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Feasibility Study Using Added Value Calculation Analysis for Palm Oil Supply Chain

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Abstract

The Palm Oil Supply Chain (POSC) is a series of companies dealing with materials or products derived from oil palm fresh fruit bunches. The chain is interdependent sequentially and cooperate in the control, management and improvement of the flow of products, money and information from the upstream side to the downstream side. The POSC consists of palm oil seed growers, farmers, traders, CPO factory, refinery factory, distributor/retailers, and consumers. The first party in the chain is the palm oil seed or seedling growers. These growers have a very important role for palm oil farmers because the quality of the seeds determines the quality of further fruits. The aims of this study are to evaluate the feasibility study of growing the seedlings, and measure the sensitivity of the factors to the profitability. By using modified Hayami method for the supply chain, the added value obtained is Rp5.950.227.861 which is 34,73% of the sales. The feasibility analysis calculation with an interest rate of 13.5%, shows the NPV of Rp 38.439.321.865, with the BEP of Rp 828.430.058, while ROI result 78,62%, Payback Periode value 1,27, Modified B/C Ratio 1,69, and IRR 78,33%.

1. INTRODUCTION

Palm oil commodities, especially crude palm oil (CPO) is one of the agricultural commodity mainstay in Indonesia, followed by rubber, the value of exports of both nearing the export value of oil and gas. The increasing demand for CPO in the international world is not accompanied with increased added value or advantage to be gained by the local Palm Oil Supply Chain (POSC).

Currently there is no comprehensive formulation model which discusses about added value for POSC actors especially with the inclusion of the seed growers. The POSC consists of palm oil seed growers, farmers, traders, CPO factory, refinery, distributor/retailers, and consumers. Each of the POSC actor will strive to achieve optimum value added. One additional the POSC member is palm oil seedling grower. In previous research (Hidayat *et al*, 2012) the seedling grower was not yet included in the Palm Oil Supply Chain.

The objective of this study is to do a feasibility study, by using modified Hayami method, with the inclusion of the palm oil seed grower actor into the chain. The second objective is to study the sensitivity of the business factors.

2. LITERATUR REVIEW

2.1 Supply Chain Management

Supply chain is a network of companies that jointly work together to create and deliver products into the hands of end users. Companies involved usually are suppliers, factories, distributors, stores or retailers, and supporting companies like logistic services company (Pujawan, 2010). In a supply chain there are usually three kinds of streams that must be managed. Firstly is the stream of products that flow from upstream to downstream. Secondly is the money flow from downstream to upstream. The third is the flow of information that can occur from upstream to downstream or vice versa. Supply chain is not only oriented to the internal affairs of a company, but also external affairs concerning the relationship with the partner companies.

2.2 Cost calculation

Mulyadi (2012) stated that in the broad sense, the cost is the sacrifice of economic resources measured in units of money, which has occurred or may occur in order to achieve certain goals. In the narrow sense, the cost is part of the money being sacrificed in an attempt to earn income.

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Classification of costs according to their behavior and their relationship to changes in the volume of activity is divided into:

1. Fixed cost: expenses which amount remains constant, not influenced by changes in the volume of activity or output until a certain level of activity is achieved. For example: production director's salary. Fixed cost per unit is inversely proportional to the change in the volume of activity or capacity.
2. Variable cost: is the cost that changes on a comparable basis (proportionally) with the change in the volume of activity. The higher the volume of activity, then proportionally the higher the total variable costs. Example: cost of materials, cost of direct labor.
3. Semi Variable Cost: charges that the total change is not proportional with the change in volume of activity. Semi-variable cost may have an element of fixed cost and variable cost, for example; the cost of electricity used.

2.3 Business feasibility analysis

In evaluating the feasibility of developing oil commodity processing business, we conduct a financial analysis based on four criteria: Pay Back Period (PBP), Present Net Value (NPV), Internal Rate Of Return (IRR), and the Benefit Cost Ratio (BCR) (Rustiadi *et al*, 2009; Suliyanto, 2010).

