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Cost-Volume-Profit Analysis and Linear Programming as Profit Planning Instruments

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Abstract

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This study aimed to analyze the amount of costs, production volume, revenue, and business profit of CV Tani Subur and analyze the BEP and optimize the use of resources in organic fertilizer production in CV Tani Subur to produce maximum profit. The study was conducted in December 2019 at CV Tani Subur, Sleman. The research method used was quantitative method with cost-volume profit and linear programming data analysis. The results showed cost-volume profit analysis is unsuitable to be used in CV Tani Subur profit planning. The re- event point of CV Tani Subur in 2017 had the highest value and caused losses to CV Tani Subur due to its inability to break even. Furthermore, the analysis of linear programming in CV Tani Subur shows that the company will get optimal results if it only produces cow organic fertilizer as much as 548.3925 tons per year. The advantage achieved if producing organic cow fertilizer which is calculated by calculating the simplex method using POM Quantitative methods for windows version 3 software is IDR. 248,392,500 per year.

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INTRODUCTION

The use of organic fertilizer is identified with the success of fertilization and sustainable agriculture because of its ability to increase soil protection and conversion. The use of organic fertilizer can return organic material into the soil, furthermore, can increase production and yields from plants (Subowo, 2010). The high price of chemical fertilizers and the economic conditions of farmers who mostly are in the middle to lower economic conditions require farmers to consider the natural potential that exists in their surrounding such as fertilizer derived from livestock manure. The existence of the Go Organic Program in 2010 was one of the reasons farmers began to switch to organic fertilizer and together with the government succeeded in the organic farming program in Indonesia. According to Suwantoro (2008), the government had launched the Go Organic program in 2010 with the aim of supporting the independence and resilience program in agriculture in Indonesia. The existence of Go Organic program requires the private sector to participate in the success of the independence and resilience program in agriculture. The government hopes that the program launched will support the development of the agricultural industry, one of which is the organic fertilizer industry. CV Tani Subur is one of the household scale producers of organic fertilizer. It is very important for the CV to maintain business sustainability with the expected amount of profits increasing each year and the volume of production that can meet consumer demand.

Following up on the program and expectations of the government, the organic fertilizer industry is demanded to be able to run its business effectively and efficiently. Generating optimal profits is one of the ways that a company can do. These objectives require companies to plan and utilize resources optimally so that company goals can be achieved.

Following up on the program and the expectations of the government, the organic fertilizer industries are demanded to be able to run its business effectively and efficiently. The way that the company can do is to produce optimal profits. These objectives require companies to plan and utilize resources optimally so that company goals can be achieved.

Analysis used to help the company achieve its objectives effectively and efficiently was analysis of costs, volumes, and profits. Analysis of costs, volumes and profits provides information on the amount of product sales that must be achieved by the company. In addition, cost-volume-profit analysis is a short-term profit planning technique that bases the analysis on the variability of results from sales and the costs incurred on the number of activities. Another analysis that can help managers to plan or make decisions in the allocation of limited resources in order to achieve company goals is linear programming. The purpose of a company in general is to maximize profits or profits, but because of limited resources, the company can also minimize costs incurred.

The aims of this study were 1) analyzing the cost, production volume, revenue and business profit of organic fertilizer at CV Tani Subur for the period 2015 to 2019, 2) analyzing the BEP (value for money) and BEP (unit) on the production of organic fertilizer at CV Tani Subur, 3) analyze the optimization of the use of resources in the production of organic fertilizer in CV Tani Subur in order to produce maximum profit.

The benefit of this research for CV Tani Subur is as a contribution of consideration to take policy in planning future profits.

RESEARCH METHODS

This research was conducted in December 2019 at CV Tani Subur, located in Ngaglik Village, Sleman, Special Region of Yogyakarta. The research location was chosen deliberately with the consideration that CV Tani Subur is an organic fertilizer company that requires financial analysis in order to plan future profitability. The method used in this research was quantitative approach. The type of data used were quantitative data in the form of company time series data from 2015 to 2019 and qualitative data in the form of data from interviews with the owner of CV Tani Subur. Data were collected by interviewing the owners and workers of CV Tani Subur.

