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## Sensitivity and Feasibility Analysis of Citronella Oil Business

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### Abstrak

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Today, citronella essential oil business in Indonesia is fronting two major problems: a diverse range of product quality and fluctuated price. Meanwhile, the global market demand keeps increasing until 3–5% per year. This fact indicated that the citronella essential oil business was having a high chance of participating in the global market. This study aimed to analyze the citronella essential oil business feasibility as a “people-oriented-economy” activity and determine variables that affected the feasibility in implementing this business. Citronella essential oil is produced by a steam distillation process with a production capacity of 2,400 kg/year. The number of citronella essential oil international product sales was reaching 76% with the selling price of IDR 360,000/kg and reaching 24% on the local market with the selling price of IDR 180,000/kg, therefore the total of sales in 300 days/year was IDR 7,360,320,000. Based on this calculation the total of profit obtained in a year was IDR 99,463,383. An effort through managing the material and selling price sensitivity already done to maintain the BEP and B/C values. The increasing price was anticipated by managing the product selling price fraction, while the decreasing of the selling price anticipated by managing the market fraction.

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## INTRODUCTION

The citronella essential oil was widely known as Java Citronella oil. Its price fluctuated in each year. The lowest export volume happened in 1997 with a total volume of 85 tons with a total price of US\$325,000. After that, the export volume was increasing slowly and reached the highest export volume in 2007 with a total of 2,663 tons with a total price of US\$69.5 million. The export volume then decrease significantly until it reached 992 tons with a total price of US\$37,4 million (General Directory of Estate, 2013).

The global market demand for the citronella essential oil was increasing 3–5%/year. Some countries like the United States of America, China, Taiwan, Singapore, Holland, Jerman, and the Philippine were routinely imported the Indonesian citronella essential oil (UNIDO & FAO, 2005). The selling price was ranged between IDR 120,000–140,000/kg with the price of its raw material of 250,000–500,000/kg (Department of Industry and Trade, 2002; Paimin & Yunianti, 2002). In 2018 the citronella essential oil price increased significantly, it reached IDR 215,000–225,000/kg and the price of its raw material was reaching IDR 1,000/kg. These facts indicated that citronella essential oil business was highly potential to be developed in a wider range.

The citronella essential oil business in Indonesia was facing two major problems, the diverse product quality and its fluctuated price. The problems related to the procurement of the raw material, farmer's responses, production process, and production process technology have affected the quality of the citronella essential oil production in Indonesia. Strict competition between Indonesia and Sri Lanka in producing raw material was also being an important hindrances on this business. Indonesia farmers were tending to be planted a wet type of citronella which produced low quality of essential oil. This problem highly affected the quality of essential oil on the global market. Technological devices are required to be adopted to improve the quality of essential oil. A modern distillation and isolation process could be improved by this technological adoption (Abimanyu, Tursiloadi, & Rusli, 2019).

Citronella essential oil is a type of essential oil obtained by distilled citronella's leaves and stems. The essential oil obtained from the distillation process is having bright yellow color with a unique scent (smells like wood, grass, or lemon scent). There were two types of citronella in the field of trade: (1) Ceylon Type which is obtained from the *Cymbopogon nardus* Rendle (inferior type) and (2) Javanese Type which is obtained by *Cymbopogon winterianus* Jowitt (superior type).

The citronella cultivation is relatively easy to do. Citronella could be planted in marginal land or an ex quarry land. The citronella essential oil demand was relatively increasing in each year. The National Insititute of Statistic was stated that the export of essential oil was increasing significantly which ranged between 9-10% each year. Citronella essential oil was contributed to the national export income as much as 6.89% from the total of essential oil export, placed on the third rank, after patchouli oil (60%) on the first place, and vetiner oil (12,47%) on the second place (Sulaswatty, Abimanyu, & Syahbana Rusli, 2019).

Citronella was spread in all area in Indonesia. The citronella was highly produced in Nanggroe Aceh Darussalam (NAD) Province, West Java, and Central Java with the total production of 95% from the total of citronella production in

Indonesia (General Directory of Estate, 2013). The central area that produce a high number of citronella were Pandeglang, Bandung, Sumedang, Ciamis, Cianjur, Lebak, Garut, and Tasikmalaya. The National Institute of Statistics (2017) stated that the total is of citronella plantations in Indonesia was 19.300 ha in 2014 with the level of productivity of 3,100 tons.

