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A Conceptual Framework for Essential Oils Marketing: A Systems Approach

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ABSTRACT

Essential oils have a high economic value because of their utilities as perfumes, food flavors, and medicinal raw materials. Indonesia is one of the countries producing and exporting essential oils in the world, although the development of Indonesian essential oils industry has not been able to meet global demand. The main problem of Indonesian essential oils marketing is the fluctuating in price. Some research conducted only focus on certain factors that influence the dynamics of Indonesian essential oils prices, but no researches have integrated factors that influence the dynamics. An integrated model, in which all variables that influence the dynamics of Indonesian essential oils prices are illustrated in a relationship between variables, will help policy makers to understand the system better. This research uses a systems dynamic approach, a conceptual framework that has been developed to show various factors that have an impact on fluctuating prices of Indonesian essential oils. A causal loop diagram is developed based on literature review and statistical analysis, while regression analysis is used to validate the framework. The Causal loop diagram illustrates the reciprocal relationship between several variables that affect the dynamics of fluctuating prices of essential oils. This framework can be used as a basis for further research related to the development of the essential oils agro-industry.

Keywords: Essential oils prices; systems dynamics approach; causal loop diagram; regression analysis.

1 Introduction

Essential oil, also known as volatile oil, is a concentrated liquid that is not water soluble and contains aromatic compounds derived from various plants, such as lemongrass, cinnamon, patchouli, and cloves. Essential oils are usually extracted from roots, stems, leaves, and flowers of plants (Bey-Ould Si Said et al., 2016; Kusuma and Mahfud, 2017a, 2017b). In the modern era, essential oils have been used as binders in perfumes, flavoring in food, beverage ingredients, as well as as raw material for medicines, such as antiseptics and antimicrobial that can inhibit bacterial and fungal growth in human bodies (Adrar et al., 2016; Fernandes et al., 2016; Ortiz de Elguea-Culebras et al., 2016; Zlotek et al., 2016). Therefore, demand for essential oils continues to increase because of awareness about the dangers of synthetic chemicals (Shaaban and El-Ghorab, 2012).

Indonesia is one of countries of origins for crude essential oil (Alighiri et al., 2017). The development of the Indonesian essential oils industry has recently experienced an increase in terms of product demand, but the essential oils industry in Indonesia has not been able to meet the global market demand of essential oils (Table 1).

Table 1.
Global Essential Oils Market Demand and Indonesian Essential Oils Production (Alighiri et al., 2017)

Essential Oil(s)	Global Demand (Tons)	Indonesian Production (Tons)
Clove oil	5000-6000	3500-4000
Patchouli oil	1200-1500	800-1000
Lemongrass oil	>2000	500-600
Turpentine oil	>10000	10000
Cajeput oil	>1000	350-400
Nutmeg oil	>400	350-400

Fluctuating prices are a major problem in Indonesian essential oils marketing. The prices of Indonesian essential oil are influenced by global prices of essential oils. As a result, it causes essential oils farming and refining businesses to be in a high risk of loss (Hendrastuti et al., 2012; Wahyudi and Ermiati, 2012). Kotler and Armstrong (2012) have stated that for producers, prices are one of the most important marketing mix elements. A comparison between the price of output and the price of input received by farmers and refiners will directly influence their motivation in running essential oils farming and refining businesses. It has an impact on the number of essential oils farmers and refiners who switch to other businesses (Suyono and Purwastuti, 2011; Yuhono and Suhirman, 2006).

An analysis of the dynamics of essential oils prices is critically needed in order to increase the essential oils production and the profit for agro-industrial supply chain actors of essential oils. Factors that influence the price of essential oils are, inter alia, inefficiency in supply chains caused by poor marketing systems, non-standardized quality and quantity of essential oils, the role of government, quality of human resources, production costs, inflation rates, and the availability of raw materials.Many researchers conducted research to analyze the relationship of these various factors with the dynamics of essential oils prices.