The framework of this research was the problem that originated from CV Tani Subur as a household scale organic fertilizer company with fertilizer distribution throughout Indonesia. Therefore, it is necessary to plan profits in order to continue the business to run and not suffer losses in the future. Profit planning was done by using *cost-volume-profit* analysis and *linear programming*. *Cost-volume-profit* analysis was obtained by calculating fixed costs and variable costs, predicting variable costs, sales quantities, selling prices and sales revenue and doing *contribution margin* analysis, *breakeven point* analysis, profit target analysis and sensitivity analysis. The *linear programming* analysis was done by determining the objective function, which was optimizing profits through the use of resources available at CV Tani Subur, followed by determining the constraint function that shows the company's limitations, namely raw materials, capital, labor, fixed costs and starters. *Linear programming* analysis was calculated using *POM Quantitative methods for windows version 3 software* in order to obtain the most optimal amount of profits obtained by CV Tani Subur. The results obtained were the factors that influence the achievement of earnings and determine the right analysis for earnings planning in CV Tani Subur.

Analysis of the data used was in accordance with the objectives of the research conducted, namely:

1. Answering the first problem, which was analyzing the magnitude of costs, production volume, revenue and business profits obtained by CV Tani Subur for the 2015-2019 periods.
 - a. Production costs; according to Malombeke (2013) were calculated using the formula:

$$TC = FC + VC (Q)$$

Explanation:

TC : total cost (IDR)

FC : fixed fee (IDR)

VC : variable cost per unit (IDR)

Q : units produced (tons)

- b. Revenue; according to Mulyadi (2005) production costs were calculated using the formula:

$$TR = Q \times P$$

Explanation :

TR : total revenue (IDR)

Q : units produced (tons)

P : selling price (IDR / ton)

c. Operating profit

$$\text{Profit} = \text{TR} - \text{TC}$$

Explanation :

TR : total revenue (IDR)

TC : total cost (IDR)

2. To answer the second problem, namely the effect of BEP (value for money) and BEP (unit) on CV Tani Subur's profit planning, the data were analyzed quantitatively using cost-volume profit analysis.

a. *The contribution margin*, according to Pangemanan (2016), determines the contribution margin used by the formula:

$$3. \text{CMR} = 1 - \frac{\text{Variable cost}}{\text{Revenue}}$$

b. *Break event points*, according to Sihombing (2013) determine break event points that can be used using the formula:

$$\text{BEP (price)} = -1 \frac{\frac{\text{Fixed cost}}{\text{Revenue}}}{\frac{\text{Variable cost}}{\text{Revenue}}}$$

c. Determine the Margin of safety, which in the opinion of Riyanto (2004) is calculated by using the formula:

$$\text{Sales Margin} = \text{Total Sales} - \text{Break even sales}$$

$$\text{Percentage of sales protection} = \frac{\text{margin of sales security}}{\text{revenue}}$$

d. Analysis of profit targets was used to determine sales volume in order to achieve profit targets. The target profit analysis formula according to Assa (2011) is as follows:

$$e. \text{ATL} = \frac{\text{Fix cost} + \text{Profit target}}{\text{CMR}}$$

f. Sensitivity analysis was used to calculate the possibility of changing variables in the cost volume of profit. The sensitivity analysis formula according to Assa (2011) is as follows:

$$\text{Income statement} = \text{sales} - \text{variable costs} - \text{fixed costs}$$

g. Time series analysis was able to describe the achievements in series. Then the trend of the line is seen in future numbers as forecast numbers. The least square time series analysis formula according to Duyo (2013) is as follows:

$$(Y = a+bX)$$

where:

$$a = \frac{\sum Y}{n}, b = \frac{\sum XY}{\sum X^2}$$

The time series moment analysis formula: $(Y = a + bX)$ where,
 $\Sigma Y = (axn) + bx \Sigma X$, $\Sigma XY = (ax \Sigma X) + (bx \Sigma X^2)$

Explanation:

Y = profit

X = calculated year units (2015 to 2019)

a = value of the trend in the base period

b = trend change (coefficient of line direction)

n = amount of data

3. To answer the third problem, namely the optimal design of resource management in the production of organic fertilizer in CV Tani Subur in order to produce maximum profit, the data were analyzed quantitatively with linear programming analysis.

Analysis of linear programming according to Aprilyanti (2019) is:

a. Determine the cost of production

b. Research Model

1. Determine the decision variables in solving linear program problems, namely the type of fertilizer produced at CV Tani Subur:

x1 = organic cow fertilizer

x2 = organic goat fertilizer

2. Determine the objective function of the linear program problem:

$$Z_{\max} = C_1 X_1 + C_2 X_2 - C_3 X_3 - C_4 X_4 - C_5 X_5 - C_6 X_6 - C_7 X_7$$

3. Determine constraints in solving linear program problems.

The constraints can be written as follows:

