Abstract

This study aims to identify the primary factors and subfactors that affect the development of the patchouli oil industry in Indonesia. FDM is used to compile and classify the primary factors and subfactors of patchouli oil development in Indonesia based on seven expert evaluations, five experts from practitioners, and two experts from academicians. There are 13 main factors identified from a total of 16 primary factors and 37 subfactors identified from a total of 41 subfactors. From the result of the study, there are some critical factors in patchouli oil industry development in Indonesia. There are quality, total revenue, and markets as the main factor, as well as the distillation method, global patchouli standard price, and production cost, as a subfactor. From all of these factors, the quality of patchouli oil, which is influenced by the refining method, is a very significant factor in determining the development of Indonesia's patchouli oil industry.

Keywords

fuzzy Delphi, patchouli oil industry, agroindustry development, Indonesia

A study on influence factors of patchouli oil industry development in Indonesia

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Keywords: fuzzy Delphi; patchouli oil industry; agroindustry development; Indonesia.

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1 Introduction

Essential oil, also known as volatile oil, or aromatic oil, is a type of vegetable oil that distilled various kinds of plants. It produces thick liquid at room temperature but quickly evaporates, so give a distinctive aroma. Patchouli oils have the following properties:

a volatile at room temperature without decomposition

b have a bitter taste (pungent taste)

c soluble in organic solvents and insoluble in water.

Essential oils are used to produce cosmetics, perfumes, antiseptics, medicines. It also functions as a flavouring agent, food, beverages, cigarettes, and aromatherapy (Elguea-Culebras, 2016; Barros et al., 2016; Złotek et al., 2016). Among the many essential oils on the market are fennel/foeniculi oil, sandalwood oil (sandalwood oil), clove flower oil (eugenol oil), and clove leaf oil (leaf clove oil), eucalyptus oil (cajuput oil), patchouli oil and many more. In general, essential oils extracted from roots stems and leaves of plants (Kusuma and Mahfud, 2017; Bey et al., 2016).

One of Indonesia's essential oils, namely patchouli oil, is the highest percentage of export commodities compared to other types of essential oils. Indonesia supplies around 90% of the world's needs or 1,600 tonnes per year (Directorate General of Plantations, 2016). In 2011 Indonesia exported 66,742.46 tonnes of essential oil with a value of 438.16 million US$ (Central Statistics Agency, 2011). Patchouli oil is produced in various regions in Indonesia. But its predominance comes from the Special Region of Aceh, North Sumatra, and West Sumatra, with a total supply of 80% of the total national production. Statistical data shows that Indonesia in 2015–2017 produced an average of 1,977 tonnes of patchouli oil, of which approximately 197 tonnes came from West Sumatra Province (Directorate General of Plantations, 2016).

Presidential Regulation of the Republic of Indonesia Number 28 of 2008 concerning National Industrial Policy is further translated by the West Sumatra Provincial Regulation Number 13 of 2012. It is concerning the Regional Spatial Plan of West Sumatra Province in 2012–2032, making the volatile industry one of the leading sectors of West Sumatra Province. West Sumatra Province Regional Regulation Number 5 of 2011 concerning the West Sumatra Provincial Medium Term Development Plan 2010–2015. States that West Sumatra has potential in the field of plantations, and the essential oil is one of the commodities to be developed into a superior product in West Sumatra.

Patchouli oil processing industry has many advantages for the surrounding community if it is well developed. Regarding raw materials, the presence of patchouli oil processing industries can increase the added value of patchouli plants. It uses optimally (Juniardi, 2015), increasing local employment (Nurhilal and Saruman, 2013; Junaedi and Hidayat, 2010). The impact of patchouli development on socially, among others:

1 open new jobs both regarding cultivation

2 improvement quality of farmers

3 increased knowledge and skills farmers in patchouli cultivation and processing

4 the ability to organise with its formation patchouli cooperatives in several villages (Winarti et al., 2005).