Research by Alighiri et al. (2017) has concluded that complex supply chain systems cause fluctuations of essential oils prices. The length of Indonesian essential oils marketing chains has resulted in inefficient supply chain performance. The presence of intermediaries in the supply chain of essential oils results in a low bargaining position of farmers and refiners. Research by Djuwendah and Rachmawati (2008) has proven that without the presence of intermediaries in essential oil marketing, the prices received by refiners increased by 88.33%. This result indicates that efficiency considerations ask for supply chain integration (Suyono and Purwastuti, 2011). In addition, the integration between essential oil business actors can provide convenience in obtaining market information and has an impact on achieving price stability (Maulidah, 2010). Further research has been conducted by Efendi et al. (2014) using VSM (Value Stream Mapping) method. The research has shown that the establishment of cooperatives can improve supply chain performance, thus helping business actors to obtain market information. The structure of the supply chain of essential oils in Indonesia is shown in Figure 1.

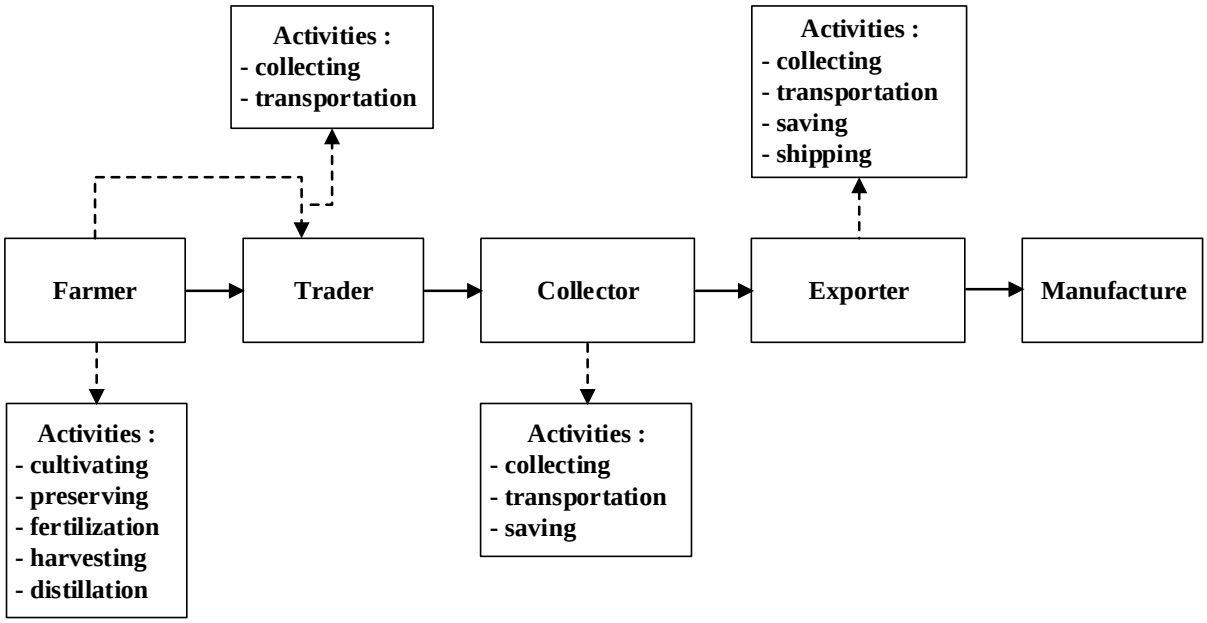

Figure 1. Supply Chain of Essential Oils (Rahmayanti et al., 2018)

Other research has focused on the relationship between essential oils prices and the quality and quantity of production. Fitri and Mohammad (2015) have stated that prices fluctuate and prices tend to be low for essential oils production in Indonesia due to quality that does not meet national/international quality standards. This problem can be caused by planting processes of essential oil plants that are not in accordance with the Standard Operating Procedure (SOP) and still use traditional production technology. Further research, using fuzzy method, has concluded that the quality and quantity of production can be improved by selecting quality seeds of essential oil plants and by adopting improved technology of essential oil production and refining processes (Erni and Marimin, 2005). Further research has shown that the quality and quantity of production also can be improved by providing training to employees and by modifying refining equipment (Salviana, 2012).