1. Availability of production costs:

$$C_3 X_3 + C_4 X_4 + C_5 X_5 + C_6 X_6 + C_7 X_7 \leq BP$$

2. Transfer of income:

$$C_1 X_1 + C_2 X_2 - C_3 X_3 - C_4 X_4 - C_5 X_5 - C_6 X_6 - C_7 X_7 \geq 0$$

3. Transfer amount of *starter*:

$$C_{13} X_1 + C_{23} X_2 - X_3 \geq 0$$

4. Transfer of cow manure raw materials:

$$C_{16} X_1 \geq 0$$

5. Transfer of goat fertilizer raw material:

$$C_{27} X_1 \geq 0$$

6. Transfer of use of labor:

$$C_{14} X_1 + C_{24} X_2 - X_4 = 0$$

7. Fixed costs:

$$C_{15} X_1 + C_{25} X_2 - X_5 = 0$$

8. Availability of number of starters:

$$X_3 \leq MPm$$

9. Availability of cow manure raw materials:

$$X_6 \leq MPbks$$

10. Availability of goat fertilizer raw material :

$$X_7 \leq MPbkk$$

11. Availability of labor:

$$X_4 \leq MPtk$$

12. Provision of organic fertilizer moles:

$$X_6 + X_7 - 2 X_3 = 0$$

Non negativity constraints:

$$X = X_1, X_2, X_3, X_4, X_5, X_6, X_7 \geq 0$$

Explanation :

- c_1 = Selling price of cow fertilizer per ton (IDR)
 - c_2 = Selling price of goat fertilizer per ton (IDR)
 - c_3 = price / liter mol (IDR)
 - c_4 = labor wage (IDR)
 - c_5 = total fixed costs for 1 year (IDR)
 - c_6 = price of raw materials for cow fertilizer Per ton (IDR)
 - c_7 = price of goat fertilizer raw material (IDR)
 - x_1 = amount of cow fertilizer produced (tons)
 - x_2 = amount of goat fertilizer produced (tons)
 - x_3 = number of moles used (liters)
 - x_4 = number of workers used
 - x_5 = fixed costs used for production (IDR)
 - x_6 = raw material for cow fertilizer for production (tons)
 - x_7 = goat fertilizer raw material for production (tons)
 - BP = Production costs available (IDR)
 - MPm = Number of moles available (liters / year)
 - MPbks = amount of cow dung available (tons / year)
 - MPbks = amount of goat dung available (tons / year)
 - MPtk = number of available workers (person / year)
- c. Determined the optimum amount of production using *POM Quantitative methods for windows version 3 software*.
 - d. Analyzing the results of *POM software Quantitative methods for windows version 3*.

RESULT AND DISCUSSION**Business Overview of CV Tani Subur**

Meat consumption needs in the community are increasing along with people's awareness about nutrition. This has a positive impact on beef cattle entrepreneurs as meat suppliers. Seeing this, breeders in the Sariharjo Ngaglik District of Sleman also took part in this opportunity. Nearly every dukuh is built by a herd of cattle and goats. The rise of cattle and goat cage groups has positive and negative impacts on the environment. The positive impact of the establishment of cattle groups is to increase cattle farmers' income, increase meat supply and the positive activities of Sariharjo residents. While the negative impact is the accumulation of livestock manure cause air pollution by the bad smell of manure and filthy environment. For cattle farmers who also work as crop farmers, this negative impact can be overcome by utilizing livestock manure as organic fertilizer in their paddy fields to diminish the problems for the environment. For cattle farmers only, the animal wastes can cause problems. Environmental problems that arise, become an opportunity for CV Tani Subur, which is located in Wonorejo Village, Sariharjo, Ngaglik, Sleman to process these manure wastes professionally both in terms of processing and management. The benefits of the establishment of CV Tani Subur are reducing the impact of environmental pollution, collecting manures from farmers groups in the environment of Sariharjo, Ngaglik, Sleman and improving the economy for the founders of CV Tani Subur in particular and cattle farmers in general.

Costs, Production Volume, Revenue, and Profit of Organic Fertilizer Business in CV Tani Subur

CV Tani Subur is a manufacturing company engaged in agriculture, located in Sleman area and produces organic fertilizer from cow and goat manures. The activities carried out by CV Tani Subur are production and non-production activities which naturally produce costs that must be taken into account. Production costs consist of expenditures of raw materials, namely manures of cows and goats, starters, overhead costs, and labor costs, while costs other than production costs consist of administrative costs and marketing costs. This is in accordance with the opinion of Koraag (2016) which states that the breakdown of costs for production are expenditures for raw materials, additional material costs, costs for labor, electricity costs, vehicle costs and service costs. Costs incurred by the company affect the cost of goods sold or the sale price, while the selling price affects the fertilizer unit sold. This is in accordance with the opinion of Lasut (2015) which states that COGS (cost of goods manufactured) is influenced by costs incurred by the company. The sale of organic fertilizer is expected to cover the costs incurred by the company and even exceed that in order to be a profit for CV Tani Subur. These conditions indicate that there is an unbroken relationship between costs, sales quantity and selling prices. This also happened at CV Tani Subur which has a close relationship between costs, sales quantity and selling price. This is in accordance with Sihombing (2013) which states that the costs incurred by the company determine the selling price to achieve the desired profit, the selling price affects the sales volume, the sales volume directly influences the production volume, and the production volume influences the cost, so there are five factors which are related to each other.

