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A Study of Sustainable Palm Oil Model as Energy Source Considering the Economic, Social, Enviromental and Security Balance Variables

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ABSTRACT

As energy source, palm oil has become a serious concern for various palm oil stakeholders because it is related to the vegetable oil needs for 7.7 billion people in the world. Nagan Raya District is a central of palm oil in the western region of Aceh and inseparable from the issue of sustainability. This study is designed using quantitative approach. The data collected by self-administered questionnaire to 300 palm stakeholders. The results indicated that the social variable has strong contribution to sustain the palm oil as one of primary energy source. Also, the economic, environmental and security variables have moderate strength in sustainable palm oil. In addition, the sustainable palm oil model which is built from 20 indicators depicts that the concern of plantation companies in fostering smallholders and communities around the plantation is the strongest indicator, while the indicator of protecting endangered plant and animal species and predatory animals in the natural cycle is the weakest indicator of variables in influencing sustainable palm oil in Nagan Raya Regency.

Keywords: Palm Oil, Economic, Social, Environment, Security Balance, Aceh's Palm oil Production
JEL Classifications: Q12, Q15, Q16, Q43

1. INTRODUCTION

Sustainable development has become an interesting issue discussed around the world because it is related to the survival and livelihoods of 7.7 billion people on earth today. Along with the development of science and culture, the concept of sustainability has also been a concern of the scientific community and has been written extensively in various internationally reputed scientific journals (Lozano et al., 2013; Fabbrizzi et al., 2016). As a concept that refers to meeting current needs without compromising the needs of future generations, the sustainability of the agricultural sector is believed to provide good income for the community, especially farmers (Dehen et al., 2013; Pirker et al., 2016).

A country or region that wants to achieve sustainable development must start from the agricultural sector with commodities that have real growth, environmentally friendly, market-oriented, high competitiveness, and integrated with other sectors (Todaro, 2011). Palm oil products and their derivatives are plantation commodities that have the sustainable criteria (Pirker et al., 2016). Today, sustainable palm oil is receiving very serious attention from many palm oil stakeholders (Basiron, 2007; Ivancic and Koh, 2016). This can be seen from the formation of the roundtable sustainable palm oil (RSPO) organization by global palm oil stakeholders, Indonesian sustainable palm oil (ISPO) by the Indonesian government (Cattau et al., 2015; Hidayat et al., 2018), and Malaysian sustainable palm oil (MSPO) by the Malaysian government (Kuntom et al., 2015; Vogelgeseng et al., 2018). These organizations set the standard principles and criteria for sustainable management of palm oil.

As a producer of vegetable oil, palm oil provides 37.60% of the world's vegetable oil (USDA, 2017). Domestically, palm oil

provides IDR. 265 trillion of export value, providing 16.3 million jobs, replacing the use of 2.3 million kilo liters of diesel through the Mandatory Biodiesel program on August 2015 - April 2018 with foreign exchange savings of 2.26 billion US $ or IDR. 30 trillion from imported diesel (Indonesian Ministry of Agriculture, 2019). However, the development of palm oil also has an impact on human life and environmental balance so it needs to be managed appropriately through sustainable concepts (Kospa, 2016; Khatun et al., 2017; Mongabay, 2015; Hooijer et al., 2006; Carius, 2007)..

In Aceh which is a westernmost point of Indonesia, palm oil has long time been an important crop for the people's economy. Aceh provides 537 thousand hectares of 14.03 million hectares of Indonesian palm oil or ranks 9th (BPS Indonesia, 2018). Nagan Raya District as a research area is the region that has the most extensive palm oil plantations in Aceh (Saifuddin et al., 2015), and as a palm oil production center for the west coast region (Dinas Pertanian dan Perkebunan Aceh, 2018).