On the other hand, the presence of agroindustry can open new business fields for the surrounding community (Ichsan, 2017; Muchi, 2008). Different needs must be met to carry out activities such as the purchase of machine components, plastics, transportation, and so on. But in reality, the current essential oil processing industry has not developed well (Fitri and Mohammad, 2015). Indonesia's patchouli production in recent years has tended to be unstable and declining (Central Statistics Agency, 2015).

Since patchouli oil has the potential to be developed and has a transparent market, it is necessary to work on solutions and plan for the development of the patchouli oil industry. At present, the patchouli oil processing industry is still carried out on a small scale and is home-based. Small and medium enterprises are one of the industry models that are suitable to be developed in Indonesia because they can survive in various economic conditions. The role of government is needed in the development strategy of small and medium industries because small and medium sectors play a role in the economy of a country (Amaradiwakara and Gunatilake, 2016). Small medium enterprises (SMEs) contribute to the gross domestic product, by reducing the level of unemployment, reduction in poverty levels and the promotion of entrepreneurship activity (Sitharam and Hoque, 2016; Farrokh et al., 2016). Unfortunately, there is no reference for the government to design a development strategy for small and medium industries in the field of patchouli oil processing.

Table 1 Summary factors related to strategy development in agriculture

Researchers	*Main topic*	*Factors*
Helena (2007)	Factors were important for farm performance.	Several geographic locations (external-internal environment), internal environment was considered, size of fields, distance to fields, bunker silo and tower silo, quality of forage machinery and a high focus on dairy production.
Pender et al. (2006)	Factors influence agricultural development in the East African Hightlands.	Agricultural potential, access to markets and population pressure.
Wood et al. (1999)	Spatial aspects of the design and targeting of agricultural development strategies.	Agricultural potential, population density, and access to infrastructure and markets are matched against a similarly characterised, spatially-referenced (GIS) database.
Scherr and Hazell (1994)	Factors influencing the pace and scale of land transformation.	Farmer knowledge of degradation of the degrading resource, incentives for long-term investment; capacity to mobilise resources for land investment; level of economic returns to such investment; and factors affecting the formation and function of local groups to help mobilise resources and coordinate landscape-level change.

The purpose of this study is to determine the critical factors that affect the development of the patchouli oil industry. These factors will be used as a reference in strategy design. On the other hand, it can be an input for the government and related parties to establish policies related to the strategic development of the patchouli oil industry. Agroindustry development strategy can be designed by adjusting the characteristics and problems of industry concerned. This strategy can be done by determining the factors affecting the growth of agroindustry. These factors need to be traced to identify the source of the problem. So, appropriate solutions can be given. Strategy development should come from the source of the issues that occur – currently, no studies related to factors affecting the growth of patchouli oil agroindustry. But research related to factors influencing industrial development strategy in agriculture has been done.

2 Literature review

This research adopts prior researcher related to agro-industry development strategy and adjust with patchouli oil agro-industry. Some of the previous research related factors that influence development strategy in agriculture can be seen in Table 1.

Several other studies that have been conducted related to the development of agro-industry can be seen in Table 2.

Table 2 Agroindustry development research

Researcher	*Objective*	*Approachment*	*Aspect development*
Pisania and Scrocco (2016)	Comparing new business opportunities such as the cultivation of asparagus, avocados, oranges with current agriculture cotton.	Scenario and sensitivity analysis	Supplier
Machfoedz (2015)	Determine the effect of situation instability on the import base industry and agro-based industry.	Literature review	Policy
Gu et al. (2013)	It is stimulating the development of the corn industry in Heilongjiang Province, increasing wheat production capacity, as well as developing the economy and increasing the income of local farmers.	SWOT analysis	Technical
Satu et al. (2011)	Determine strategies for dealing with global climate change and environmental challenges in the paper processing industry. For this reason, many traditional pulp and paper industries are required to create new business opportunities.	System dynamic	Technical
Augustine (2010)	Increased production of corn seeds.	Literature review	Supply
Ferreira et al. (2016)	Integrated production planning to improve competitiveness.	System dynamic	Technical

