Design of Medium Scale-Integrated Patchouli Oil Agro-Industry in East Java

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Abstract

The goal of designing an integrated agro-industry of patchouli oil with medium scale in East Java is to determine an ideal conditions of companies production with a 200 kg / day of patchouli oil capacity and 20 kg/day of fractionation products. The experimental, quantitative and descriptive method with primary and secondary data sources were used. The result of this design is the established production plan patchouli oil agro-industry in East Java as much as 756 ha. Cropping pattern shade with a partnership Operational Cooperation Agribusiness (OCA) is used in this design. By using financial analysis such as NPV, IRR, PI, PP, B/C ratio and the BEP, integrated agro-industry of patchouli oil with medium scale that produce three products: patchouli oil, patchouli alcohol and guaienee in Blitar feasible to be realized.

Keyword: Agro-industries design, Distillation Fractionation, Financial Analyses, Patchouli Oil

INTRODUCTION

Indonesian is the major supplier of patchouli oil in the world. Patchouli oil is an essential oil used as a perfume and cosmetics. The design of integrated agro-industry patchouli oil include patchouli planting pattern, design agro-industry in which includes distilled patchouli leaves become patchouli oil, patchouli oil fractionation into patchouli alcohol and guaiene until the financial analysis of agro-industry with mediumscale.

Patchouli oil is distilled of patchouli leaves. Patchouli oil has various constituent elements. Patchouli oil is currently exported to various countries as raw material for the manufacture of perfumes and cosmetics.¹ Patchouli oil distillation has a strategic potential in the world as a binder scent and cosmetics.² Some of these components include Patchouli alcohol (PA) which have anti-inflammatory properties,³ and anti-depressants.⁴

Other processed components of patchouli oil that serves as an anti-inflammatory guaiene to cause asthma, inflammation, and allergy.⁵

The average export Indonesian patchouli oil is 1000 tons / year while the overall volatile oil export capacity is 2,633 tons / year.⁶ Patchouli oil export destinations are Singapore, India, and most countries in Europe.⁷ Patchouli oil price per June 2015 reached Rp600,000-Rp700,000/liter. Sourced on *Sigma Aldrich* chemicals trader based

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Email : pratiwikusumaningayu@gmail.com Address : Jl. Bendungan Sigura-gura 5 No 8A, Malang in Singapore, Guaiene price reached Rp975.000 per 100ml and *Patchouli Alcohol* price reached Rp1,500,000 per 100 grams from the largest online community of Indonesia, Kaskus.

Sulawesi patchouli oil becomes production centers that contribute significantly to exports currently. However Sulawesi patchouli oil prices lower than the patchouli oil that produced in Aceh and Java.⁸ The soil conditions that caused Sulawesi patchouli oil have a lower pH than in Patchouli Aceh and Java.

The aim of this study to analyze the initial planning system an integrated agro-industry patchouli oil that can be maintained in quality and quantity in East Java, as well as analyzing the feasibility of both aspects of the market, technical and facilities as well as financial aspects.

MATERIAL AND METHODS

The experimental, quantitative and descriptive method with primary and secondary data sources as material research were used.

- 1. Experimental methods conducted in two cases with primary data:
 - a. Determination of cropping on open land and expanse land.
 - b. Post-harvest treatment, patchouli oil production and separation patchouli oil component with fractination method.
- 2. Quantitative descriptive method with secondary data were used as well as the adaptation of the experimental results.
 - a. Market aspects
 - b. Determination of production capacity
 - c. Design of agro-industry

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Some of the assumptions used in this study includes the raw materials used (patchouli leaves) have stable quality. Project period in agro-industry design is set to 20 years. Prices and costs in a financial analysis with the calculation of loan interest rates when the research was carried out by 22%. The location study performed in Blitar, East Java

Method of collecting data

Determination of cropping pattern

Experimental methods performed to determine the appropriate cropping patterns. The experimental method was performed on eight land with two types of cropping patterns: patchouli plants with other plant shade and without shade (open). This cropping pattern will determine the most suitable partnership scheme carried out by company.