1. Break Even Point (BEP)
   BEP is a state where the operating results obtained is equal to the capital spent so that the business incurred no loss and no profit. BEP is calculated as follows:
   $$BEP = \frac{FC}{1-\frac{VC}{R}} \text{.....(1)}$$
   where:
   BEP : value of revenue at no loss nor profit
   FC : Fixed Cost
   VC : Variable Cost
   R : Revenue
2. Return of Invesment (ROI)
   ROI is an analysis to determine the efficiency of capital use in relation to investments that are used. If the ratio of ROI is low, then the business is run inefficiently. ROI is calculated by the following formula:
   $$ROI = \frac{\pi}{TC} \text{.....(2)}$$
   where:
   $\boldsymbol{\pi}$ = Net Profit
   TC = Total Cost
3. Net Present Value (NPV) Method
   NPV is a method or technique that best to know the picture of the profitability of a project, because this method takes into account the time value of money. This method determine the difference between the revenue and value of money now with the invested amount.
   $$NPV = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1+r)^t} \text{.....(3)}$$
   where:
   Bt = Revenue in the year of t
   Ct = Expense in the year of t
   r = Bank interest rate (%) each year
   t = year (1, 2, 3, ..., n)
   If NPV > 0, the investment is feasible and if NPV < 0, then the investment is not feasible. If NPV > 0, the company will receive a larger income than the cost of capital, so it is an advantage for the company.
4. Payback Period Method (PBP)
   PBP is the length of time necessary to recover the costs of capital invested in a project, the formula is as follows:
   $$PP = \frac{Initial\ Investment}{Annual\ Cash\ Inflow} = \frac{C_0}{C} \text{... (4)}$$
   Where:
   C_0 = The investment costs
   C = Revenue each year
5. Net Benefit Cost Analysis (B/C analysis)
   B/C Analysis is used to evaluate a project. A project is feasible or could be implemented if the ratio of benefits to costs is needed is greater than one.
   $$Modified\ B/C = \frac{b-d-m\&o\ cost}{i} \text{.....(5)}$$
   where:
   b = *benefits*
   d = *disbenefits*
   m&o = *maintenance and operations*
6. Interest Rate of Return (IRR)
   IRR is an indicator of the efficiency of an investment. A project / investment can be taken if the IRR is greater than the rate of return if invested elsewhere (interest on bank deposits, mutual funds and others). IRR is used in determining whether the investment should be carried out or not. Usually the IRR should be higher than the minimum acceptable rate of return or atractive Minimum rate of return (MARR). MARR is usually the interest rate of depositing money in a bank.
   $$IRR = i1 + \frac{NPV1}{NPV\ 1-NPV2}\ x\ (i2 - i1) \text{.....(6)}$$
   where:
   i1 : interest rate makes a positive NPV
   i2 : interest rate makes a negative NPV
   NPV1 : total positive net present value
   NPV2 : total negative net present value

2.4 Hayami Method

Hayami method is a method that facilitates the added value and marketing analysis with qualitative and quantitative analysis, and then perform the processing and analysis of data. Hayami analysis method is a common method used to analyze the value added calculation in agricultural business system. Table 1 shows the original Hayami Method to calculate the added value in conducting agricultural business. The modified Hayami method is shown on Table 7.

Table 1.
Original Hayami method template

No	Variable	Unit
1	Raw Material Requirements	Rp/kg
2	Product Selling Prices	Rp/kg
3	Total Added Value per kg output	Rp/kg
I.	Output, Input, and Prices	
4	a. Output (sales volume)	kg
	b. Output (sales value)	Rp
5	Raw Material Purchases	Rp
6	Direct Labour	Manday
7	Conversion Factor (Output/RM)	
8	Coefficient - Direct Labour	Rp/Manday
9	Direct Labour Wage	Rp
II.	Revenue and Added Value	
10	a. Other Input costs - Production	Rp
	b. Other Input costs - Non Production	Rp
11	a. Added Value (Profit)	Rp
	b. Added Value Ratio	%
III.	Rewards to the owner of Production Factors	
12	Margin (Rp/Kg)	Rp
	a. Contribution of other input	%
	b. Company Profit	%
IV.	Portion of added value per kg of product	
13	a. Real Added Value for Actor	Rp
	b. Supply Chain Added Value	Rp
	in %	%
	d. Added Value Per Farmer	Rp/year

(Source: Hidayat et al., 2012)

3. METHODOLOGY

Figure 1 shows the methodology in conducting the feasibility analysis of breeding the palm oil seedling. Data needed to support this study are the investment, materials and operational costs and the number of palm oil seeds to grow the palm oil seedlings. The required primary data was obtained from PTPN VII. The secondary data to support the study was obtained from available literatures.