A Cost-Volume-Profit Analysis of Earnings Planning Instrument

An earnings planning is a systematic analysis of the revenue and costs of each unit of product produced by the company in order to obtain optimal profit. Data analysis that can be used to obtain optimal income is *cost volume profit* analysis and *linear programming* analysis. The following is a summary of 2020 and 2021 profit planning based on *cost volume profit* analysis:

Table 1. Summary of Profit Planning with Cost-volume-profit Analysis in 2020 and 2021

L / R (IDR)	2020	2021
Fixed cost	19,673,500	19,673,500
Variable cost	303,532,100	309,715,000
Total expenditure	323,205,600	329,388,500
Cow manure sales quantity (kg)	288,191,5	272,002
Sales quantity of goat fertilizer (kg)	19,386	17,043
Selling price of cow fertilizer	940	960
Selling price of goat fertilizer	1,380	1,400
Total sales revenue	297,652,690	284,982,120
Profit and loss	-25,552,910	-44,406,380
Sensitivity analysis (estimated 1)	167,742,389	249,256,609
Sensitivity analysis (estimated 2)	146,183,308	227,008,429

Source: CV Tani Subur (data processed).

Cost-volume-profit analysis is a useful instrument for planning and making decisions. This analysis helps managers understand the relationship between costs, volume and profits by focusing on five factors namely product selling price, activity level, variable cost per unit, total fixed costs and the type of product sold. Profit planning using cost-volume-profit analysis consists of several analyzes, namely contribution margin, breakeven point, profit target and sensitivity analysis. Profit planning using cost-volume-profit analysis can obtain results by calculating product selling prices, activity levels, variable cost per unit, total fixed costs using the analysis mentioned and then do time series forecasting analysis. The least square time series analysis is used to predict variable costs and sales quantity while the time series moment analysis is used to forecast the selling price.

Forecasting results with the least square time series analysis of variable costs incurred by CV Tani Subur increased in 2020 and 2021, namely Rp 303,532,100 and Rp 309,715,000, while the quantity of organic fertilizer sales decreased in 2020 and 2021. Results of forecast selling prices the time series moment analysis shows that the selling price of organic fertilizer always increases in 2020 and 2021. Based on forecasting that has been done, CV Tani Subur suffers losses due to variable costs incurred by CV Tani Subur are high and not in line with the high quantity of organic fertilizer sales. This shows that the cost-volume-profit analysis cannot be used as a profit planning tool in CV Tani Subur; therefore CV Tani Subur needs to make a decision so that the profit obtained is stable. CV Tani Subur needs to step into the decision making stage, which is to re-plan the desired sales policy in the near future. Profit planning not only pays attention to how to achieve the highest sales, but also needs to pay attention to the possibility of changing production factors. This analysis helps companies to find out the best policy that needs to be taken so that the profit target is achieved, namely by using two alternatives that will be used to reduce losses experienced by the company. The sensitivity analysis used by the company is variable cost decreased by 30% and fix cost increased by 25% and selling price decreased by 15% and sales volume increased by 60% (Estimated 1), whereas estimation 2 i.e. selling price decreased by 15%, sales volume increased by 75% , variable cost decreased 45% and fix cost increased by 35%.

Based on the sensitivity analysis that has been done, the most likely short-term policy is the second policy. CV Tani Subur needs to reduce variable cost expenditures such as reducing raw material costs and reducing the use of labor. The suppression of variable costs causes the selling price of the product to decrease, with the decrease in selling price it is expected that the sales quantity will increase so that it can achieve the profit target set by the company.

The advantage of using cost-volume-profit analysis is that companies can find out sales at the break-even point by using break-even point analysis and the company can find out how many sales must be achieved to achieve certain profits by using profit target analysis. Sensitivity analysis in cost-volume-profit analysis can be used to find out the maximum profit gain, by increasing and decreasing fixed costs, variable costs, and sales quantity. The disadvantage of cost-volume-profit analysis as a profit planning tool is the method used is too long and complicated and the results obtained are less detailed, besides that there is significant uncertainty in the cost-volume-profit analysis that is the factor of the cost volume profit model, price, sales level desired, variable cost and fix cost. Another disadvantage of cost-volume-profit analysis is that data for cost-volume-profit analysis cannot be taken directly from the income statement, because the impact of the activity on costs cannot be determined directly.