The citronella essential oil was already used as the material for basic ingredients of cosmetics or perfume, medicines, as well as food ingredients such as menthol, flavoring, antiseptics, cosmetics, medicines, food, or drink flavors, and clove cigarette mixers (Ketaren, 1985). The citronella essential oil and its main component (citronellal, citronellol, and geraniol) were having some medication-like effect for anti-diabetes, anti-bacterial, antioxidant, anti-cholesterol, anti-virus, and anti-cancer. The development of the derivatives products such as geranyl ethyl ether, ester citronellol-amino levulinate, geranyl amida, citronellal butylina,  $\alpha$ -penilselena citronellal, and geranyl trioxolone were having better activity compare to citronella essential oil. On the other side, the derivative of those chemicals could be used to produce artemisinin as the anti-cancer and antimalarials medication (Hanafi & Artanti, 2019).

The main chemical component on the citronella essential oil is the functional group of aldehyde compound (citronellal) and alcohol functional group (citronellol and geraniol). The citronella essential oil obtained from the distillation process consisted of citronellal 32–45%, citronellol 11–15%, geraniol 10–12%, geranyl acetate 3–8%, citronellal acetate 2–4%, and other compounds (Agustian, Sulaswatty, Tasrif, Laksmono, & Badria, 2007; Masada, 1976). According to the international market standard, the citronella essential oil must be contained more than 35% alcohol. The citronellal and alcohol in the citronella leaves that harvested too early caused the citronella essential oil produced do not met the national standard (Sastrohamidjojo, 2002).

The citronella essential oil production process was done through a steam, water, or steam-water distillation method in 3–4 hours. The average yield was ranged between 0.6–1.2% that depends on the plant function, management, and distillation effectivity (Sulaswatty & Adilina, 2019). The leaves must be dried under the sun in 3–4 hours (the front and backside). The leaves must be distilled as soon as possible. Keeping the dried leaves too long causes lower quality of essential oil produced.

A conventional method in producing the essential oil was done through the steam distillation and water distillation. The citronella leaves must be dried under the sun before it distilled. After the distillation process (steam) the essential oil with a concentration of 0.33% (the geraniol concentration was 39.9%) and water with a concentration of 0.32% (the geraniol concentration was 33.7%) would be obtained (Sastrohamidjojo, 2002). The effective steam pressure used for the distillation process must be not higher than 3 atm. High-quality citronella essential oil gained by a steam distillation on 500-600 kg raw materials using 1 to 1.5 atm steam pressure in 2 hours (Virmani & Datta, 1971). The steam used was the saturated steam with pressure more than 1 atm (Feriyanto, Sipahutar, Mahfud, & Prihatini, 2013; Lutony & Rahmayati, 2002).

Hazwan et al. (2012) was stated that citronella essential oil could be obtained by a hydrodistillation process using Ohmic Heater. Cassel and Vargas (2006) was also using the same system in creating a citronella essential oil (the percentage of

dry yield was 0.8% in four hours and the percentage of wet yield was 0.9% in two hours).

The type of problem faced by the citronella essential oil was different in each decade. The problems is developing dynamically, therefore a revolution to manage the problem is really important to be addressed. Technology-based management was highly potential to manage the problem on this decade (Alighiri, Eden, Supardi, Masturi, & Purwinarko, 2017).

A business involving a distillation process must be invested in the tool, place, raw material, energy, and worker recruitment cost. The combination of those components must be arranged to reach an economic production scale. Some variables such as product efficiency, raw material continuity, and product marketing must be considered as an important factor in the production. One hectare could produce 30-40 tons of citronella leaves. If the yield was 0.08, 210-240 kg of essential oil could be produced. The capital, workers, and working devices contributed an important role in the profit obtained by the company (Damanik, 2007).

An agribusiness analysis method using sensitivity analysis already done by Bimantio (2018). Based on the study, the sensitivity and feasibility analysis was done in a slow-release urea and zeolite fertilizer agribusiness. The analysis showed that the business was able to produce a profit with a short POT and high ROI value. But on the other side, the business was easily affected by the raw material fluctuated price and product selling price. Low raw material price able to increase the profit to three times than the usual profit and DCFRR to two times than usual. The increase of the product selling price also able to increase four times than the usual profit and DCFRR two times than usual profit.

The management parties in a citronella essential oil business must be considering the benefit of more advanced technology in producing high-quality products. Using advanced technology devices would target a more specific market, but the price could be higher than the usual essential oil (Setiawan, Lestari, & Abimanyu, 2019).