The calculation for the added value of the POSC actors is done using the modified Hayami method. The results of the calculations are used to perform sensitivity analysis. The analysis are performed by changing the input and output sales in percentages of 4%, 6%, dan 10%. The added values are recalculated, as well as the corresponding NPV, BEP, ROI and B/C values.

4. RESULTS AND DISCUSSION

4.1 Palm oil seedling process

Palm oil seedling process is done with germination process in advance. Germination process is done by entering the oil palm seeds in a plastic bag for 80 days until the seed sprouts appear. After germination, the seeds should be sown in advance until ready for planting in a pre nursery small polybag already containing soil mixed with urea. After 3-month-old the seedlings have about 4-5 strand of leaves, are then transferred into a bigger polybag and put in place an outdoor seedbed.

Seedlings are ready for sale usually 1 year old. Standard palm seedlings ready for planting when it has about 5-18 leaves with a trunk diameter of 5,5-6,0 cm and a height of 101,9 to 126 cm (Direktorat Jendral Perkebunan, 2013). During the process of breeding, there is usually a failure of 15%, according to data from PTPN VII.

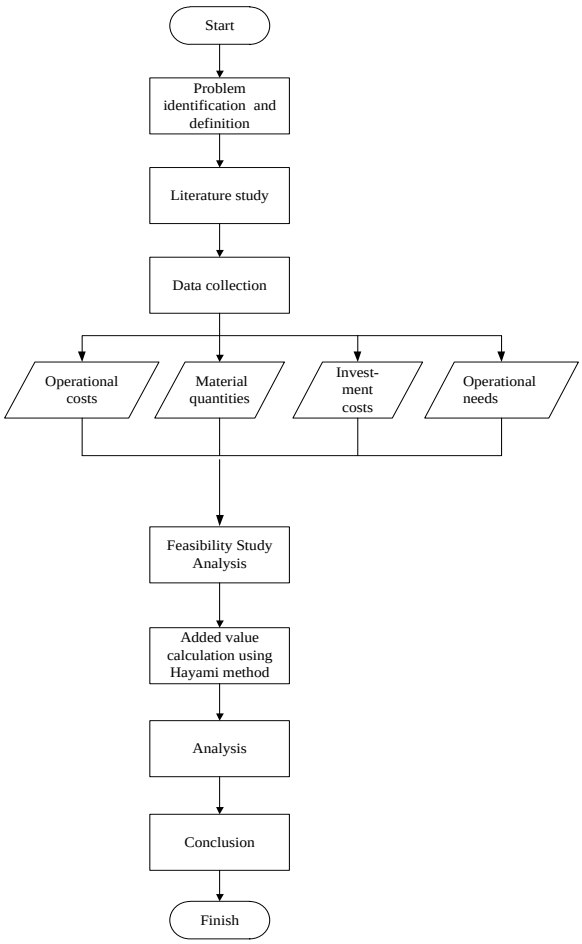

Figure 1.
Research flowchart

4.2 Palm oil seedling process

Along with increasing demand for CPO as much as 236 million tons in the next 7 years in the world. This potential will drive business of growth palm oil seedling. Although the expansion or increase in interest in palm oil business is only about 7 years or only until the year 2020 to 2022, global demand for vegetable oils will continue to grow along with the growth of population. Therefore, business planning of palm oil seedling carried out to 10 years, i.e. until 2025. In the business feasibility analysis, data required are investment costs, operational and manpower to identify cashflow in Table 2 which is calculated for the next 10 years. Total variable costs required by oil palm nursery actor is Rp8.001.451.367 in one year and the beginning of the planning palm oil seedling. Number of fixed costs to the business of oil palm nursery is Rp441.513.982 in one year and the beginning of the planning palm oil seedling. Total

investment costs for palm oil seedling business is Rp3.907.000.000 in one year and the beginning of the planning palm oil seedling. Next, making of cashflow for the seedling business for 10 years. Calculation of Net (gains) derived from the value of sales minus the cost of fixed and variable costs incurred during the year breeding. Here are the assumptions used in the calculation of cash flow and methods of business feasibility analysis in ideal conditions:

1. *Life cycle time* palm oil seedling business is one year.
2. The value in 2015 was investment costs plus legal fees, land clearing for oil palm nurseries, total operational costs, as well as the salaries of workers needed.
3. The interest rate used is loan interest rate of 13.5% (Bank Mandiri, August 2016).
4. In 2016, palm oil seedling has been selling products of palm oil seedlings age 1 year.