Other studies focusing on the impact of price fluctuations on production costs. Fluctuations of essential oils prices cause refiners to suffer a loss due to uncertain production costs (Rahmayanti et al., 2018). A research conducted by Effendy et al. (2019) has shown that there is a significant relationship between production costs and prices of essential oils. Research by Hendrastuti et al. (2012), using Fibonacci optimization technique, has resulted in a price agreement between farmers and refiners in accordance with the production costs incurred.

In all, previous research utilizing econometrics and statistical approaches only considers limited relationships (Lyneis, 2000) and it does not present an integrated view of the system structure that shapes the dynamics of Indonesian essential oils prices. Meanwhile, essential oil market dynamics analysis needs such a comprehensive framework upon which further research could be conducted more systematically. Our research did not conduct a complete literature review but determined research gaps through a selective and systematic literature review. The purpose of this research is to develop a comprehensive framework which can integrate various factors that influence the prices of Indonesian essential oils, using a system dynamics approach.

A system dynamics approach is a suitable tool for understanding the causes of behavior, detecting behavioral changes, and determining factors that predict behavior significantly (Lyneis, 2000; Sterman, 2000). In this research, after identifying factors that influence the dynamics of Indonesian essential oil prices using statistical tools, develops a detailed cause and effect structure from the interrelationships between the main variables. The structure is described in a causal loop diagram.

2 Methodology

Figure 2 shows the research approach of this paper. In the first step, a brief literature review was conducted to determine factors that influence market dynamics of essential oils.

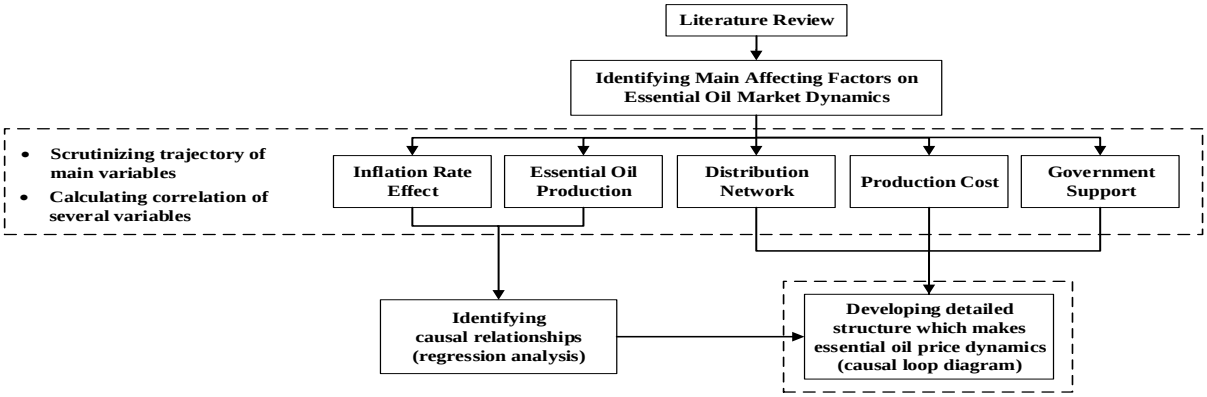

Figure 2. Steps and Research Tools

In the next step, in order to develop a causal loop diagram, it is necessary to analyze market data in order to form hypotheses that explain the dynamics of essential oil prices. The analyses are as follows:

- Examining paths of the main variables that influence essential oils prices (Shone, 2002).
- Calculating correlation of several variables (Boker et al., 2002) which affect essential oils prices.