Palm oil has been known in Nagan Raya District since the Dutch Colonial period, where the company of Belgian Sociate Des Cautthautc Medan SA is now called PT. Socfin Indonesia which was the first or in 1926 establishing an palm oil plantation in Nagan Raya District (Gustina, 2011; Suprianto et al., 2015). Soil and climate conditions that are very suitable for palm oil plantations make palm oil develop well in Nagan Raya District. In 2018, palm oil plantations in Nagan Raya District were recorded at 100,547 hectares consisting of 47,756 hectares of community plantations and 52,791 hectares of company plantations. This area occupies 28.37% of the Nagan Raya District area. The community's palm oil plantations are owned by 21,245 HF farmers or 51.88% of the 40,950 HF communities of Nagan Raya District. If it is seen from the contribution to community income, community palm oil produces 1,046,365 tons of FFB per year with a value of IDR. 1,046,365,000,000. This amount was allocated to farmers as much as IDR. 42,252,299, - per HF/year or IDR. 4,104,248, - per HF/month (Dishutbun Nagan Raya, 2018; BPS Nagan Raya, 2018).

As a production center with a large potential for palm oil in Nagan Raya District, sustainable management of palm oil in Nagan Raya District is vital to maintain. So that land conflicts, company conflicts with communities, floods, forest fires and excessive exploitation of peatlands no longer occur in Nagan Raya District (Mongaby, 13/2/15; Dishutbun Nagan Raya, 2018). As an initial step to overcome this, information on sustainable palm oil in Nagan Raya District needs to be examined, so that the condition of palm oil based on the principles and criteria of sustainability can be found. The results of this study are expected to be a guideline to minimize failures and adverse impacts of palm oil development in Nagan Raya District.

2. MATERIALS AND METHODS

2.1. Time and Location of Research
This research was carried out in Nagan Raya District, Aceh Province on May-October 2019. The selection of research sites is based on the consideration that Nagan Raya District is a production center with the largest palm oil land in Aceh, and palm oil has

an important role in the economy of the people of Nagan Raya Regency.

2.2. Population and Sample
The population of this research are all stakeholders of sustainable palm oil in Nagan Raya District with 300 respondents consisting of: (1) palm oil farmers of 110 persons; (2) palm oil plantation employees as many as 68 persons; (3) ex-combatants from the free aceh movement (GAM) of 27 persons; (4) government employees (PNS) of 27 persons; (5) academics/NGOs as many as 14 persons; (6) plantation entrepreneurs of 27 persons; (7) TNI/Polri of 27 persons. Sampling is carried out intentionally or purposively, in which stakeholders who are involved in and understood palm oil plantations, and are also palm oil farmers. As for respondents from GAM ex-combatants, sampling is taken by Snow Ball Sampling.

2.3. Research Variables and Indicators
According to Sugiyono, (2013), research variables are a description of the attributes, traits, values or activities that have certain variations set by researchers to study and to conclude. The variables of this study are the Sustainability of Palm Oil Development in Nagan Raya District (*SD*), Economic Balance (*EqE*), Social Balance (*EqS*), Environmental Balance (*EqL*), and Security Balance (*EqK*).

2.4. Data Collection
This research was conducted descriptively using primary and secondary data. Primary data is obtained from the answers to questions raised by respondents refer to the research questionnaire with answers arranged based on a Likert scale, such as, very corresponding score 5; corresponding score 4; neutral score 3; not corresponding score 2; very not corresponding score 1. While secondary data is obtained from literature, institutions or organizations related to research refer Table 1.

2.5. Data Analysis
To measure the accuracy of research instruments or qustioner, validity analysis is carried out using Bivariate Pearson correlation (product moment pearson) and using Cronbach's Alpha method for reliability analysis. Furthermore, for the palm oil sustainability model test refers to the analysis of functions and multiple linear regression with the following formulation:

$$SD = f(EqE, EqS, EqL, EqK) \tag{1}$$

SD = Sustainable Palm Oil in Nagan Raya District.
EqE = Economic balance
EqS = Social balance
EqL = Environmental balance
EqK = Security balance

