Analysis of Profit Maximization of Areca Farming in Jambi Province, Indonesia

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Abstract: This study was conducted to produce a reference for the development of the areca nut business in determining a profitable level of productivity. Data were analyzed from the results of the estimation of the feasibility of farming including production data, production costs, and prices during the productivity period of areca nut (21 years). Maximum profit analysis is done mathematically using a differential approach. The formation of revenue functions and production costs as forming the profit function is carried out using regression techniques in the form of non-linear equations. The results of the analysis showed that the production capacity of areca nut farming was 7,180.3 kg/ha/year with a maximum profit rate of Rp. 96,686,216.82. To achieve this production capacity, efforts that can be made by farmers in the short term are to increase the use of fertilizers, medicines and the use of labour to carry out maintenance and processing of produce.

The results of this analysis provide implications for farmers to optimize the use of inputs efficiently in order to produce maximum profits. To support the success of these efforts, the government's role is needed in creating a conducive market, both in terms of price and demand levels. To strengthen areca nut farming, corporate social responsibility (CSR) is needed, both in terms of financing and cultivation techniques and product processing.

Keywords: Maximum profit, areca nut farming

1. Introduction

Areca nut is one of the leading commodities of Jambi Province besides rubber, oil palm and deep coconut. There are 28,551 households or about 4.29 percent of farmers in Jambi Province who use areca nut farming as a source of family income. In general, areca nut farming is still done traditionally (Wahyudi, 2018) so that the level of plant productivity has not contributed significantly to family income. This condition occurs because the areca nut farming managed by the community is not supported by adequate capital and has a small business scale. This limitation encourages farmers to carry out the right strategy in managing their business so that the farming they run produces optimal profits. According to Margaretha\&Supartika (2016), among these strategies is outsourcing to support the production process, namely by renting tools or technology from other entrepreneurs who have succeeded in developing farming. In this way, farming that is run will be more efficient because the cost of buying assets will be reduced.

The large scale of the business allows farmers to access greater resources and increase the profitability of the business they run. In addition, farmers can also run businesses at the most economical scale so that they have more potential to generate maximum profits (Margaretha\&Supartika, 2016). Profit maximization is the main goal for all businesses, whether small, medium or large. Maximum profit can be achieved through various strategies, including reducing low quality work, carrying out work on time, reducing the negative impact of work, increasing productivity, proper work procedures, continuity of supply and improving work experience (Kyssima et al., 2020).

Areca nut farming has a huge opportunity as a job for the community because it is easy to cultivate, both in terms of availability of planting material, easy growing process, low capital, not too long harvest time, and high level of demand (Rajasree et al., 2019). In India, the areca nut does not only play a role in the economic life of the community but also has a very important role in religious, social and cultural affairs (Danti\&Suresha, 2012). Nearly 10 percent of the world’s people consume substances produced from areca nut (Garg et al., 2014). Areca nut plants have a variety of uses, including areca nut fruit and roots that can be used as medicinal ingredients, areca nut stems are useful for building construction materials, areca leaves are useful for making alcohol, areca nut midribs are used as a wrapping tool, sandals and hats are made of materials (Staples). andBevacqua, 2006), betel...
nut as a biosorption material to remove Pb(II) metal ions (Utami and Lazulva, 2017), and areca nut can also be used as an ingredient for making drinks or syrups (Yenrina et al., 2014). Ripe betel nut has a high content of tannins, protein and carbohydrates (Shwetha et al., 2019).

The problems faced by farmers in developing betel nut farming do not only occur in Indonesia, the world's largest betel-producing country (India) also experiences the same problem, namely pests and diseases that result in economic losses reaching 13.9 percent (Ramappa, 2013). There is a tendency for the younger generation, especially those with higher education, to dislike work in the agricultural sector, thereby reducing the availability of labour. This condition causes labour wages to increase (Hegde& Deal, 2014). If the cost of labour increases, farmers tend to reduce the use of labour so that production decreases and profits decrease (Edison, 2020). This condition will affect the sustainability of areca nut farming in the future. Thus it is necessary to make efforts to increase the value of higher commodities to be more competitive in generating maximum profits. These profits can be generated by increasing revenue and reducing unit costs or can be done in both ways (Dey, 2007). According to Ray et al. (2004), maximum profit can only be achieved by entrepreneurs if they are able to utilize resources efficiently. By measuring the level of profit efficiency, farm performance will be easier to evaluate than doing financial and accounting measurements (Arbelo et al., 2021). Mahoney and Pandain (1992) argue that entrepreneurs can achieve greater profits not because they have superior resources but because their special competencies allow them to use those resources more efficiently. That is, the entrepreneur may have the skills to pool resources, but these resources will not be sufficient to achieve a competitive advantage; in addition, these resources must be used efficiently (Majumdar, 1998; Peteraf, 1993). In short, firms that do not use their resources efficiently in the production process cannot expect to derive a potential competitive advantage from them (Ray, Barney &Muhanna, 2004).