In this step, several hypotheses were formulated about the impact of relationship between essential oil production and the effect of inflation rates on the dynamics of oil prices. To validate the hypotheses, multiple linear regression analysis was used. Multiple linear regression is a statistical method to determine the pattern of linear relationship between two or more independent variables (X_1, X_2, ..., X_n) and a dependent variable (Y). The model to predict factors that influence essential oils prices has the following form (Ross, 2005):

$$Y = a + b_1X_1 + b_2X_2 + ... + bnXn \quad (1)$$

Annotations:
Y = dependent variable
X_n = independent variable(s)
a = constants
b_n = regression coefficient

The final step was to develop an integrated comprehensive framework using a system dynamics approach by creating a causal loop diagram (Sterman, 2000).

In order to make this research more comprehensive, primary data and secondary data were collected. Primary data were obtained from interviews on 4 essential oil refiners, 1 essential oils collector, 10 collectors of essential oils plants, and 34 farmers. Farmers, collectors of essential oils plants, and essential oil refiners are located in Blitar Regency, while essential oils collector is located in Jakarta. Secondary data, in the form of Indonesian patchouli oil production data, inflation rate, and Indonesian patchouli oil prices, were obtained from various sources, namely Statistics Indonesia, relevant journals, and Bank Indonesia. Case studies were taken from 2001 to 2017. Data on patchouli oil were used as sample because Indonesia is supplier of 90% of world's patchouli oil. Indonesia exports its patchouli oil to the United States, the main market for patchouli oil in the world (Rahmayanti et al., 2018; Sari and Hartono, 2010).

3 Results and Discussion

3.1 Identification of Factors That Influence Market Dynamics of Essential Oils

Factors that influence market dynamics of essential oils are categorized as follows:

1. Fundamental Factors
   Fundamental factors have a long-term impact on market dynamics, which determines the overall trend of oil prices. These factors include essential oils supply and demand, fluctuating essential oil prices in global market, and essential oils marketing patterns (Alighiri et al., 2017).
2. Technical Factors
   These factors have a short-term impact on market dynamics (Widyastuti et al., 2012). One example of technical factors is the production capacity of refinery.

3. Political Factors
   These factors have a medium-term impact on market dynamics. Political factors include government support in providing and delivering information about essential oil prices via related agencies (Suyono and Purwastuti, 2011).

3.2 Analysis of Indonesian Essential Oil Prices

Hypotheses formulated in this research were:

- The prices of Indonesian essential oils are influenced by essential oils production (Fitri and Mohammad, 2015).
- Indonesian essential oil prices are influenced by inflation rate (Rahmayanti et al., 2018).

Factors that influence oil prices can be found using an Ordinary Least Square (OLS) Method. A multiple linear model of function of essential oil prices is presented in the following table.

Table 2.
Results of Multiple Linear Regression of Function of Essential Oil Prices

Regression Statistics	
Multiple R	0.808059276
R Square	0.652959793
Adjusted R Square	0.60338262
Standard Error	3.46295321
Observations	17

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	2	315.884218	157.942109	13.17057348	0.00060626
Residual	14	167.8886291	11.99204493		
Total	16	483.7728471			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	74.01957657	9.586658294	7.721103048	2.06474E-06	
Production of essential oil (ton)	-0.036120151	0.008002207	-4.513773732	0.000486209	
Inflation rate effect (%)	0.763762954	0.345709247	2.209263883	0.044323482	

Table 2 shows that the adjusted R-squared was 0.6034, which means that 60.34% of the diversity of essential oils prices (Y) was explained simultaneously by the diversity of essential oil production (X_1) and inflation rate (X_2), while the remaining 39.66% was explained by other variables that were also influential, but not included in the model. Based on this result, it can be stated that the estimator model matches the data available in this research.