3 Method

This paper uses a qualitative and quantitative approach. The qualitative approach emphasises aspects that are not easily measured by numbers to explain the phenomenon under study. The qualitative approach is time-consuming and appears difficult to juggle with quantitative methods. On the other hand, quantitative methods develop over time, and demand increasingly elaborate competences (Dana and Dumez, 2015). Factors influencing the development of patchouli oil agroindustry are explored through observation and interviews with several experts after obtaining potential factors with

qualitative techniques with giving numerical weights. Next will be processed using the fuzzy Delphi method (FDM) as a quantitative step. This approach focuses on the mathematical aspects as the data, both in the process and the results. This research was conducted comprehensively so that the results are more optimal. This research is a case study because the patchouli business system is specific and tends to be influenced by local culture. If we accept that entrepreneurs are influenced by culture, then the most straightforward research unit possible to understand entrepreneurship is a case study (Dana and Dana, 2005).

Current factors that affect the development of the patchouli oil industry will obtain by using the FDM. The Delphi method (DM) in association and has widely practiced in many areas, e.g., forecasting, public policy analysis, organisational management, and project planning. However, the traditional DM also has some disadvantages, such as low convergence expert opinions, high execution cost, the possibility of filtering out particular expert opinions, and so on (Ma et al., 2011). Noorderhaben (1995) indicated that applying the FDM to group decisions can solve the fuzziness of the shared understanding of expert opinions. The FDM is the modified and enhanced version of the classical Delphi technique. An improvement was made to rectify the imperfection of the traditional DM that leads to low convergence in retrieving outcomes, loss of valuable information, and continued progress of the investigation. Nevertheless, this approach was employed in various application domains, including humanities, management, business, physical science, and engineering.

Research related to identifying factors in various uses of FDM has widely practiced, such as applying FDM. It uses to identify critical factors associated with the wafer construct sets of road safety performance indicators (Ma et al., 2011), define the essential personalised attributes in a customised mobile advertising message for different products (Chen and Hsieh, 2012). As for the selection of fuzzy membership functions, previous researches were usually based on the triangular fuzzy number (TFN), trapezoidal fuzzy number, and Gaussian fuzzy number (Farnad, 2016). This study applied the angular membership functions and the fuzzy theory to solving the decision. This research expends two rounds to identify factors related to the development of the patchouli oil industry. First-round aims to identify the principal elements, and the second round aims to identify the subfactors that influence the primary factor.

3.1 Questionnaires design

The appearance of ideas from experts done through direct interviews, they have explained the purpose of research and fundamental knowledge on the development of the current condition. Those ideas collected designed in the form of questionnaires. Primary factors that influence patchouli industry development divide into five grades; strongly agree, agree, moderate, disagree, and strongly disagree. While for subfactor given the assessment of maximum and minimum with values between 0 and 100. There are seven experts in this research, consist of five practitioners and two academics. Table 3 shows the expertise of each expert in each field.

Table 3 Expert specification

Code	*Field*	*Position*	*Experience*
P1	Practitioner	Head of agro, Department of Industry and Trade, West Sumatera	5 years
P2	Academic	Pharmacy lecturer, herbalist and member of the National Essentials Association	25 years
P3	Academic	Coordinator of the national essentials association for West Sumatra, pharmacy lecturer	15 years
P4	Practitioner	Exporter	10 years
P5	Practitioner	Patchouli oil collector, head of PT. Raja Bor-bor	25 years
P6	Practitioner	Patchouli oil intermediate trader	30 years
P7	Practitioner	Head of aromatic medicines and plants	25 years

Table 4 Definition of every fuzzy number

Fuzzy number	*Definition*
1 = (0, 0, 0.2)	Strongly disagree
2 = (0, 0.2, 0.4)	Disagree
3 = (0.2, 0.4, 0.6)	Moderate
4 = (0.4, 0.6, 0.8)	Agree
5 = (0.6, 0.8, 1)	Strongly agree

Source: Liu (2013)

3.2 Collect opinions

Factors collected from observation, deep interview with experts and then give it back to experts. Experts will provide an assessment of existing elements that collecting before. Furthermore, experts will add views about factors that do not yet exist. This factor will be confirmed again by other experts so that the agreement reached and the expert gives an assessment. It was done by spreading and filling the questionnaire for each expert. Experts are required to fill the checkmark in the available field for the main factors that give the value between 0 and 100 for subfactors.