The orientation of farmers to develop areca nut farming is the level of profit that will be generated. Profit is the basis of policy for farmers in deciding the use of investment and determining the level of financing for farming. Where the picture of the ratio of profit to sales and total assets will determine the survival of the farm in the long term (Batchimeg, 2017). The problem faced by entrepreneurs, both small, medium and large businesses is how to generate maximum profits using minimum costs (Anggoro et al., 2019). According to Nwafor (2014), entrepreneurs try to maximize profits because they want to get output in the short and long term as a manifestation of their responsibility to the workforce, customers and all consumers around them. As a farmer, the biggest responsibility is to the family. In an effort to maximize profits, farmers must pay attention to the amount of output that will be produced in addition to the use of estimation methods to produce these outputs. By targeting the amount of output it will be more profitable than using general rules in generating profits (Lemmens& Gupta, 2020).

Many assume that entrepreneurs maximize their own profits. Thus, it is often recognized that the goal of a business is to maximize profits (Mer, 2018). The Profit-Maximization Approach proposes that the main objective of a business's concern is to maximize its profits. Therefore, any decision should be measured by profit criteria only and should be taken only if it ultimately leads to profit maximization. A farm with healthy profits is considered efficient both in terms of operations and investment. With this approach, the more profits obtained by farming, the better the business will be, because profits are treated as a barometer of farming efficiency. A farm with adequate profits will be able to sustain enough to support itself in an economic downturn or financial hardship. Therefore, profits act as the foundation for the farm against such financial shocks. Investors also prefer to invest their surplus in farming with healthy returns, because they anticipate regular income in the short term and capital appreciation in the long term.

The sustainability of farming depends on profitable production. Profit is the main motive in economic growth which is based on private ownership of factors of production and the application of market mechanisms in determining prices (Brink, 2019). Maximizing profit is an effective strategy to develop farming when farmers face a declining economic condition (Gan et al., 2009). To make a decision on the level of output to be produced, producers need to estimate production costs in order to generate maximum profit. Borah et al. (2020) detail the costs needed to run areca nut farming, namely (1) the cost of establishing an areca plantation including land cultivation, purchasing seeds and planting betel nut, (2) labour costs in managing and maintaining areca nut plants, and (3) harvesting costs. and the cost of transporting the produce.

Studies on areca nut commodities are mostly carried out on the substance contained in it as a reference for the manufacture of medicines and food ingredients. Studies that lead to business development need to be carried out
comprehensively, both in terms of cultivation techniques and financial analysis that will provide information on the level of profit generated. Borah (2020) examines betel nut farming in India from the level of Profit Volume Ratio (PVR), which is the level of land effectiveness in producing areca nut. The results explain that the wider the areca nut plantations, the higher the PVR value of farmers. In India, the average Profit Volume Ratio (PVR) is 62.94 on a land area of 7.5 – 15 bigha or 0.56 – 1.2 hectares. This study has not revealed the level of profit that will be obtained by farmers from the farming they run. Profit analysis provides an overview of the extent to which the level of output is generated from a number of costs incurred to generate maximum profit. This analysis cannot be done with a simple technique using a table approach of total production, average production, and marginal production of labour and its application to the curve, as done by Cipta et al. (2020). Although the maximum profit level can be explained through this method, it does not provide information on the relationship between production and income and costs as the main variable in the analysis of maximum profit. Therefore, this study tries to analyze the relationship between these variables statistically in order to produce a pattern of relationship and farming capacity to generate maximum profit.

2. Research Method

This research was conducted to complete the feasibility study of areca nut farming as the basis for rejuvenating areca nut plantations in MuaraSabakTimur District, TanjungJabungTimur Regency, Jambi Province. Data were analyzed from the estimation of the feasibility of farming for 25 years, namely production data, prices, and production costs.

