disease. One of the causes of disease susceptibility is the erratic change of seasons which causes disease to attack each production period.

PT Moringa Organic Indonesia faces various risks in producing moringa, one of which is production risk due to its fluctuating productivity. This can be caused by several sources of production risk factors, such as rainfall, seasonal differences, disease, and human resources, which become an obstacle that causes the total production of moringa to decrease every year with a fixed area of land. Proper handling is needed to deal with these risks to produce maximum production with the quality or quality standards of moringa that a company expects under market demand. Therefore, it is necessary to analyze the sources of risk of Moringa production and the level of risk in the rainy and dry seasons at PT Moringa Organic Indonesia.

RESEARCH METHODS

Method of Collecting Data

The method used in this research is a case study on a plantation company PT Moringa Organic Indonesia in Kunduran District, Blora Regency, Central Java. The data used in this study are primary data and secondary data. Primary data were obtained in the form of data on the general condition of the company, data on sources of risks faced by the company which were obtained from interviews with the production manager, plantation manager and marketing manager of the company PT Moringa Organic Indonesia and made observations at PT Moringa Organic. For secondary data obtained from PT Moringa Organic Indonesia related to the data needed in the study. The data used is on the results of moringa production obtained every month of harvesting every month in one year from 2016 to 2020.

Data Analysis Method

There are two analyzes used, namely descriptive analysis and production risk analysis. Descriptive analysis will be used to identify sources of production risk. Descriptive analysis is a method used to analyze data by describing the data that has been collected as it is without intending to make conclusions that apply to the public

or generalizations (Sugiyono, 2018). Furthermore, production risk analysis uses the coefficient of variation (CV). The coefficient of variation (CV) measures relative risk obtained by dividing the standard deviation by the expected value.

According to Sugiyono (2016), risk is systematically formulated as follows:

1. The formula for the average production according to can be calculated using the formula:

$$E = \frac{\sum E_i}{n}$$

Note: E = Average production of Moringa; Ei = Total production value of Moringa (tons/ha); and n = Number of months in each season (months)

2. Variance Formula (V^2) can be calculated using the formula as follows:

$$v^2 = \frac{n\sum_{i=1}^{n} E_i^2 - \left(\sum_{i=1}^{n} E\right)^2}{n(n-1)} \text{ or } v^2 = \frac{n\sum_{i=1}^{n} (E_i - E)^2}{n-1}$$

Note: V^2 = Variance; and E = Average Production of Moringa (tons/ha).

3. The formula of Deviation Standard (σ) is as follow:

$$\sigma = \sqrt{V^2}$$

Note: σ = Standard Deviation; and V^2 = Variance

4. The formula for the Coefficient of Variation is as follow:

$$CV = \frac{\sigma}{E}$$

Note: CV = Coefficient of Variation; σ = Standard Deviation; and E = Average Production of Moringa (tons/ha)

The smaller the CV value with the criteria, the smaller the risk obtained. On the other hand, the higher the CV, the greater the risk. If the CV value 0.5, it has a low risk, whereas it has a high risk if the CV > 0.5.

5. The lower limit value (L) can be calculated using the formula :

$$L = E - 2\sigma$$

Note: L = Lower limit value of moringa production; σ = Standard Deviation; and E = Average Production of Moringa (tons/ha)

To evaluate the lower production limit value, if the L value is 0, there will be no loss, whereas if L < 0, there will be an opportunity to experience a loss. The higher the value of the lower production limit, the better the production results. In comparison, the lower the value of the lower production limit obtained, the lower or worse production results.

RESULTS AND DISCUSSION

Identification of Risk Sources

Plantation Production PT Moringa Organic Indonesia, in carrying out production activities, is faced with various sources of risk. To find out the sources of production risk, researchers conducted interviews and analyzed the company's production reports. Production risk that occurs in the company is in the form of ups and downs in production caused by external risks (outside the company) and internal risks (inside the company).

External Production Risk

The company's external production risk is the risk that comes from outside the company or that occurs in the farm section, which consists of:

Weeds

Some of the dominant weeds found in the company's Moringa plantations consist of grasses and nutgrass. The large number of weed species found in Moringa plantations is because the plantation area is still open. The most common weeds are from the Gramineae family. The high level of species diversity and families of Gramineae is because of the ability of these weeds to adapt to their environment. In addition, this species has a means of vegetative and generative reproduction. The fast adaptability of graminae to its environment is supported by the potential for releasing allelopathic compounds it possesses. Allelopathy can increase weed aggressiveness in the interaction relationship between weeds and cultivated plants. This causes a decrease in production that can reach 10-50 percent depending on the density between weeds and the main crop (Palman, 2020). In the research of Tjitrosoedirdjo et al (1984) so that Moringa plants have high production and can grow well, it is necessary to control Imperata cylindrica weeds by spraying herbicides.