Function analysis result of essential oils prices can be written as follows:

$$Y = 74.0196 - 0.0361X_1^{**} + 0.7638X_2^{**} \quad (2)$$

Annotations:
** = α 5%
Y = Essential oils prices (US$)
X_1 = Essential oils productions (tons)
X_2 = Inflation rate (%)

Simultaneous testing was conducted using statistical test, namely the F-test, in order to test simultaneous influence of independent variables on the dependent variable. The result of F-test analysis has shown a significant level (α) = 0.05, which was more than the p-value = 0.00060626. It can be concluded that at the same time, essential oils production and inflation rate affect essential oils prices.

Furthermore, partial testing was conducted using statistical test, namely t-test, to partially test the influence of each independent variable (X_i) on the dependent variable (Y). The influence of each input factor on prices of essential oils can be described as follows:

1) Essential Oils Production (X_1)

The result of the t-test has shown a significant level (α) = 0.05, which was more than p-value = 0.000486209. It can be concluded that the production of essential oils affects essential oils prices. Meanwhile, the regression equation has shown that the coefficient of essential oil production was negative (-0.0361), which means that there was a negative correlation between essential oils production and essential oils prices. It indicates that an increase of 5% essential oils production will decrease essential oils prices by 0.0361%, with assumption that other variables are constant.

2) Inflation Rate (X_2)

The result of the t-test has shown a significant level (α) = 0.05, which was more than p-value = 0.044323482. It can be concluded that inflation rate has an influence on essential oils prices. Partial testing has shown that inflation rate has a regression coefficient of 0.7638. It indicates that an increase of 5% inflation rate will increase essential oils prices by 0.7638%, with assumption that other variables are constant.

Based on actual data and predictive data from regression analysis, Figure 3 shows the plot that connects independent variables, which were essential oils production and inflation rate, with the dependent variable, which was the price of essential oil. Predictive data were obtained by using the equation of regression analysis formula.