The existence of farmers in the output market cannot affect the market as described in the perfect competition market structure, because there are many and sell similar commodities. The hallmark of a perfectly competitive firm is that the total cost curve resembles an inverted U or S and a quadratic profit function. Firms achieve maximum profit when marginal revenue equals marginal cost (Dubas et al., 2011). There are two approaches to calculating profits, namely; subtracting total revenue by total cost (TR – TC) and subtracting marginal revenue by marginal cost (MR – MC). Maximum profit is reached when MR = MC (Dey, 2007). In this condition, there is no incentive for the company to get even if the output produced is more or less.

Anggoro et al. (2019) use the simplex method to estimate the maximum profit, which is a method to produce the best objective function. The assumption of this method is that if the company produces the optimum product, the maximum profit will be obtained. The result of optimizing the output is maximum acceptance. Thus the company's goal to generate maximum profit is maximum revenue. However, these efforts are constrained by the level of costs incurred to produce/sell these products. Mathematically these conditions can be formulated in the form of the following equation:

Objective function (TR):

\[ TR = PQ \] ............................(1)

Where TR is Total Revenue, P is the price level and Q is the quantity of goods. If the supply of a commodity is indicated by the function \[ P = \alpha_0 - \alpha_1Q \], then the form of the revenue function for the production/sales of the commodity becomes:

\[ TR = \alpha_0Q - \alpha_1Q^2 \]

Constraint function (TC):

\[ TC = \beta_0 + \beta_1Q + \beta_2Q^2 + \beta_3Q^3 \] ...........................(2)

Where TC is Total Cost, Q is the amount of production, \( \beta_0 \) is a constant, and \( \beta_{1,2,3} \) is the coefficient Q.

Profit function (\( \pi \)):

\[ \pi = TR - TC \] .................................(3)
\[
\pi = \alpha_0 Q - \alpha_1 Q^2 - (\beta_0 + \beta_1 Q + \beta_2 Q^2 + \beta_3 Q^3)
\]
\[
\pi = \beta_0 + (\alpha_0 - \beta_1) Q - (\alpha_1 + \beta_1) Q^2 - \beta_3 Q^4
\]

The first derivative of the profit function determines the point from which the maximum profit is generated, as shown in the following equation:

\[
\frac{\partial \pi}{\partial Q} = \frac{\partial TR}{\partial Q} - \frac{\partial TC}{\partial Q} \quad \text{or} \quad \frac{\partial \pi}{\partial Q} = MR - MC
\]

......................(4)

\[
\frac{\partial \pi}{\partial Q} = (\alpha_0 - \beta_1) - 2(\alpha_1 + \beta_2) Q - 3\beta_3 Q^2
\]

When the first derivative of the profit function is 0, the magnitude of \( Q \) is the production that will maximize profit, so:

\[
0 = (\alpha_0 - \beta_1) - 2(\alpha_1 + \beta_2) Q - 3\beta_3 Q^2
\]

............................(5)

To determine the quantity of \( Q \) that satisfies the equation, it is calculated using the following ABC formula (Gan et al., 2009):

\[
Q_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]

..............................(6)

\[
Q_1 = \frac{-(-2(\alpha_1 + \beta_2)) + \sqrt{(-2(\alpha_1 + \beta_2))^2 - 4(3\beta_3)(\alpha_0 - \beta_1)}}{2(3\beta_3)}
\]

.............................(7)

\[
Q_2 = \frac{-(-2(\alpha_1 + \beta_2)) - \sqrt{(-2(\alpha_1 + \beta_2))^2 - 4(3\beta_3)(\alpha_0 - \beta_1)}}{2(3\beta_3)}
\]

.............................(8)

The first derivative condition is a necessary condition to determine the amount of production at maximum profit. However, this condition has not proven whether at that level of production the profit generated is maximum or minimum so that a condition is needed to suffice the proof, namely through the second derivative of the profit function. If the value is negative or less than 0, then the maximum profit (\( \Pi \)) on production is \( Q \), and if \( \frac{\partial^2 \pi}{\partial Q^2} > 0 \), then the minimum profit (\( \Pi \)) on production is \( Q \).