Patchouli oil refining and separation components Patchouli Oil

Refining or distilled patchouli oil were done in PT. UB PHKI Kesamben Blitar conducted to determine the optimal state of patchouli oil by determines the capacity. In the minor component separation, fractionation vacuum method conducted to determine the optimal state in the capacity of 2 liters bait. overseas. Determine market segmentation patchouli oil production capacity by first determining the market positions. With this capacity will determine the location of the company, production methods, the number of machines up to the amount of product produced.

Design of Agro-industry Patchouli oil and its fractional product

Consider the capacity, the equipment in accordance with aspects of the market. In addition the calculation of financial analysis as the main parameters of the economic feasibility of whether the company is worth realized or not. Some indicators of financial analysis used is the Net Present Value (NPV), Internal Rate of Return (IRR), Pavback Period (PP), Pavment Investment (PI), Benefit Cost Ratio (B / C ratio) and Break Event Point (BEP),

RESULTS AND DISCUSSION

Determination of Cropping Pattern

This study were held on eight sections of land that consists of four shade pattern and four overlay (open) pattern. Results can be seen in **Table 1**.

Market and Technical Aspects

Market segmentation and target of patchouli oil company and product fractionation are

Table 1. Comparison of Patchouli oil content in the Land Overlay and Shade pad in July until October

Overlays					Shade	
% Yield	Refractive Index (nD)	Density (g/ml)	Land	% Yield	Refractive Index (nD)	Density (g/ml)
3.85	1.5675	0.984	1	4.29	1.56 0	0.997
4.44	1.575	0.995	2	3.71	1.575	0.991
3.18	1.57 0	0.966	3	4.44	1.575	0.992
3.84	1,561	0.996	4	4.08	1,565	0.983
3.83	1,568	0.985	Average	4.13	1,569	0.991

Table 1 shows the average with shading yield 0.48% greater than the yield on overlay pattern. In addition to the yield, the other physical indicators of the refractive index and density are also better with shade pattern than overlay pattern. This is because according to Santoso (1990),⁹ for optimal growth and good in producing patchouli oil, patchouli requires enough sunlight, though not directly

exposed. Making it possible to intercropped (shade) with other plants.

Some patchouli cultivation centers use intercropped (shade) pattern due to more favorable auspices that can optimize land use and reduce operating costs. In line with the analysis Ditjenbun Jatim in 2013,¹⁰ on the financial side with the shade cropping pattern system will provide several benefits. Reduce the cost of maintenance, reduce the risk of failure due to fluctuations price and increase the productivity of the soil.

With the shade pattern was applied, then the selection of a suitable partnership patterns should also be performed. The partnership pattern appropriate to be applied to the cropping pattern shade for the new company is a partnership of Cooperation Operational Agroindustry (COA). This partnership has a concept where partners provide land, facilities and personnel. While the company partners provide cost, capital, management and processing of production facilities to commercialize or cultivate a commodity agribusiness.¹¹

Patchouli Oil Production and Fractional Product Patchouli Oil

Patchouli oil production performed with distillation method. Patchouli oil distillation process held in PT. PHKI UB in Blitar with 300kg operating bait in 8 hours and a distillation pressure column 2.4 bar. Patchouli leaves will undergo a preliminary process before hanging in air for 1-2 weeks and curing for 3 months. This process produce 2% from leaves. Distilled patchouli oil compared to SNI can be seen in Table 2.

 Table 2. Characteristics of patchouli oil in accordance with

 SNI

Characteristics	Patchouli oil			
	Raw material	SNI *		
Color	Dark yellow	Yellow reddish-brown		
Density (g/ml)	0,953	0,950-0,975		
Refractive Index (nD)	1,497	1,507 to 1,,515		
PA Level	15,48%	At least 30%		

Table 2 shows the PA level of patchouli oilthat used as raw material does not meetmaximum National Standards of Indonesia(SNI). PA condition is affected by theproduction process and feed, in this casepatchouli leaves. Although other indicatorsshow that the raw materials in line with SNIFractional Patchouli Oil Product

Patchouli oil was separated into its component e.g PA and Guaiene etc. The two main components were identified by GCMS and reduced data at >90% SI. Fractionation ideal time conditions are 48 hours of operation with an engine capacity of 5 liters at a pressure of 0-1 bar. The complete result shows in Table 3 below.