This study aimed to analyze the citronella essential oil business feasibility as a “people-oriented-economy” activity and determine variables that affected the feasibility in implementing this business.

## **RESEARCH METHODS**

This study was conducted in Sumedang Regency, Jawa Barat Province. This area was chosen because it produced a high number of citronella essential oil in Indonesia. Ninety-five percent of citronella essential oil in Indonesia was produced in Sumedang Regency.

The analysis was started from the production process selection. The production process expected able to produce high-quality yield, did not cause any damage to the raw material, and ended by producing good quality products. This production process must be economically feasible and sustainable. The economic feasibility was measured by some parameters, they are:

- *Percent Return on Investment (ROI)*

ROI is the annual return of investment from the profit. The formula for ROI is as follow:

$$ROI = \frac{\text{profit}}{\text{investment}} \times 100\% \quad (1)$$

The number of ROI is varied. It depends on the business risk of failure.

- *Pay Out Time (POT)*

POT is the return investment period based on the profit obtained by the according to the depreciation. The POT formula is as follows:

$$POT = \frac{\text{investment}}{\text{profit} + \text{depreciation}} \quad (2)$$

- *Break Event Point (BEP)*

BEP is the equivalent point between the sales and the total cost that showed the production level, where the sales would be equal to the total cost. Operating the business under the capacity or the selling price would cause the loss. BEP is represented by the production capacity (BEP(q)) or the selling price (BEP(IDR)) with the following formula:

$$BEP_{(q)} = \frac{\text{Total of Cost}}{\text{Selling Price}} \quad (3)$$

$$BEP_{(IDR)} = \frac{\text{Total Cost}}{\text{Total Produksi}} \quad (4)$$

- *Benefit Cost Ratio (B/C)*

*Benefit-Cost ratio* is the comparison between the income (B) with the total of production cost (C). The B/C *ratio* is calculated based on the interest level. The value of B/C was show the potential implementation of a business. If the B/C *ratio* > 1, the business is highly potential to be implemented, but if the B/C *ratio* < 1, the business is having a low potential to be implemented. The B/C *ratio* formula is as follows:

$$\frac{B}{C} = \frac{\text{Total of sales (during the production period)}}{\text{Total of cost (during the production period)}} \quad (5)$$

- *Internal Rate of Return (IRR)*

The economic feasibility according to IRR is arranged according to amount of money that keep changing toward time and non-return investment in the end of the each year in 10 years of the company age.

## RESULT AND DISCUSSION

### Production Process

The steam distillation method was applied in this citronella essential oil production. This method is relatively easy to apply, inexpensive, and appropriate for a wider product production range. The type of steam distillation method used was the steam and water distillation method. This method was able to produce an appropriate and equal heat in all material surface during the distillation process, able to maintain the steam continuation, maintaining the operating temperature, and shorten the production time. The production process is shown in Figure 1.

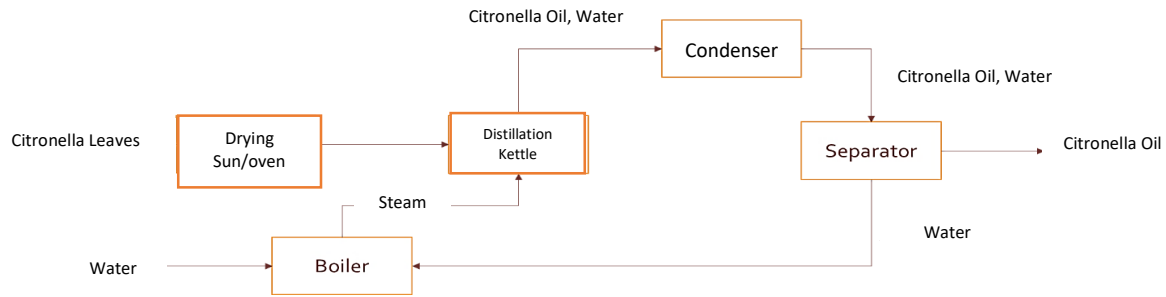


Figure 1. Production Process Citroneall Essential Oil Diagram

The business operational hours were arranged in the form of a batch session. A batch was required 8 hours or 300 hours in a year. If the yield value was 0.8% on the production process of 1,000 kg raw materials, a total of 8 kg essential oil could be produced in a day or equal to 2,400 kg essential oil in a year.