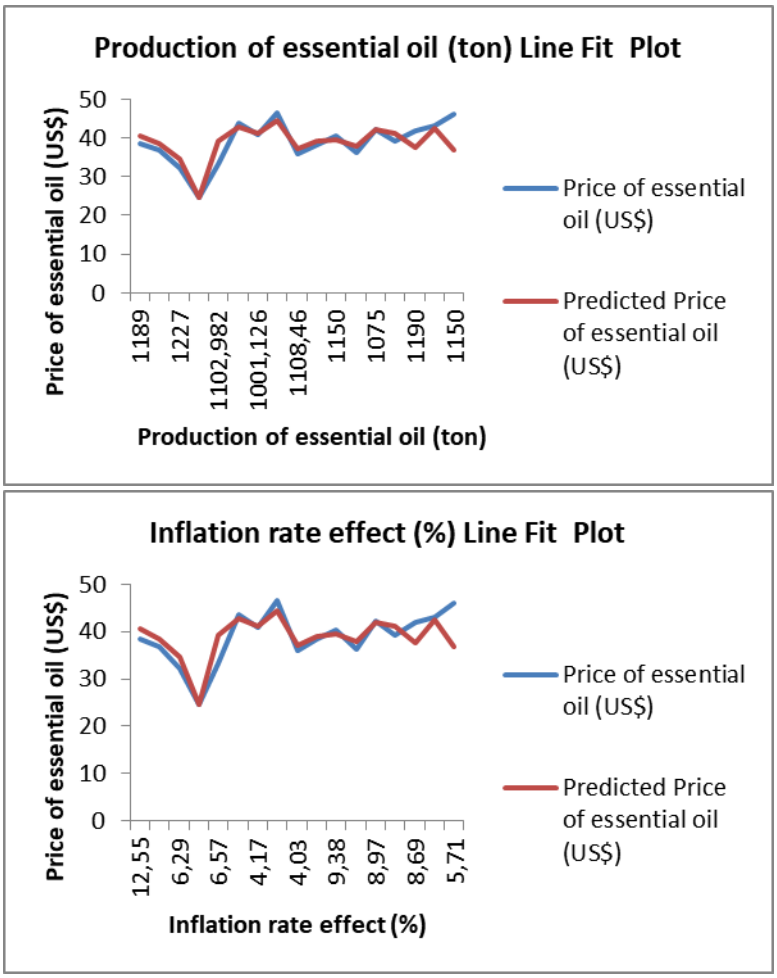

Figure 3. The Differences between Historical Data and Regression Results

3.3 Conceptual Framework for Indonesian Essential Oil Prices (Causal Loop Diagram)

The dynamics of Indonesian essential oils prices is influenced by various factors. Statistical analysis using multiple regression has showed that essential oils prices are affected by essential oil production and inflation rate. The results of the analysis showed that essential oil production has a negative influence on essential oils prices, meaning that if production increases then prices will decrease. Meanwhile, inflation rate has a positive influence on essential oils prices. This means that if inflation rate increases, the prices of essential oils will also increase. However, statistical analysis only shows limited relationship between several factors and the dynamics of essential oil prices. Therefore, a system dynamics approach was used to integrate various factors that influence the prices of Indonesian essential oils. The integration was presented in the form of a conceptual framework based on literature review and a statistical analysis. The conceptual framework integrates factors that influence the dynamics of Indonesian essential oils prices, as shown in Figure 4.

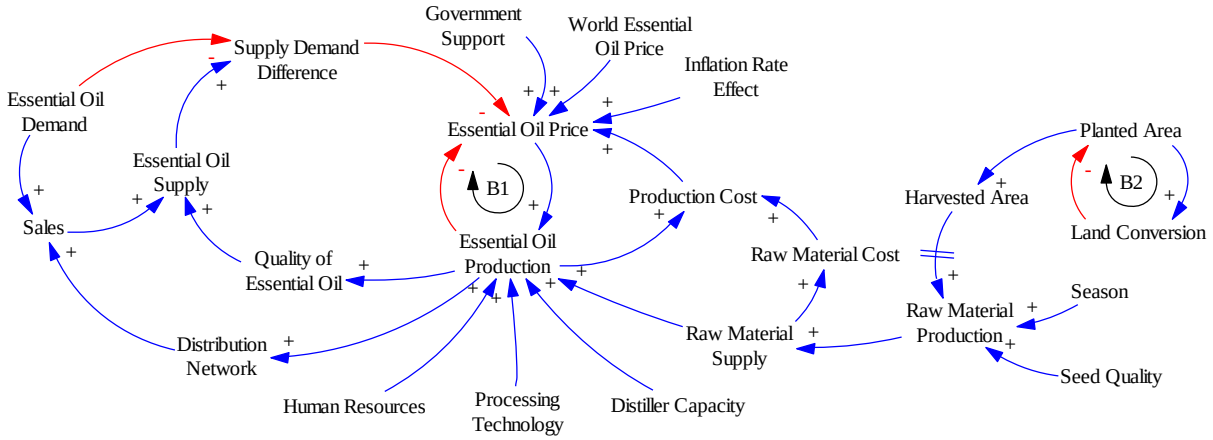

Figure 4. Conceptual Model of The Dynamics of Indonesian Essential Oils Prices

The imbalance between demand for essential oils and supply of essential oils, global essential oil prices, and essential oils production affect Indonesian essential oils prices (Alighiri et al., 2017). Besides production costs (Hendrastuti et al., 2012), government support (Salviana, 2012), and inflation rate (Rahmayanti et al., 2018) also have a direct influence on Indonesian essential oils prices.