Table 3. PA and Guaiene yield and purity level						
Batch	Fraction	Guaiene	PA yield(%)			
_		(%Area)	(%Area)			
1	1.12	94,63	2,40	7,45		
2	2.12	89,23	0,43	17,00		
3	3.20	96,68	0,69	14,80		
4	4.23	76,42	3,51	6,50		
1	1.16	24,70	30,65	0.77		
2	2.16	10,80	77,41	10,00		
3	3.27	3,55	87,29	10,00		
4	4.38	3,75	87,26	2,25		

Table 3 shows the highest result of guaiene yield is 17% with a purity level of 89.23%, while patchouli alcohol has the highest yield 10% with a purity level of 87.29%.

Market and capacity Aspects

Data Ditjenbun (2008) shows export destinations patchouli oil Indonesia are Singapore (37.17 %), United States (17.92%), Spain (16.45%), France (8.85%), Switzerland (6, 93%), UK (4.42%) and other countries (8.26%).⁷ Data were obtained from DAI (Council of Indonesian Essential) one of the departments under the auspices of the Ministry of Agriculture says that in 2013 the amount of exports to countries is not much different from that ranges from 1000 tons per vear.¹⁰

Market positioning of integrated patchouli Oil Company at challenger position, because there are several industry with similar product as competitor. Number of percentage of market positioning for the challenger is 30% from patchouli oil market. According to Kotler (2009),¹² a company with a market share of about Challenger position \leq 30%. Determination of production capacity the company can be seen in Table 4

Table 4. Production capacity Patchouli oil

Description	Amount
The number of Indonesian exports / year	1000 tons / year
Capacity production Patchouli Oil in Java (Assumption)	20% x 1000 = 200 tons / year

Company	30% x 200 ton = 60
Capacity <i>(Challenger)</i>	ton/year
Capacity Per day (300	60 ton / 300 = 200 kg
working days)	/ day = 210 liters / day
Capacity of dry leaves / day (Yield 2% patchouli oil)	10500 kg per day of dried leaves
Capacity of fresh leaves / day (Yield of 25% of dry leaves)	42000 kg of the fresh leaves

Sources: Data processed, 2015

Table 4 consist of production capacity begin from fresh leaves until became patchouli oil product. Capacity of fresh leaves is 42.000/ day with 200 kg of partchouli oil as product. Three hundred days/year with 24 working hours used to produces patchouli oil with optimal yield is 2% of fresh leaves.

Agro-industry design

Demand of export and domestic patchouli oil market were strongly influence by the quality of Patchouli oil based on SNI. Some of these standards can be realized with the supporting technical factors. In practice the yield of fresh patchouli leaves toward the patchouli oil is only about 0.5%, so that the above standard can be reliazed while the location of the company needs to be closer with patchouli farm. In addition to the above considerations, Blitar was elected to be a location of the integrated agro-industry patchouli oil plan in East Java with a variety of considerations such as:

The distance to the source of raw materials

The planned factory will be established in Selorejo District. The location was chosen because Selorejo have nearby access to raw material sources that spread in Kesamben, Selorejo and Doko District.

The distance to the distribution and transportation marketing

As the company's *challenger* in Blitar, these conditions can be utilized as the starting marketing location. Selorejo can be reach ± 4 hours or ± 178 km from the Port of Tanjung Perak Surabaya and Juanda International Airport for distribution into and out of the island.

Site determination

Patchouli can grow well at altitude (200-600) m above sea level, while according to Santoso (1990) patchouli well grow in the range (100-400) m above sea level (asl),⁹ Selorejo situated at an altitude (250-500) m asl, based on these conditions, District Selorejo suitable for the establishment of patchouli oil processing industry beside the location of the plant must be adjacent to the raw material.

Labor

Labor will be planned to be taken out of the productive society around the industry site. According to BPS data in 2014, the number of working age in the Selorejo District reaching around 16,000 people.