3. Results and Discussion

This study attempts to analyze the maximum profit of areca nut farming that will be developed in MuaroSabakTimur District, TanjungLabungTimur Regency. The data were analyzed from the estimation of the feasibility of betel nut farming for 25 years. Farming profits are obtained from the level of acceptance after deducting production costs. The maximum profit is calculated based on the concept of MR = MC.
Revenue is obtained after the areca nut farming begins to produce, namely at the age of 5 years. The level of acceptance of areca nut farming is influenced by the level of productivity and the level of prices prevailing in the producer market. The production of areca nut in the 5th year is estimated to be 4,371 kg/ha and decreased from the 15th to the 25th year. The price of areca nut is estimated to have increased in accordance with the inflation rate of plantation crop prices of 3.1% per year. Based on the level of development of areca nut production and prices, the pattern of supply/sales of areca nut is analyzed, as shown in Table 1 below:

Table 1. Supply of Areca Commodity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>29,457.84</td>
<td>3210.912</td>
<td>9.17429</td>
<td>0.0000</td>
</tr>
<tr>
<td>Q</td>
<td>-1.769123</td>
<td>0.59134</td>
<td>-2.991718</td>
<td>0.0075</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.32 \]
\[ F_{stat} = 8.95 \]

Source: primary data processed

Table 1 explains the negative relationship between price and production/sales of areca nuts. This condition does not mean that the decline in betel nut production is the result of an increase in prices, but rather that the age of the plant is getting older resulting in a decrease in productivity. On the one hand, prices have increased every year, but on the other hand, productivity has decreased after reaching production capacity, thus illustrating a pattern of opposite relationship between the two. Based on the data in Table 1, the pattern of the relationship between prices and sales of areca nut is described in the following equation:

\[ P = 29,457.84 - 1.77Q \] \hspace{1cm} (10)

At the price level described in equation 10, the amount of farmers' income depends on the level of production/sales of areca nut, as explained in the following equation:

\[ TR = 29,457.84Q - 1.77Q^2 \] \hspace{1cm} (11)

From equation 11, it can be seen that the additional level of income obtained by farmers from each additional sale of areca nut commodities, which is the first derivative form of the revenue function as described in the following equation:

\[ MR = 29,457.84 - 3.54Q \] \hspace{1cm} (12)

Based on equation 12, the marginal rate of revenue decreased by Rp. 3.54 from every sale of 1 kg of areca nut. This decline will continue to occur until maximum profit is generated from the areca nut production. Thus, farmers will continue to increase their production to the maximum production capacity, namely by increasing the use of production inputs in the form of fertilizers, medicines and labour for garden maintenance, harvesting and processing of produce. As a consequence of the use of these inputs, farmers have to spend a certain amount of money to finance it. Thus, the cost of farming becomes an obstacle for farmers in obtaining profits.

In this study, the costs taken into account are short-term costs, namely costs incurred for the use of production inputs that can be increased in number within one year or production inputs that determine the increase in the amount of production in the short term, such as fertilizers, medicines and labour. Based on this concept, the amount of production costs depends on the level of products produced. Therefore, the pattern of the relationship between costs and production forms a non-linear relationship following changes that are always fluctuating. By using the cubic equation, the resulting pattern of the relationship between costs and production is shown in Table 2 below:
Table 2. Cost of Production/Sales of Areca Commodities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-6,078,556</td>
<td>3373809</td>
<td>-1.80169</td>
<td>0.09</td>
</tr>
<tr>
<td>Q</td>
<td>7,303.08</td>
<td>2112.601</td>
<td>3.456916</td>
<td>0.003</td>
</tr>
<tr>
<td>Q^2</td>
<td>-0.87</td>
<td>0.4295</td>
<td>-2.026647</td>
<td>0.050</td>
</tr>
<tr>
<td>Q^3</td>
<td>0.00006</td>
<td>0.0000</td>
<td>2.104767</td>
<td>0.050</td>
</tr>
</tbody>
</table>

R^2 = 0.99  
F_{stat} = 4361.111  

In Table 2, the modification of production variables to the power of two and three is quite significant as forming the production cost function because it is significant at an error rate of 5 percent, which is mathematically described in equation 13 below:

TC = -6,078,556 + 7,303.08 Q - 0.87 Q^2 + 0.00006 Q^3  

From equation 13, it can be seen the level of additional costs that will be incurred by farmers from each additional betel nut production, as explained in equation 14 below:

MC = 7,303.08 - 1.74 Q + 0.00018 Q^2  

In equation 14, the relationship between marginal costs and production forms a quadratic equation, so the pattern that will occur is that additional costs will decrease due to additional products and will increase when maximum profit is generated, where the position of MC = MR. In this condition, farmers will not get incentives even though the product produced is more or less (Dey, 2007). By using the MR = MC approach, the production level will determine the maximum profit, as described in the following equation:

MR = 29,457.84 - 3.54 Q  

MC = 7,303.08 - 1.74 Q + 0.00018 Q^2  

By making the equation MR = MC, the resulting profit optimization equation is as follows:

29,457.84 - 3.54 Q = 7,303.08 - 1.74 Q + 0.00018 Q^2  

0 = -22,154.76 - 1.80 Q + 0.00018 Q^2  

To determine the amount of production (Q) that meets equation 15, calculations are carried out using the following ABC formula:

\[ Q_1 = \frac{-(-1.8) + \sqrt{-1.8^2 - 4(0.00018)(-22,154.76)}}{2(0.00018)} = 7,180.3 \]  

\[ Q_2 = \frac{-(-1.8) - \sqrt{-1.8^2 - 4(0.00018)(-22,154.76)}}{2(0.00018)} = -17,198.95 \]  

To prove that the level of production is the determinant of maximum profit, a sign test is carried out using the second derivative of the following profit function:

\[ \pi = 6,078,556 + 22,154.76 Q - 0.90 Q^2 - 0.000060 Q^3 \]
The profit function is given by
\[
\pi = 22,154.76 - 1.8Q - 0.00018Q^2
\]

and the second derivative is
\[
\pi'' = -1.8Q - 0.00036Q
\]

Based on the sign test, the amount of areca nut production that will generate maximum profit is 7,180.3 kg/ha/year, with a profit of Rp. 96,686,216.82 which is obtained from the difference between revenues of Rp. 120,305,970.54 and production costs of Rp. 23,619,753.73. By using a graph, the estimate can be explained as follows:

**Figure 1. Profit Curve**

In Figure 1, the maximum profit level of Rp. 96,686,216.82 is obtained at the time of production as much as 7,180.3 kg/ha/year. This condition is also explained by the intersection of the MR and MC curves in Figure 2.

**Figure 2. MR and MC curves**
The curve also explains that at the beginning of production the increase in profit occurs very quickly, but the increase slows down to a maximum and decreases as production continues to increase. In this condition, farmers are required to make efficient use of inputs so that the farming they run generates maximum profit.

Efforts to create betel nut farming profits are not enough to be done through farming efficiency by farmers. Support from the upstream sector is needed in the form of price stability and demand for areca nut commodities. Therefore, the government's role is needed so that the company's existence is not just looking for profit, but it takes corporate social responsibility (CSR) as an effort to reduce the socio-economic inequalities of society (Valach, 2015). Mutually beneficial relationships between companies and farmers will form a mutually beneficial business climate (Hillman and Keim, 2001). The long-term survival of farming is not only determined by the level of profit generated, it takes the responsibility of the company to maintain and increase community loyalty so that it becomes an opportunity to create profit (Hategan et al., 2018). With CSR, the company will have a competitive advantage and build a good relationship between the company and the community (Hermawan&Mulyawan, 2014; Kolstad, 2007).

4. Conclusion

The feasibility analysis of areca nut farming is needed to ensure that the farming is profitable for farmers. Efforts to maximize betel nut farming profits provide an overview of the level of business capabilities that can be achieved by farmers and become the basis for efficient use of resources. The results of the analysis of the maximum profit of betel nut farming show that farmers can achieve a maximum profit of Rp. 96,686,216.82 by producing areca nut as much as 7,180.3 kg/ha/year. Efforts that can be made by farmers to increase the production of areca nut in the short term are by increasing the use of fertilizers, medicines and the use of labour to carry out maintenance and processing of produce.

The results of this analysis provide implications for farmers to optimize the use of inputs efficiently in order to produce maximum profits. To support the success of these efforts, the government's role is needed in creating a conducive market, both in terms of price and demand levels. To strengthen areca nut farming, corporate social responsibility (CSR) is needed, both in terms of financing and cultivation techniques as well as product processing.

5. References

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