The imbalance between supply and demand has a negative influence on Indonesian essential oils prices. This is in accordance with the law of demand which states that the quantity demanded for a good or service rises as the price falls and vice versa, ceteris paribus (Mankiw, 2007). The imbalance between supply of essential oils and demand for essential oils is indirectly influenced by marketing distribution network. Product marketing which is still through intermediaries results in a long marketing distribution and it causes inefficient supply chain performance (Alighiri et al., 2017). Later, the imbalance causes a decline in the prices of Indonesian essential oils.

Government support is one variable that affects essential oils prices as well. Government support has a positive impact on Indonesian essential oils prices, as stated in Regulation of the Minister of Industry No. 136/M-IND/PER/10/2009 concerning road map for developing industrial cluster of essential oils. Its broad vision is to make Indonesia the center of high-quality essential oils in 2025. Policy strategies for the essential oil agro-industry must be able to solve all problems and reach all agro-industry actors, so that essential oil agro-industry actors can benefit from those policies. It is also necessary for related agencies to provide information about essential oils prices for stakeholders because information about market has an impact on price stability. A policy that can address all aspects is not easy to develop and requires a comprehensive understanding of the system.

In addition, Indonesian essential oils prices are also influenced by global essential oils prices and it causes fluctuations in essential oils prices. This condition certainly does not benefit business actors. Farmers will have uncertain income and even have the possibility of loss, while refiners also bear uncertain production costs (Hendrastuti et al., 2012). The results of interviews with essential oils agro-industry entrepreneurs have revealed that fluctuating prices of essential oils cause the interest of entrepreneurs in essential oils agro-industry to decline, so that many entrepreneurs prefer other more profitable businesses. Large number of business actors who turn to other businesses causes the production of essential oils to decline.

Loop B1 shows the relationship between essentials oil production and prices. Production has a negative relationship with essential oils prices because if production increases then essential oils prices decrease. This is in accordance with the research conducted by Wheat (2007) which has stated that if producers increase their production, prices will decrease. In the meantime, essential oils production is influenced directly by the technology applied, supply of raw materials, human resources, and capacity of refinery machines (Salviana, 2012). So far, essential oils production has not implemented GMP (Good Manufacturing Practices). Essential oil processing technology needs to be innovated in order to increase production (Fitri and Mohammad, 2015). The increase made on these factors will have an impact on increasing Indonesian essential oil production.

Supply of raw materials is directly affected by the production of raw materials from essential oil plants. The production of raw materials is influenced by harvesting area, seed quality, and seasonal factors. Loop B2 shows the relationship between land-use change and planting area. Land-use change has a negative relationship with planting area. If land-use change increases, planting area will decrease (Indayani et al., 2017). The implementation of extensification of essential oils plants can increase raw material production (Rahmayanti et al., 2017), but still land-use change indirectly affects raw material production from essential oil plants. Another factor that influences the production of raw materials is the quality of seed. The use of high-quality seed will increase the production of raw materials (Erni and Marimin, 2005).

4 Conclusion

The main problem of Indonesian essential oils marketing is fluctuating prices. Previous studies have not shown any integration between factors that influence the dynamics of essential oil prices. In this research, factors that influence the dynamics of Indonesian essential oil prices are determined through literature review. In the next step, hypotheses are formulated and validated through regression analysis. The results of the regression analysis have shown that essential oil prices are influenced by production and inflation rates. Regression analysis has not been able to explain the complexity of the factors that influence the dynamics of Indonesian essential oil prices.

In this research, a conceptual framework was developed to integrate factors that influence the dynamics of Indonesian essential oil prices in detail. Factors that influence essential oils prices directly are essential oil production, inflation, production costs, global essential oil prices, and imbalance between supply and demand. From the conceptual framework, it can be seen a feedback structure that illustrates the dynamics of Indonesian essential oil market.

The conceptual framework was developed using a system dynamics approach. The framework is a qualitative phase of a dynamic system which can be used for further research by developing a quantitative phase related to market dynamics of essential oils. Furthermore, this conceptual framework is expected to be used by policy makers in developing an Indonesian essential oils marketing strategy.

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