The FDM steps for the main factors are as follows:

Step 1 Set up fuzzy triangular numbers. The result of the questionnaire is the linguistic variable that shows the level of expert approval for the main factors affecting the development of the patchouli oil industry. This study referred to a model proposed by Liu (2013) and Etebarani (2012). The results convert into the TFN. TFN has three values, the lower limit (l), the middle value (m), and the upper limit value (u). Table 4 shows the definition of every fuzzy number.

Hence, the fuzzy weight number of expert *i* on managerial competence indicator *j* can present as follows:

$$W_{ij} = \left(l_{ij}, m_{ij}, u_{ij}\right) \tag{1}$$

$$l_j = Min\left(l_{ij}\right), i = 1, 2, ..., n;\ j = 1, 2, ..., m \tag{2}$$

$$m_i = \left(\prod_{i=1, j=1}^{n,m} m_{ij}\right)^{\frac{1}{n}}\ i = 1, 2, ..., n;\ j = 1, 2, ..., m \tag{3}$$

$$u_i = Max\left(u_{ij}\right), i = 1, 2, ..., n;\ j = 1, 2, ..., m \tag{4}$$

where

n number of experts

m number of indicators.

Step 2 Determining selected factors (defuzzification). The results in the previous stage were used to calculate a single name (crisp number). Defuzzification was done using the pure centre of gravity method. The formulation used to get a crisp value:

$$S_i = \frac{i_i + m_i + n_i}{3} \tag{5}$$

Selection of indicators was done by taking into account the value of the threshold used. The criteria in the selection of indicators are as follows.

If the value is $S_i \geq r$, then the factor is accepted.

If the value of $S_i < r$, then the factor is rejected/deleted.

The FDM steps for subfactors are as follows:

Step 1 Each expert separately assesses each evaluation item, giving a possible range of values. The minimum value of this interval indicates this expert's 'most conservative cognitive value' whereas the maximum value of indicates the expert's 'most optimistic cognitive value'. This study used the geometric mean model of mean general model proposed by Klir (1995) for FDM to find out the common understanding of group decision. This method is also used by Chen and Hsieh (2012) to identify the key personalised attributes.

Step 2 For each evaluated item *i*, analyse the 'most conservative cognitive value' and 'most optimistic cognitive value'. Among the remaining 'most conservative cognitive values', find the lowest value C_L^i, the geometric mean C_M^i, and the maximum C_U^i. Among the 'most optimistic cognitive values', find the minimum O_L^i, geometric mean O_M^i, and maximum O_U^i.

Step 3 Through the above steps, we can establish the TFNs $C^i = (C_L^i, C_M^i, C_U^i)$ for the 'most conservative cognitive value'.

Step 4 Finally, the level of expert consensus can be tested as follows:

1 There is no grey area.

If $C_U^i > O_L^i$, that is, the two TFNs, do not overlap, then the experts' interval values have a concord section. This indicates that for the assessed item *i*, the most conservative cognitive values of all the experts have reached a consensus. Similarly, for the assessed item *i*, the most optimistic cognitive values of all the experts have also reached a consensus. Therefore, let the assessed item *i*'s 'consensus importance value' G^i be equal to the arithmetic mean of C_M^i and O_M^i:

$$G_i = \left(C_M^i + O_M^i\right)/2$$

If $C_U^i \le O_L^i$, that is the two TFNs overlap, and the fuzzy relationship's grey area $Z^i = C_U^i - O_L^i$ is less than the interval range $M^i = O_M^i - C_M^i$ of the geometric mean of the positive cognitive value and conservative cognitive value, then although the interval value of the experts' opinions generates a fuzzy zone. The experts who gave extreme opinions do not have a huge different opinion from the views of the other experts; thus, there is no opinion divergence. Therefore, let the 'consensus importance value' G^i equal the fuzzy set $F^i(x_j)$ calculated from the intersection of the gray area of the two TFNs. Calculate the quantitative score $\mu_{F4}(x_j)$ with the maximum degree of membership in the fuzzy set. The expression is as follows:

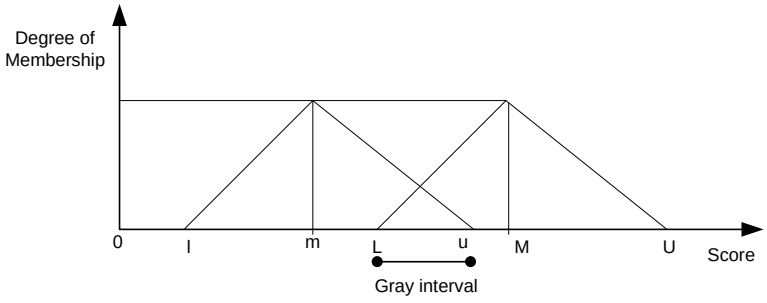
$$\left(x_j\right) = \left\{\int_x \left\{\min\left[C^i\left(x_i\right).O^i\left(x_i\right)\right]\right\} dx\right\} \tag{6}$$

$$G^i = \left\{x_j \middle| \max \mu_f^4\left(x_i\right)\right\} \tag{7}$$

2 There is a grey area, and there is a big difference between the views of experts.

If $C_U^i = NO_L^i$, the two overlapping TFNs overlap, and the fuzzy grey area $Z^i = C_U^i - O_L^i$ is higher than the interval range $M^i = O_M^i - C_M^i$ of the geometric mean of the positive and conservative cognitive values, then the range of values of the views of the experts create a fuzzy zone without consensus. It means that the extreme values given by some experts have a significant difference from the perspectives of other experts, resulting in opinion divergence. Therefore, we must allow the experts to assess the geometric mean of the optimistic cognitive and conservative cognitive for the items that did not achieve convergence. Repeat steps 1–4 to conduct another survey until all evaluated items produce convergence and the consensus importance value G^i calculation. Schematic diagram of the FDM shown in Figure 1.

Figure 1 Schematic diagram of fuzzy Delphi



Source: Liu (2013)

4 Result and discussion

4.1 Result

Based on interviews and discussion conducted with experts, 16 factors influence the development of the patchouli oil industry. Expert opinions converted into fuzzy numbers then used to calculate geometric averages. The geometric mean calculations are used to obtain the lower limit value (l), the mean value (m), and the upper limit value (u) in each factor. In this paper, the threshold value set as 0.6. Then the selection criteria are as follows:

1 If $S_i \geq 0.6$, this performance indicator is accepted.

2 If $S_i < 0.6$, this performance indicator is rejected.

It can be seen from Table 5 that 13 factors were accepted and three elements deleted. The accepted indicators are an investigation, labour, price, total production, total revenue, marketing, government support, supportive services, cultivation skills, market demand, technology, management, and quality. The deleted indicators are employment opportunity, area availability, and capital.

Subfactors only determined for selected factors, from 13 main elements will be defined subfactors that affect it. The procedure is almost identical to the selection of the main factors but using different calculations. Seven experts are asked to give an idea of the subfactors that affect the main factors. At this stage used the FDM to determine the subcriteria of factors that influence the development of the patchouli oil industry. The higher value indicates a more important variable. In detail, respondents' assessment using FDM can be seen in Table 6.