Table 2.
Cash flow palm oil seedling business for 10 years

Period	Sales	Expenses	Net
2015		12.187.415.349	12.187.415.349
2016	17.131.991.240	7.549.760.349	9.582.230.890
2017	17.131.991.240	7.549.760.349	9.582.230.890
2018	17.131.991.240	7.566.760.349	9.565.230.890
2019	17.131.991.240	7.549.760.349	9.582.230.890
2020	17.131.991.240	7.614.760.349	9.517.230.890
2021	17.131.991.240	7.549.760.349	9.582.230.890
2022	17.131.991.240	7.566.760.349	9.565.230.890
2023	17.131.991.240	7.549.760.349	9.582.230.890
2024	17.131.991.240	7.547.997.849	9.583.993.390
2025	17.131.991.240	8.256.760.349	8.875.230.890

Table 3.
Business feasibility analysis calculation results

Criteria	Value
NPV (Rp)	38.533.571.686
BEP (Rp)	828.430.058
ROI	78,62
Payback Periode (yrs)	1,27
Modified B/C	1,69
IRR (%)	78,33

NPV Calculation

Based on calculations using equations 3 and the value of the Net cashflow in Table 2, the resulting NPV value for business planning palm nursery for 10 years is Rp38.439.321.865. The investment for breeding is attractive.

BEP Calculation

Based on calculations using the equation 1, the value of Break Event Point is 828.430.058. This value indicates that this business will experience no loss condition. If converted into the form of products, the project should sell about 26.724 seedlings to be planted.

ROI Calculation

Based on calculations using the equations 2, the value of the resulting return on investment is 78.62%. This value indicates the business is attractive to an investor.

Payback Period Calculation

Based on calculations using the equations 4, Payback Period value obtained was 1,27. This value indicates that the invested amount to the business of palm oil seedling will be back at 1 year and 3 months after the development of business.

B/C Ratio Calculation

The value of B/C Ratio is 1,69 which is greater than 1. This means the business of oil palm breeding is feasible.

Sensitivity Analysis

A project is basically the face of uncertainty as influenced the changes, both in terms of expenditure and revenue which ultimately will affect the feasibility of a project. Therefore, there is a need to conduct sensitivity analysis on several possibilities. In this study, sensitivity analysis is performed by changing the input buying prices and selling output product prices in percentages of 4%, 6%, and 10%. The demand for oil palm seed production is assumed to be constant.

The results of the sensitivity analysis calculations are shown in Table 4, Table 5 and Table 6, which show the changes in the values of NPV, BEP, ROI, and Modified B/C Ratio. The greater the percentage increase and decrease, the price of the input and output will also greatly affect the rise and decline. From the above calculation, the largest NPV value obtained from changing the input price decrease by 10% and the higher price of output by 10% equals Rp50.716.489.972 with an ROI of 106.13% and the value of Modified B/C ratio 2,29. This means that oil palm breeding is feasible. However, the NPV value obtained if the smallest input prices increased by 10% and selling prices were decreased by 10%, i.e. Rp21.106.606.199 with Modified B/C ratio of 0.88. When the Modified B/C Ratio obtained is less than 1 then the business is not attractive.

Table 4.
Results NPV calculation, BEP, ROI, and B/C Ratio by Percentage 10%

Change (%)		NPV	BEP	ROI	Modified B/C Ratio
Input price	Output selling price				
0	-10	Rp29.420.179.139,70	Rp917.796.895	64,57	1,25
0	10	Rp47.646.964.231,84	Rp442.087.459	92,68	2,13
10	0	Rp31.454.628.977,13	Rp486.428.886	58,99	1,32
-10	0	Rp41.603.097.426,89	Rp397.873.545	90,51	1,85
-10	-10	Rp32.489.704.880,82	Rp397.930.400	74,89	1,46
10	10	Rp39.333.391.291,82	Rp486.359.378	71,00	1,75
10	-10	Rp21.106.606.199,68	Rp486.513.869	46,99	0,88
-10	10	Rp50.716.489.972,96	Rp397.827.040	106,13	2,29