Energy and Utilities

Water

The total amount of water needs in the production of patchouli oil and its fractional is 67 m^3 per day. Meanwhile, according to the annual report of data Perum Jasa Tirta I can supply the water needs of Blitar and Tulungagung with discharge reaches 13.76 m³/s.

Electricity

The total amount of electricity needs in patchouli oil production and its fractional products are 350,611.2 kWh per year, while the working area PJT Blitar which has a capacity of hydropower and micro power plants with a capacity up to 1,160 GWh per year. Especially for the area around the company, there is Kesamben hydropower plant with a capacity of 34.6 million kWh / year.

The number of machines and equipment *Analysis of the needs of the machine*

Besides the location, technical factors that influence the selection of the location after determining the appropriate process technology. Secondary data PT PHKI UB with a quantitative approach is based on fulfillment of the production capacity thus obtained suitable amount of machines for the patchouli oil company.

Optimal machine capacity containing 300 kg in distillation yielding the patchouli oil with amount 2% yield of the dry leaves or 0.47% of the wet leaves. Company's raw materials within 1 day distills 10500kg dry leaves so that the engine needs can be drawn in diagram multiplication of the machine. That the total needs required machinery contained in Table 5.

Table 5. Machinery

Kind	Machine	Specification	Number of Units
	Boiler	1500	4
		Watt; 1000	
		kg / hour of	
		steam	
Machinery Production	Destilator	300 kg	12
	Column Cooling	380x280 cm	12
	Vacuum	6 Liter	8
	fractionation		
Production	GCMS star		
Support	brand variants		
Equipment	cx 3400		1
	Barrow		3
	Scales sitting		2
	Sheeting	(6x5) m	75
	Cars Offices		1
	Pick Up Box Used		1
	Used Trucks		2

Source: Data Processed, 2015

In **Table 5** shows the requirements of machinery and equipment supporting of production patchouli oil that has been calculated based on the company's capacity 200kg patchouli oil per day and 20 liters per day for fractionation process. Some equipment support is also needed to support the production process.

Machinery and equipment for 24 hours run per day. But there is 300 work days within a year means that there are two days off in a week which can be used as *maintenance*.

Cash flow inflow

Financial feasibility studies of integrated agroindustry patchouli oil

Patchouli oil companies and fractionation, some calculation assumptions used are: (1) repayment of bank loans made within 5.4 years; (2) the age of the plant project is estimated for 20 years with the company during the construction period of 1 year; (3) The effective interest rate is 22% with 10% inflation; (4) income tax rate in accordance with article 17 of Law No. 7 of 1984; (5) Taxable Income (PKP) up to Rp10,000,000 = 15%. PKP more than Rp10 million up to Rp50,000,000 = 25%, more than Rp50,000,000 = 35%; (6) first year the production performed 8 months, the 2nd year production for 10 months and the next year the production fixed for 12 months.

Estimation on Patchouli Oil and Fractional Product Investment

Determination of total capital investment is the accumulated total investment costs were used both direct costs and indirect costs. On this analysis, feasibility discussed the calculation and analysis of the costs incurred for the investment period and the company's overall costs used in the production of the (0 + 1) year.

Based on the calculations, the total capital investment of Rp45.165.097.918,93. Details of the value of the fixed capital investment can be seen in **Figure 1 and Figure 2**



Figure 1. Details Total working capital [Rp (n x 1 million)]



Figure 2. Details of total fixed capital investment [Rp (n x 4412.564445 x 1 million)]

Other data needed to analyze the feasibility of a project is the cost of production (HPP). This price is obtained by comparing the overall cost of production incurred by the number of products produced.



Figure 3. Details Total working capital fractionation unit [Rp (nx 1 million)]

In the first production year the company planned to operate for eight (8) month, 10 months in second year, and 12 months in the third year onwards. In the first year 42,000 liters patchouli oil production by HPP of Rp527.327,558 / liter or Rp2.636.637,24 / 5 liter jerry-can with HPP declined in every year and mark up increase every year until production period 12 months in the third year and next. The selling price and mark up price for the first year is 14%, at Rp600.000.000 / liter. The price is taken from some Indonesian patchouli oil distributor.