First, respondents provide the highest and lowest values that represent the importance of each criterion. Next, calculate the most conservative cognition and the most optimistic cognition. The minimum amount for the most conservative perception is the minimum value of the lowest assessment of the seven respondents to a subfactor. The maximum value for the most conservative cognition is the maximum value of the lowest valuation of seven respondents to the subfactor. The medium value for the most conservative perception is the geometric average of the minimum and maximum value of the most

conservative cognition. That is the root of the minimum value multiplication of the most conservative cognition with the maximum amount of the most conservative perception.

Next, calculating the minimum value, maximum value, and medium value of the most optimistic cognition. The difference is the minimum and maximum value obtained from the lowest assessment of the seven respondents to the subfactor. Then grey interval is taken from the maximum amount of the most conservative cognition and the minimum value of the most favourable perception. The median or middle value of the grey interval is the sum of the maximum value of the most conservative cognition and the minimum amount of the most positive perception, then divided by two. If the median of grey interval ≥70, then the subfactor is used on factors affecting the development of the patchouli oil industry. Of the 41 subfactors proposed, only 37 subfactors were agreed upon by the respondents and considered important as factors influencing the growth of the patchouli oil industry.

Table 5 FDM for main factors

No.	*Factors*	*Codes*	*L*	*M*	*U*	S_i
1	Investation	F1	0.400	0.707	1.000	0.702
2	Labour	F2	0.400	0.651	1.000	0.684
3	Price	F3	0.400	0.737	1.000	0.712
4	Total production	F4	0.400	0.737	1.000	0.712
5	Total revenue	F5	0.600	0.800	1.000	0.800
6	Marketing	F6	0.600	0.800	1.000	0.800
7	Government support	F7	0.400	0.679	1.000	0.693
8	Cooperative services	F8	0.400	0.707	1.000	0.702
9	Cultivation skills	F9	0.400	0.768	1.000	0.723
10	Employment opportunity	F10	0.000	0.334	0.800	0.378
11	Market demand	F11	0.200	0.695	1.000	0.632
12	Area availability	F12	0.000	0.297	0.600	0.299
13	Technology	F13	0.200	0.667	1.000	0.622
14	Capital	F14	0.200	0.517	1.000	0.572
15	Management	F15	0.200	0.667	1.000	0.622
16	Quality	F16	0.600	0.800	1.000	0.800

4.2 Discussion

Primary factors are selected based on the threshold value of 0.6. Elements with S_i value above 0.6 will categorise as the chosen factor. The highest S_i value is 0.800, while the lowest S_i value is 0.299. The selected coefficients are investment, labour, price, total production, revenue, marketing, government support, supportive services, cultivation skills, market demand, technology, management, and quality. Factors with S_i value 0.800 are total revenue, marketing, and quality. Revenues are related to profits earned by industry actors from farmers to exporters. Marketing is about sales and quality targets relating to the quality of patchouli compared to the standard class that has set. These three factors are inseparable and mutually integrated; the condition will determine the price of products applicable in the market and directly affect the benefits gained. The

amount of profit is also influenced by the area of marketing (Gusrizaldi and Komalasari, 2016). Factors that have a value less or equal than 6.00 are area availability, employment opportunity, the capital. These factors do not include influencing agroindustry employment opportunities related to the availability of processing time for harvesting, drying, and refining activities. Regarding land and capital do not become an obstacle for farmers, because the area is available and the required money is also not too large.

Subfactors are the factors that influence the main factors; 13 main elements selected will be developed into 41 subfactors, from 41 chosen subfactors 37 subfactors. Subfactors are determined based on the median of grey interval values. Chosen subfactors are distillery, refining equipment, number of labour, labour ability, labour salary, selling price at farmer level, selling price at intermediate trader, selling price at collector, selling price at exporter, type of patchouli, type of refining equipment, weather, patchouli oil price global standard, production costs, patchouli oil price in every actor, domestic sales, overseas sales, tools and seeds from the government, training program, number of cooperatives available, type of cooperative business, the role of organisations, Fertilisation time, harvest time, inflation, planting system, drying system, distillation system, salary payment system, groups of farmer, selection of varieties, raw material condition, equipment, distillation method and storage procedure.