Disease

One of the causes of moringa's low quality is disease. Plant disease is a disorder in plants caused by microorganisms. Pathogenic bodies that can cause plants to become sick are fungi, bacteria, viruses, protozoa, nematodes, etc. Diseases often found in Moringa plants are fungi, while bacteria or viruses are rarely found in Moringa plants and do not cause damage. Several types of diseases attack leaves and roots in the company's plantations, namely leaf spot disease and root rot disease. There are several diseases found in Moringa, namely leaf spot disease caused by the fungi Cecospora spp and Septoria lycopersici (Anggraeni, 2009; Mahonara, 2007) and tends to transmit to other moringa plants quickly and can cause death, so the company controls it by trimming the plant parts that are affected. damaged and provide bioinsecticides and plant-based fungicides. Next is leaf spot disease, which is caused by the pathogenic fungus Altenaria sp (Guo-Yin et al, 2013) and can cause severe damage (Agrios, 2005; Jones et al, 2013). Leaf spot control can be done intensively using fungicides (Suhardi, 2007). The effect on Moringa production is that the leaves become wrinkled and fall off, resulting in reduced crop yields. Control is carried out by taking care of the environment around the affected plants, weeding weeds and weeding stagnant water. Root rot is also one of the diseases that mostly attack Moringa plants, this disease is caused by the fungus Phytophthora paracitica, Phellinus spp and Genoderma spp. Symptoms seen in plants affected by brown root rot disease are diseased tree leaves can change color from normal to pale green to brown due to infection originating from the roots close to the base of the stem, while the inner root bark is covered by white to brown mycelia. (Hidayati, 2013). Control of Moringa plants that are attacked by root rot disease by spraying residual fungicides onto plant body parts (leaves, fruit, seeds and seedlings) and releasing natural enemies or biological agents that can suppress pathogens (Sastrahidayat, 2011; Sutarman, 2017; Effendi et all, 2019)).

Season

A change in the season that is difficult to predict greatly affects production results. The seasons faced are rainy and dry, where every two seasons, the company's plantations experience quite high rainfall in the rainy season, and the sun's heat during the dry season, which creates its source of risk in each season.

The risk during the rainy season faced by the company is related to the pruning workforce which if it rains during working hours then the trimmer becomes unable to harvest so that it reduces the production of moringa leaves produced, in addition if it rains continuously there will be puddles of water inside the soil that causes the roots of moringa to rot. In addition, during the

rainy season, humid weather conditions make it susceptible to fungal growth, which can cause death in Moringa plants.

There is a risk that during the dry season, there will be an increase in air temperature, which will increase the rate of evaporation of plants and soil which causes the depletion of the availability of nutrients and water, which can cause drought. During the dry season, leaf fall can also result in lack of water availability. The decrease in soil water content during the dry season affects the absorption of water and plant nutrients, which will affect plant metabolism. The direct effect that occurs due to a prolonged lack of water is the reduced growth rate, so that the growth of Moringa and Moringa leaves fall and the leaves turn yellow. This causes the photosynthetic capacity of Moringa plants to decrease so that the production of moringa leaves also decreases, besides that during the dry season, Moringa plants are also susceptible to disease, causing a decrease in Moringa production.

Internal Production Risk

The company's internal production risk is a risk that occurs due to the influence of human resources. Human resources can affect the effectiveness and efficiency in production activities. Human resource risk can be defined as the risk associated with the workforce. A skilled, educated and experienced workforce is very important for the company, to support the effectiveness and efficiency of production activities. However, labor is often the cause of production risk. Unskilled labor can be a source of production risk for the company. These labor errors occur when workers make mistakes in harvesting, especially in pruning Moringa stems, errors in processing, and lack of control of pests and diseases. This error is very detrimental to the company because this source of risk greatly influences other sources of risk, especially as a source of pest and disease risk that will be even greater. This is in line with the results of research Narendracista and Yasa (2018) which states that the workforce can affect the performance of the company.

Production Risk Analysis

PT Moringa Organic Indonesia in producing moringa faces several risks in running its business. To minimize potential losses, it must know how much risk it faces. The magnitude of the level of risk cannot be measured precisely because natural factors strongly influence agriculture business. However, this can be done through several approaches. In this study, the risk of Moringa production in each rainy and dry season was analyzed by looking at the value of variance, standard deviation, coefficient of variation and lower production limit value by looking at the value of Moringa production in 2016-2020. In analyzing the level of risk of a business, it is necessary to know the frequency of occurrence in a certain period. This is needed to determine how much opportunity the profit or loss value may be received.