By setting the selling price patchouli oil, are used to determine the estimated total revenue to be received by the company. Total revenue earned by the company per year is amounted Rp25.200.000.000 with 42,000 liters of production. Total revenue will increase and constant in the third year with revenues Rp.37.800.000.000 with a total production of 63,000 liters.

By setting the selling price of patchouli alcohol (PA) and guaiene, it can be calculated the estimated total revenue to be received by the company on a fractionation unit for each product. Total revenue received by the company for the PA in first year is equal to Rp5.460.000.000,00 for the production of 4200 bottles, and will stabilize at 3rd year with a production of 6300 bottles and total revenue Rp8.190.000.000,00. As for products guaiene amounted Rp5.355.000.000,00 for 7140 bottles, and will stabilize at 3rd year with a production of 10,710 bottles with total revenue Rp8.032.500.000,00.

Criteria Financial Feasibility Analysis

To assess the feasibility of patchouli oil agroindustry development models planned, then analyzed using indicators feasibility of a design firm. Indicator of the feasibility of patchouli oil and fractionation can be seen in **Table 6.**

Table 6. Financial Feasibility Indicators Patchouli Oil and Fractional Product

No.	Economic Aspects		Patchouli oil	Patchouli alcohol	Guaiene	Criteria	Description
1	Total	Capital	45,165,097,918.93	5,655,370,316.25	5,655,370,316.25	-	-
	Investment (USD)						

2	Production Costs Year 1 (USD)	22,147,752,819.00	3,451,781,295.50	3,451,781,295.50	-	-
3	Total revenue year to 1 (USD)	25,200,000,000.00	5,460,000,000.00	5,355,000,000.00	-	-
4	NPV (Rp)	28,500,761,738.00	13,046,684,995.14	10,574,318,375.75	>1	Feasible
5	IRR (%)	27	64	56	> interest	Feasible
6	PI (%)	2.31	5:26	4:45	>1	Feasible
7	PP (year, month)	3.1	2.0	2.1	<life of<br="">the project</life>	Feasible
8	B / C Ratio (%)	1.39	1.69	1.66	>1	Feasible
9	BEP (liter)	3,398	301	535	-	-
	BEP (Rp)	2,038,795,816.51	390,114,829.38	400,832,818.36		

In **Table 6** shows that both patchouli oil production, as well as the fractional products namely PA and guaiene feasible to be develop as NPV, IRR, PI, PP, B/C ratio and the BEP are eligible.

Gain value on fractional products is larger than the patchouli oil product, but both of these products are in concave market share which means the demand is limited ever rarer. So, both of these products worth if produced on a small capacity and become by-product of the integrated patchouli Oil company.

CONCLUSION

- By building an integrated agro-industry patchouli oil (distillation and fractionation) medium scale in East Java, patchouli oil products can be centralized so that the guarantee of the quality and quantity of products patchouli oil can be reached.
- The potential of land and farmers involved in the design of integrated agro-industry patchouli oil is located in three districts namely Selorejo, Kesamben, and Doko, Blitar. Shade cultivation farming model is chosen. Development of Operational Cooperation Agri-business (OCA) is selected in accordance with the method of granting seeds to the farmer with one seed 100cm x 100cm each area of 756 hectares.
- Integrated agro-industry patchouli oil capacity (distillation and fractionation) medium-scale planned for 200kg of patchouli oil, 2100mg Patchouli Alcohol and 3570ml Guaiene per day.
- 4. The financial viability test results showed the patchouli oil integrated agro-industry

(distillation and fractionation) in East Java deserves to be realized.

SUGGESTION

- Need more study on the modification of the fractionation distillation machine in large capacity, because if solely factor increases the size of the water vapor and steam pressure will be disrupted which causes scorched patchouli leaves, so machinery modifications fractional distillation in mass production capacity is needed.
- 2. Need to be investigated the market share of patchouli oil fractional products
- 3. Research about the public acceptability related to the industrial development of patchouli oil and its fractional products needs to be done.

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