Linear programming analysis as a profit planning instrument

Linear Programming or often called LP is an extensive and the most well known *Operating Research* technique. Here is a summary of the profit plan in 2020 based on an analysis of *Linear Programming*:

Table 2 . Summary Analysis of Profit Planning with Linear Programming 2020

L / R (IDR)	total	Price (IDR)	Total (IDR)
Fixed cost	10,4211	19,673,500	205,019,511
Labor	87,1804	100,000	8,718,040
Cow raw material	784,2013	100,000	78,420,130
Goat raw material	0	540,000	0
Starter (Mole)	784,2019	10,000	7,842,019
Total expenditure			94,980,189
Sale of cow fertilizer	548,3925	1,000,000	548,392,500
Sales of goat fertilizer	0	1,400.00	0
Total income			548,392,500
Profit			248,392,500

Source: CV Tani Subur (data processed).

Linear programming is a programming system that is required to meet three conditions, namely: the decision variable involved must be positive, the criteria for selecting the best value of the decision variable can be explained as a linear function, and the operating rules that direct the process can be explained as an equation or linear inequality.

Based on Table 2 above, the results of linear programming calculations using the *pom quantitative method version 3 application* get a maximum profit of IDR 248,392,500. The sale of organic fertilizer that must be achieved is 548.3925 tons of cow fertilizer with 0 tons of goat fertilizer production. The number of factors of production used to achieve optimal profit is 87.1804 hpp of labor, 784.2013 of cow manure raw materials and 784.2019 liters of starter and maximum fixed costs incurred of IDR 205,019,511.

The advantage of linear programming analysis is its effortless operation because it uses computer aids and can use many variables so that various possibilities to obtain optimal utilization of resources can be achieved. Functions and objectives are flexible in accordance with research objectives and available research data and the results obtained are more detailed because it displays the results in the form of numbers that must be achieved by the company. The drawback of linear programming analysis is that this method cannot be used freely but is limited according to existing assumptions and this method can only be used for one purpose such as profit maximization or cost minimization.

CONCLUSION

Based on the results of the analysis and discussion of profit planning using cost-volume-profit analysis and linear programming in the organic fertilizer business in CV Tani Subur, Sleman, Yogyakarta, it can be concluded that the production costs and sales volume have not been able to increase the profits derived due to labor costs employment increased in recent years by a large enough amount that caused income to decline even though the selling price of organic fertilizer rose. The increase in the selling price of organic fertilizer must be accompanied by an increase in sales volume, because the cost of labor wages increased by a sizable amount in 2018 and 2019. Profits obtained by CV Tani Subur tend to decrease every year and in 2017 the

company suffered a loss of IDR 12,969,437,-. Based on cost-volume-profit analysis, profit planning in 2020 and 2021 shows that CV Tani Subur suffered a loss of IDR. 25,552,910,- and IDR 44,406,380,-. It can be concluded that the cost-volume-profit analysis cannot be used to plan profits in CV Tani Subur. Based on the calculation of breakeven points in rupiah and in units, the breakeven point of CV Tani Subur in 2017 has the highest value, causing CV Tani Subur to experience a loss because it is unable to break even. The break-even point of CV Tani Subur in other years can be achieved by the company so that the company makes a profit. Based on the optimization calculation with the simplex method using *POM Quantitative methods for windows version 3* software, it can be concluded that CV Tani Subur Sleman will get optimal results if it produces cow organic fertilizer as much as 548.3925 tons and does not produce goat organic fertilizer. The advantage achieved when producing cow organic fertilizer with the calculation of the simplex method using *POM Quantitative methods software* is IDR. 248,392,500, - / year. Profit planning in CV Tani Subur shows that the profit obtained from planning with linear programming analysis is greater than the cost-volume-profit analysis.

RECOMMENDATION

Based on cost-volume-profit analysis, CV Tani Subur should be able to reduce the variable costs to carry out the production process. The variable cost element that must be suppressed is labor in order to reduce variable cost expenditures so as to reduce the selling price which impacts the profit gained. Affordable prices can increase sales volume. Based on cost-volume-profit analysis and linear programming analysis as a profit planning tool, the authors suggest that CV Tani Subur uses linear programming analysis as a profit planning tool because it is easier to use and the results obtained are more detailed. Based on linear programming analysis, CV Tani Subur should reduce the supply of production factors, namely raw materials and moles so that expenditures do not exceed the available capital.

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