Table 1. Analysis of Moringa Production Risk at PT Moringa Organic Indonesia

Details	Season	
	Rainy	Dry
Average Production (tons)	1,53	1,52
Variance (V^2)	0,55	0,81
Standard Deviation (σ)	0,75	0,90
Coefficient variation (CV)	0,49	0,59
Lower Limit Value (L)	0,03	-0,28

Source : Processed Data (2021)

The coefficient of variation during the rainy season is 0.49 percent for every ton of moringa production obtained. The risk (loss) faced by the company is 0.49 percent as well as during the dry season the coefficient of variation value is 0.59 percent. This means that for every one tonne of Moringa production obtained, the risk (loss) faced by the company is 0.59 percent. This is in line with Anggela et al. (2019) research that coefficient variation (CV) during the dry season is higher than in the rainy season. The cause of the risk level of the dry season rather than the rainy season in the company is due to a shift in the seasons in the past 5 years, so that the intensity of rainfall occurs more in the dry season. During the dry season, it can result in leaf fall due to lack of water availability, the decrease in soil water content during the dry season affects the absorption of water and plant nutrients which will affect plant metabolism.

Calculation of the lower limit value of Moringa production during the rainy season is -0.03 and the lower limit value of Moringa production during the dry season is -0.28. This value is for every month of production obtained, then this value is the lowest production limit value that will be obtained for each season. The greater the lower limit value, the better the production, between the two seasons the production value during the rainy season is greater than during the dry season.

Seen further from the coefficient of variation of the risk value of Moringa production produced during the dry season is higher than production during the rainy season. This is because pest and disease attacks during the dry season are higher than rainy. The lack of sunlight that affects photosynthesis during the rainy season causes the risk value in the rainy season to be lower. This is in line with Ghani's (2013), Hosang et al (2012) research that rainfall is a factor that increases the risk. In addition to rainfall, the intensity of sunlight is less and the attack of pests and diseases in the form of fungi increases the risk of production.

According to field observations, the risk level for moringa production during the rainy season is smaller than the risk level for moringa production during the dry season, and the lower limit value for moringa production during the rainy season is greater than the lower limit value for moringa production during the dry season. This

is because during the rainy season the need for water is fulfilled so that the production of moringa leaves is abundant, while during the dry season the availability of water in the soil is limited so that the moringa leaves produced are not optimal, besides that the available water content must be divided by the presence of weeds. growing around Moringa plants, during the dry season there is leaf fall so that nutrients that should be maximized to increase Moringa leaf production must be shared with other plant parts so that production during the dry season has a higher risk than during the rainy season.

Risk Management Strategy

Human Resource Risk Management Strategy

Based on the opinion of the experts above, it can be concluded that human resource risk is a problem caused by the workforce so that it harms the company. Facing the risk of human resources, the company must carry out an effective strategy, the preventive strategy carried out by the company is as follows.

a) Forbidding workers to work double in focusing on their respective fields.
b) Organizing or training in the processing of workers at PT Moringa Organic Indonesia from beginning to end.
c) Conducting directives to the workforce before carrying out the work
d) Prepare job descriptions, job specifications, good performance appraisals.
e) Perform effective communication or coordination between the leadership and the workforce.
f) An effective incentive or reward and sanction system

Rainy Season Risk Management Strategy

The company's preventive strategies in dealing with risks during the rainy season are so that the Moringa plants are not threatened with crop failure in the rainy season.

a) Arrangement of drainage can be done by making beds, this is important to cope with flooding that may occur and making ditches or waterways before the rainy season
b) Applying fertilizer as much as 85% of the dry season planting because the amount of water abundant in the rainy season will easily dissolve the fertilizer in the beds.
c) The cropping pattern is recommended not to be too dense so as not to stimulate the growth and development of pests and diseases i.e 50 cm x 25 cm.

Dry Season Risk Management Strategy

Handling efforts that can be carried out by the company are in line with the research of Satoto et al., (2013) to reduce the risk of the dry season, among others:

a) Increasing organic matter through the return of plant residues, because lack of organic matter will make the soil surface weak when the rainy season comes so that water cannot enter and be stored in the soil, when dry the soil will quickly lose water.
b) Giving compost is one strategy to make the soil store more water.
c) Make water reservoirs and irrigation routes before the dry season occurs.

CONCLUSIONS AND POLICY IMPLICATIONS

Conclusions

Based on the results of the discussion, it can be concluded that the sources of production risk contained in PT Moringa Organic Indonesia consist of external and internal production risks. External production risks include the risk of weeds, diseases, and seasons, while the internal risk is the risk of human resources during *production of moringa leaves*. Furthermore, the level of risk of Moringa production during the rainy season and dry season shows the level of risk of production in the dry season with coeficient variation is 0,59 that has a high risk because it has a greater coefficient of variation than the rainy season is 0,49. The lower production limit value (L) is obtained during the dry season, between the two seasons, the lower production limit value during the rainy season is more profitable than during the dry season.

Recommendations

After identifying the sources of production risk in Moringa production, a strategy for handling the sources of production risk is decided. To minimize the impact of production risk, a preventive strategy is implemented. Companies can carry out management strategies for disease risk so that production results continue to be maximized and the risks faced are reduced, especially during the dry season on maintenance and preventive measures to providing herbicides and fungicides. In addition, the company supervises and trains the workforce to be more skilled at the workforce both in the harvesting and sorting process to reduce errors.

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