The production process consisted of some steps. The first step was the drying process. The purpose of this process is to decrease the water content on the citronella leaves. The citronella leaves then distilled to prevent contamination on the essential oil produced. The stainless steel in the spiral pipe form was usually used as the distilled material to assure the cooling down process done in a longer duration and arranged a wider area for heat transfer. The steam was the combination between the water steam and oil produces by the distillation process in a boiler. This steam would melt after it was pushed to across a condenser. After it processed on the condenser, the steam would be separated into essential oil and water based on its density. The essential oil then would be packed to distribute in the export or local market. The distilled water also could be sold in the form of floral water or could be re-used again as the steam material in the boiler.

**Economy Analysis**

The cost structure for running the citronella essential oil was consisted of: investment, fixed cost, variable cost, and sale. This cost structure was arranged for one year essential oil production:

Table 1. Fixed Capital Component

No	Type of Capital Component	Number of Unit	Unit	Price/Unit	Total Price	Note
1	Tool Purchasing	1	set	75,000,000	75,000,000	
2	Tool Installation	1	set	18,750,000	18,750,000	25% Tool Purchasing
3	Electricity Installation	1	set	11,250,000	11,250,000	15% Tool Purchasing
4	Construction	1	set	33,750,000	33,750,000	45% Tool Purchasing
5	Transportation Tool Purchasing	1	set	35,000,000	35,000,000	

6	Supporting Tool Purchasing	1	set	15,000,000	15,000,000	20%	Tool Purchasing alat
7	Contingency	1	set	7,500,000	7,500,000	10%	Tool Purchasing
<b>TOTAL</b>					<b>196,250,000</b>		

Source : Primary Data (Processed), 2018

According to the Table 1, the calculation of the supporting tool purchasing, installation, and construction cost was done using an estimation method toward the tool purchasing price. The amount of percentage value was adjusted to guidelines from Timmerhaus and Peters (1991).

Table 2. Fixed Budget Component

No	Type of Fixed Budget Component	Number of Unit	Unit	Price/Unit	Total Price	Note
1	Shrinkage	1	set	19,625,000	19,625,000	10% Investment
2	Supervisor's Salary	1	worker	3,000,000	36,000,000	12 month
3	Operator's Salary	4	worker	1,700,000	81,600,000	12 month
4	Maintenance Cost	1	set	11,775,000	11,775,000	6% Investment
5	Legal	1	set	1,962,500	1,962,500	1% Investment
6	Insurance	1	set	1,962,500	1,962,500	1% Investment
7	Land Rent	1	set		20,000,000	300 m <sup>2</sup>
<b>SUBTOTAL</b>					<b>172,925,000</b>	
8	Credit for the Business and Working Capital	1			87,078,388	13% Interest
<b>TOTAL</b>					<b>260,003,388</b>	

Source : Primary Data (Processed), 2018

On the fixed budget component (Table 2), the value for the fixed component: shrinkage, maintenance, legal, and insurance was determined using an estimation method toward the fixed capital. The percentage value used was adjusted based on a guideline arranged by Timmerhaus and Peters (1991). The business and working capital obtained from bank credit with the amount of interest for the working capital type.

Table 3. Variable Budget Component

No	Variable Budget Component	Number of Unit	Unit	Price/Unit	Total	Note
1	Marketing	1	set	7,776,000	7,776,000	1% Sales
2	Administration	1	set	7,776,000	7,776,000	1% Sales
3	Raw Material	1000	kg	700	210,000,000	300 day
4	Fuel Cost	1		548,935.36	164,680,607	300 day
5	Utility Expense (Electricity)				2,500,000	300 day
6	Utility Expense (Water)	800	kg	3.84	921,600	300 day
7	Tax	1		7,776,000	7,776,000	1% Sales
<b>TOTAL</b>					<b>401,430,207</b>	

Source : Primary Data (Processed), 2018

The variable cost was calculated based on the capacity and the production days. The production capacity was 1,000 kg of raw materials and production days were 300 days/year. While the marketing, administration, and tax cost used the estimation value on the total sale. The value percentage was adjusted using a guideline from the Timmerhaus and Peters (1991).

The production capacity was 2,400 products/year, the number of product sold to the export market covered 76% of the product produced with the selling price of IDR 360,000/kg, and the rest of the product (24%) sold to the local market with the selling price of IDR 180,000/kg. The total sale during the production period was reaching IDR 760,320,000. Therefore the total of profit gained in each year was IDR 99,463,383.