Table 5.
Results NPV calculation, BEP, ROI, and B/C Ratio by Percentage 6%

Change (%)		NPV	BEP	ROI	Modified B/C Ratio
Input price	Output selling price				
0	-6	Rp33.065.536.158,13	Rp877.515.237	70,19	1,43
0	6	Rp44.001.607.213,41	Rp789.278.593	87,06	1,95
6	0	Rp35.377.550.459,28	Rp739.824.040	70,67	1,53
-6	0	Rp41.689.592.912,27	Rp739.824.040	87,6	1,85
-6	-6	Rp36.221.557.384,63	Rp778.724.255	78,62	1,6
6	6	Rp40.845.585.986,92	Rp878.135.862	78,62	1,79
6	-6	Rp29.909.514.931,63	Rp988.750.448	62,71	1,26
-6	6	Rp47.157.628.439,91	Rp708.441.071	96,57	2,11

Table 6.
Results NPV calculation, BEP, ROI, and B/C Ratio by Percentage 4%

Change (%)		NPV	BEP	ROI	Modified B/C Ratio
Input price	Output selling price				
0	-4	Rp34.888.214.667,34	Rp859.825.860	73	1,51
0	4	Rp42.178.928.704,20	Rp801.417.977	84,25	1,86
4	0	Rp36.429.557.534,78	Rp892.865.383	73,22	1,58
-4	0	Rp40.637.585.836,77	Rp768.359.123	84,48	1,8
-4	-4	Rp36.992.228.818,34	Rp795.292.856	78,62	1,62
4	4	Rp40.074.914.553,20	Rp861.567.261	78,62	1,76
4	-4	Rp32.784.200.516,35	Rp929.442.874	78,62	1,41
-4	4	Rp44.282.942.855,20	Rp745.067.331	90,34	1,97

4.3 Modification of Hayami method

In the calculation of benefits by using Hayami method, the authors make the following basic assumptions (Hidayat *et al*, 2012):

1. Stakeholders in the POSC (RPMS) consists of nursery palm, oil palm cultivation farmers, collectors, MCC, cooking oil mill (refinery), distributors, and consumen.
2. Within one year, the number of working days is 300 days.
3. The period of productive palm oil seedling for 1 year.
4. Mortality rate of oil palm seedling is 15%.
5. The production and non-production data is obtained from PTPN VII.
6. Data productivity of trees and palm groves, farming needs, etc., taken from the PPKS report (2006).
7. Assume that an oil palm nursery garden itself and meet all the needs of TBS of oil palm plantations.
8. All material requirements and production yield is calculated for one year.

The modification process added value calculation method Hayami:

1. To maintain consistency throughout the product volume supply chain, the scale of business activities referring to the benchmark palm oil mill capacity to process 30 tons of TBS/hour (Hidayat et al., 2012).
2. For a 30 ton TBS/hour, TBS is needed for a year and required 180.000 tons of palm trees as much as 552.645 trees to be planted by smallholders (Hidayat et al., 2012).
3. With the need for as many as 552.645 palm trees to farmers, businesses need a seedling nursery as many as 650.170 for one year. The figure was derived by assuming mortality rate for the current breeding process there is an assumption of failure or damaged trees by 15%.
4. Calculated needs investment costs and operational for one year to cover the activities of palm oil seedling.
5. Supplies of palm tree seedlings are calculated to meet the needs of TBS year for palm oil mill (Hidayat et al., 2012).

The result of calculating the added value using modified Hayami method is shown on Table 7. This is only for the original condition of the analysis (case 1 below). The further sensitivity analysis calculation results are not shown on tables.

1. If the price of the input and output selling price fixed, or sales output value obtained from the nursery farmers in selling the oil palm trees aged 1 year is Rp17.131.991.240 shown in Table 7 for the first year to the actors of the cultivation of oil palm. Hayami on the calculation method, the added value obtained is Rp5.950.227.861 for one year with added value ratio of 34.73%.
2. If the price fell 10% input and output selling price rise 10%, or sales output value obtained from the nursery farmers in selling the oil palm trees aged 1 year is Rp18.845.1960.364 for 1 year to the actors of oil palm cultivation, Hayami on the calculation method, the added value obtained is Rp8.164.686.765 for one year with added value ratio of 43.33%. The value of this ratio is quite large compared to other Palm Oil Supply Chain actors ratio although the profits generated are not as large as some other POSC actors.