Subfactors distillery and refining equipment categorise as the factor influencing investment. Number, ability, and salary are subfactors that affect labour performance. The selling price on each actor affects the rate. Type of patchouli, kind of refining equipment, and weather are subfactor subfactors that determine the primary factor of production quantity. Total revenue is determined by global standard patchouli oil price, production costs, and patchouli oil price in every actor. Marketing consists of domestic and foreign sales. Government support includes tools and seeds from the government and training programs. Supportive services relate to the number of cooperatives available, type of cooperative business, and the role of organisations. Cultivation skills consist of fertilisation time, harvest time, and treatment method. The number of exports and inflation influences market demand. The technology consists of a planting system, drying system, and a distillation system. Management includes salary payment systems and groups of farmers. Quality depends on the selection of varieties, raw material conditions, equipment, distillation methods, and storage procedures.

Winarti et al. (2005) stated that various internal and external factors influence development patchouli agroindustry in an area. Among these factors are the percentage of income derived from patchouli cultivation, the land area owned by farmers on average, the productivity of leaves (leaves and twigs) patchouli produced, and level of farmers' satisfaction, production, and price of patchouli oil. This research conducted a direct survey of farmers. A little different from the research done, where the factors of development of patchouli agroindustry taken from expert opinions consisting of practitioners and academics. The distillation method is a subfactor that has the highest median of grey interval value. It means that the distillation method is a significant subfactor that determines the growth of the patchouli oil industry.

Table 6 FDM for subfactors

Codes	*Factors*	*Codes*	*Sub factors*	C_L^i	C_U^i	C_M^i	O_L^i	O_U^i	O_U^i	C_U^i	O_l^i	G_i
F1	Investation	F1.1	Patchouli leaf dryer tool	50	75	53.85	60	70	63.32	75	60	58.58
		F1.2	Distillery	50	85	66.06	60	80	74.97	85	60	70.52
		F1.3	Refining equipment	70	95	77.68	80	85	89.88	95	80	83.78
F2	Labour	F2.1	Number of labour	65	90	68.53	75	70	81.10	90	75	74.81
		F2.1	Labour ability	65	95	77.66	75	80	89.74	95	75	83.70
		F2.3	Labour salary	60	90	70.93	75	80	82.60	90	75	76.77
F3	Price	F3.1	Selling price at farmer level	60	90	68.07	70	80	78.14	90	70	73.10
		F3.2	Selling prices at intermediate trader	80	90	82.11	85	85	88.54	90	85	85.32
		F3.3	Selling prices at collector	80	90	82.11	85	85	88.54	90	85	85.32
		F3.4	Selling prices at exporter	80	90	82.11	90	85	90.00	90	90	86.05
F4	Total production	F4.1	Type of patchouli	70	90	75.55	80	80	85.57	90	80	80.56
		F4.2	Type of refining equipment	80	90	80.00	90	80	90.00	90	90	85.00
		F4.3	Weather	80	90	80.00	90	80	90.00	90	90	85.00
F5	Total revenue	F5.1	Patchouli oil price global standard	80	100	84.92	90	90	97.03	100	90	90.98
		F5.2	Production costs	80	100	84.92	90	90	97.03	100	90	90.98
		F5.3	Patchouli oil price in every actor	80	95	81.40	90	85	91.40	95	90	86.40
F6	Marketing	F6.1	Domestic sales	70	90	72.72	60	80	78.68	90	60	75.70
		F6.2	Overseas sales	70	100	79.64	80	90	92.46	100	80	86.05
F7	Government support	F7.1	Rules regarding area clearing	40	80	57.09	50	70	65.92	80	50	61.50
		F7.2	Other rules that support	40	90	63.17	50	80	73.57	90	50	68.37
		F7.3	Tools and seeds from the government	70	100	79.46	80	90	91.04	100	80	85.25
		F7.4	Training program	70	100	83.27	80	90	96.16	100	80	89.71