### Feasibility Study

The steam distillation was chosen as the main production process in producing the citronella essential oil. If we determined some values: the value of yield (0.8%), the production capacity (1,000 kg raw materials/day), operating hours (8 hours/day on a batch method in 300 days/year), and export market: local market fraction comparison (76%: 24%), we could conduct a citronella essential oil business feasibility study.

BEP value would be reached in the level of production of 2,086 kg essential oils. If the sales were stable throughout the year, the level of production was equal to 87% of the yearly production capacity. The value BEP on the product selling price in IDR was 275,357/kg.

If we assumed that the company could be operated for 10 years with the interest rate of 4% p.a., the benefit-cost (B/C) ratio value would be 1.15. This value indicated that the business can add economic value to the raw material used in producing citronella essential oil. The Return on Investment was 50.68%, the payout time was in 1.97 years, and the value of the internal rate of return was 5.4%/years (above the bank interest and inflation). All values were indicated that citronella oil is highly potential to be developed as a sustainable business in a wider range.



## Sensitivity Analysis

### The Material Fluctuation Price

According to Table 4, the  $\pm 20\%$  change on the citronella price has significantly affected the profit and the business feasibility. The increase of the citronella's price was impacted by the selling price. To maintain the BEP price from the IDR 275,352/kg to IDR 294,834/kg (increase up to 7%), the B/C ratio value would be decreasing up to 0.08 (from 1.15 to 1.07). The value of the B/C ratio would be increased if the price decreased, for instance, the B/C ratio was equal to 0.09 (1.15 to 1.24). To achieve the BEP value, the selling price should be ranged on IDR 255,879/kg (decreased up to 7.1%). The B/C ratio value could be maintained in 1.15 by maintaining the product selling price. If the local market fraction was 11%, the international market fraction must be reached 89% to maintain the B/C ratio value still in 1.15.

Table 4. The Sensitivity Analysis on the Material Price Change

Change	-20%	0	+20%
<b>Material Price</b>	560	700	840
<b>BEP(q)</b>	1706	1836	1966
<b>BEP(Rp)</b>	255.879	275.352	294.834
<b>B/C</b>	1,24	1,15	1,07

Source : Primary Data (Processed), 2018

### The Fluctuation of the Selling Price on the Market Level

As a global commodity, the price of the citronella essential oil was controlled by the market demand. The data from the National Institute of Statistics in the year of 2002-2015, the most significant price decrease of the citronella essential oil happened in 2003 (38% with the mean of 19.7%), while the most significant increase happened in 2007 (67% with a mean of 25.8%). According to Table 4, to maintain the B/C ratio value in the range of 1.15, the selling price would be adjusted. If the price was decreasing by 10% in the local market, the export market fraction ratio would be changed as much as 4 points, from 76% to 80% before the price then adjusted on the local market fraction. But, if the price was decreasing by 10% in the export market, the export market fraction ratio would be changed as much as 15 points, from 80% to 95%. These changes were made to maintain the B/C ratio still ranged in 1.15.

Table 5. The Sensitivity Analysis on the Decrease of the Selling Price

<b>Local Price</b>	180,000	144,000	180,000
<b>Export Price</b>	360,000	360,000	324,000
<b>B/C</b>	1.15	1.15	1.15
<b>Local Market</b>	24%	20%	5%
<b>Export Market</b>	76%	80%	95%

Source : Primary Data (Processed), 2018

## CONCLUSION

The main market for the citronella oil was the export market. The production capacity of the citronella essential oil business was 1000 kg/day, with the yield of 0.8%, operated for 300 days/year, with the international export market target of 76% and local target of 24%, would produce the benefit-cost ratio of 1.15 and obtained the BEP(q) value of 2,086 kg products with the BEP on the IDR was 275,352/kg, ROI as much as 50.68%, and POT in 1.97 years. On the other side, the sensitivity and the product selling price also affected the BEP value and the benefit-cost ratio. The increasing material price could be anticipated by managing the market fraction to maintain the benefit-cost ratio value and selling price. While the decreasing selling price was handled by managing the market fraction and prioritizing the product to be sold in the export market to maintain the benefit-cost value. Important steps that need to be taken to improve the citronella essential oil business are doing a technological transfer involving a research institution, government institutions, and academic parties.

## RECOMMENDATION

Further studies need to conduct a more specific feasibility analysis on this type of business. The same type of feasibility and sensitivity analysis could be implemented on the other type of business which using citronella as its main commodity in the production of its product.

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