Table 7.
Added value calculation with modified Hayami method

		BREEDING	FARMER	TRADER	CPO FACTORY	REFINERY	DISTRIBUTOR	CONSUMER
Palm Oil Supply Chain								
1 Raw Material Requirements	Rp/kg	1,080	1,209	1,423	1,162	6,500	12,000	12,420
2 Product Selling Prices	Rp/kg	1,209	1,423	1,500			12,420	
Product 1					6,500	12,000		
Product 2					3,500	5,000		
Product 3						2,500		
3 Total Added Value per kg output	Rp/kg							
I. Output, Input, and Prices								
4 a. Output (sales volume)	kg	14,170,382	90,000,000	90,000,000	43,200,000	43,027,200	32,832,000	
b. Output (sales value)	Rp	17,131,991,240	128,070,720,000	135,000,000,000	296,550,000,000	393,984,000,000	407,785,181,369	
5 Raw Material Purchases	Rp	702,184,081	4,328,092,017	128,070,720,000	209,070,000,000	280,800,000,000	393,984,000,000	
6 Direct Labour	Manday	150	4	12	80	134	12	
7 Conversion Factor (Output/RM)		24	30	1	1	1	1	
8 Coefficient - Direct Labour	Rp/Manday	4,681,227	1,082,023,004	10,672,560,000	2,613,375,000	2,095,522,388	32,832,000,000	
9 Direct Labour Wage	Rp	2,954,500,000	84,000,000	234,000,000	1,560,000,000	3,048,500,000	234,000,000	
II. Revenue and Added Value								
10 a. Other Input costs - Production	Rp	6,465,075,957	62,388,800,539	870,766,667	22,419,000,000	34,824,772,150	593,600,000	
b. Other Input costs - Non Production	Rp	4,014,503,341	17,324,126,685	1,586,928,333	19,188,225,000	24,580,726,963	3,635,114,785	
11 a. Added Value (Profit)	Rp	5,950,227,861	44,029,700,759	4,471,585,000	45,872,775,000	53,778,500,888	9,572,466,584	157,725,028,230
b. Added Value Ratio	%	35	34	3	15	14	2	
III. Rewards to the owner of Production Factors								
12 Margin (Rp/Kg)	Rp	9,964,731,202	61,353,827,444	6,058,513,333	65,061,000,000	78,359,227,850	13,207,581,369	
a. Contribution of other input	%	105	130	41	64	76	32	
b. Company Profit	%	60	72	74	71	69	72	
IV. Portion of added value per kg of product								
13 a. Real Added Value for Actor	Rp	110	107	38	1,281	1,003	77	2,616
b. Supply Chain Added Value in %	%	4	4	1	49	38	3	(NT RPMS)
c. Added Value Per Farmer	Rp/mo	327,042	2,420,003					

3. If input prices rise 10% and output selling price fell 10%, sales or value of output obtained from the nursery farmers in selling the oil palm trees aged 1 year is Rp15.418.792.116 for the first year to the actors oil palm cultivation. Hayami on the calculation method, the added value obtained is Rp3.738.281.457 for one year with added value ratio of 24.24%.

5. CONCLUSION

Palm oil seedling process is done with germination process in advance. Germination process is done by entering the oil palm seeds in a plastic bag for 80 days until the seed sprouts appear. After germination, the seeds should be sown in advance until ready for planting in a pre nursery. From the calculation results, the conclusions can be derived as follows:

1. By using modified Hayami the sales output value obtained from the nursery farmers in selling the oil palm trees aged 1 year is Rp17.131.991.240 for 1 year to the actors of the cultivation of oil palm. The added value obtained is Rp5.950.227.861 for one year with added value ratio of 34.73%.
2. Based on the sensitivity analysis, optimistic condition occurs when the input value fall by 10% and the output value goes up 10% the added value obtained is Rp8.164.686.765 with added value ratio of 43.33%. Pessimistic condition occurs when the input value rise 10% and the value of output fall 10%, the added value obtained is Rp3.738.281.457 with added value ratio of 24.24%.

Recommendation.

Supposedly, in oil palm breeding we need to evaluate the efficiency of the number of employees or buy seeds that have been through the selection process to ensure best quality of seedling. This is to ensure to cut cost of losing revenue do to bad yields from bad seedlings. That is because if the volume of production increases, the variable costs will also increase.

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