Table 6 FDM for subfactors (continued)

Codes	*Factors*	*Codes*	*Sub factors*	C_L^i	C_U^i	C_M^i	O_L^i	O_U^i	O_U^i	C_U^i	O_l^i	G_i
F8	Cooperative services	F8.1	Number of cooperatives available	60	90	69.79	70	80	79.82	90	70	74.81
		F8.2	Type of cooperative business	60	90	73.90	70	80	83.95	90	70	78.93
		F8.3	The role of cooperatives	60	90	75.38	70	80	83.95	90	70	79.66
F9	Cultivation skills	F9.1	Fertilisation time	65	90	73.19	75	80	83.24	90	75	78.21
		F9.2	Harvest time	80	95	82.74	90	90	91.40	95	90	87.07
		F9.3	Treatment method	75	90	77.82	80	80	85.57	90	80	81.69
F11	Market demand	F11.1	Number of exports	80	90	80.00	90	80	90.00	90	90	85.00
		F11.2	Inflation	70	90	77.01	80	80	87.02	90	80	82.01
F13	Technology	F13.1	Planting system	65	90	73.19	70	80	79.50	90	70	76.34
		F13.2	Drying system	70	90	72.72	75	80	81.23	90	75	76.97
		F13.3	Distillation system	80	100	82.74	90	90	92.75	100	90	87.74
F15	Management	F15.1	Business organisational structure	60	80	65.58	70	70	74.12	80	70	69.85
		F15.2	Salary payment system	60	85	67.55	70	75	77.59	85	70	72.57
		F15.3	Groups of farmer	70	95	77.96	80	90	86.11	95	80	82.04
F16	Quality	F16.1	Selection of varieties	70	100	79.03	80	85	91.04	100	80	85.04
		F16.2	Raw material condition	70	100	80.55	80	85	91.83	100	80	86.19
		F16.3	Equipment	60	100	75.85	70	85	87.12	100	70	81.48
		F16.4	Distillation method	80	100	86.24	90	95	97.03	100	90	91.64
		F16.5	Storage procedure	80	100	82.11	90	85	94.16	100	90	88.13

The distillation method is a subfactor affecting the leading factor quality. The quality of patchouli oil produced greatly influences the distillation method (Donelian et al., 2009). The distillation method associated with is typically related to the type of distilled instrument used and the distillation time. Type of distillation equipment used should be made of stainless to avoid the rusting process, while the current condition of patchouli distillers tend to use traditional tools. Traditional tools are utilising used goods such as drums. The distillation process can not do in a hurry, using big fire, because effecting the quality of oil resulted is not good. Patchouli oil generally extracted with 6–7 hours, with the small fire.

Government support can be done in various ways to maintain and improve the quality of patchouli oil. The actions that can be taken by the government in the future to realise the results of this research. The government must facilitate research support regarding the quality of patchouli oil, guaranteeing the procurement of standardised processing technology. Besides that, the government must be able to provide knowledge transfer about the quality standards of the patchouli world through training.

5 Conclusions

This study has succeeded in finding the factors that influence the development of SMEs in the agro sector. The type of agroindustry product in this study is high foreign market demand, contributes significantly to gross domestic income and capable of creating many business opportunities. Also, the industry comes from processing raw materials that are easy to obtain, simple processing technology, and relying on processing skills acquired from generation to generation. The main factors that need to be considered in the development of agroindustry are investment, labour, price, total production, total revenue, marketing, government support, market demand, cultivation technology, management, capital, technology, and quality. The main factor can be developed into various subfactors depending on the type of agroindustry. From the result of the study, there are some critical factors in patchouli oil industry development in Indonesia. There are quality, total revenue, and markets as the main factor, as well as the distillation method, global patchouli standard price, and production cost, as a subfactor. From all of these factors, the quality of patchouli oil, which is influenced by the refining method, is a very significant factor in determining the development of Indonesia’s patchouli oil industry.

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