$$EqE = f(E_1, E_2, E_3, E_4, E_5) \tag{2}$$

$$EqS = f(S_1, S_2, S_3, S_4, S_5) \tag{3}$$

$$EqL = f(L_1, L_2, L_3, L_4, L_5) \tag{4}$$

$$EqK = f(K_1, K_2, K_3, K_4, K_5) \tag{5}$$

$$SD = (E_1, E_2, E_3, E_4, E_5) (S_1, S_2, S_3, S_4, S_5) (L_1, L_2, L_3, L_4, L_5)$$
$$(K_1, K_2, K_3, K_4, K_5)) \tag{6}$$

$$EqE = a_{01}+a_1E_1+a_2E_2+a_3E_3+a_4E_4+a_5E_5+e \tag{7}$$

$$EqS = a_{02}+b_1S_1+b_2S_2+b_3S_3+b_4S_4+b_5S_5+e \tag{8}$$

$$EqL = a_{03}+c_1L_1+c_2L_2+c_3L_3+c_4L_4+c_5L_5+e \tag{9}$$

$$EqK = a_{04}+d_1K_1+d_2K_2+d_3K_3+d_4K_4+d_5K_5+e \tag{10}$$

$$SD = a_{01}+a_{02}+a_{03}+a_{04}+a_1E_1+a_2E_2+a_3E_3+a_4E_4+a_5E_5+b_1S_1+$$
$$b_2S_2+b_3S_3+b_4S_4+b_5S_5+c_1L_1+c_2L_2+c_3L_3+c_4L_4+c_5L_5+d_1K_1+d_2$$
$$K_2+d_3K_3+d_4K_4+d_5K_5+e \tag{11}$$

$$SD = (a_{01}+\ldots+a_{0n})+(a_1E_1+\ldots+a_nE_n)+(b_1S_1+\ldots+b_nS_n)+$$
$$(c_1L_1+\ldots+c_nL_n)+(d_1K_1+\ldots+d_nK_n)+e \tag{12}$$

In addition to knowing the relationship between the sustainable palm oil balance variable and the indicator variable, a correlation analysis (R) and determination analysis (R^2) are done. To find out the effect of indicator variables on the sustainability balance variable, the F test and t test are conducted.

3. RESULTS AND DISCUSSION

3.1. Validity and Reliability Analysis
Bivariate person validity test is done to compare between r count and r table by correlating each item score with the total score. The results of the validity test of the dependent and independent variables of sustainable palm oil on economic balance (X_1), social (X_2), environment (X_3), and security (X_4), each of them have a total pearson correlation score greater than r pearson product moment table 0.113 at n = 300. This means that all questions used as research indicators are declared valid and appropriate to use in research. Furthermore, the reliability test conducted show that the Croncbach's alpha value of the dependent and independent variables of sustainable palm oil is over 0.6, which means that all questions used as indicators of research are reliable or consistent to be used by different respondents (Priyatno, 2010; Sujarweni, 2014).

3.2. Correlation and Determination Analysis
Correlation analysis (R) in the Summary Model Table 2 is a value used to determine the relationship between two or more independent variables (X) to the dependent variable (Y) simultaneously. Guidelines that can be used to interpret the correlation coefficient (R) are: 0.00-0.199 very low; 0.200-0.399 low; 0.400-0.599 moderate; 0.600-0.799 strong; and 0.800-1.00 very strong (Priyatno, 2010). Correlation value (R) on the balance of Economy, Environment and Security between 0.400 and 0.599 shows moderate strength, while Social balance between 0.600-0.799 shows strong strength. Thus, the indicator as an independent variable depicts moderate to strong power in explaining sustainable palm oil in Nagan Raya District.

Furthermore, the results of the determination (R^2) analysis show that if the value goes to near 1, the regression model is stronger explaining the relationship of indicators to variables, and vice versa (Priyatno, 2010; Sujarweni, 2014). The coefficient value of determination (R^2), Economic Balance is 0,355, Social of 0,452, Environment as many as 0,293, and Security 0,324. This data shows that the indicator as an independent variable can only explain 29.30% - 45.20% of the condition of sustainable palm oil in Nagan Raya District.

3.3. Simultaneous and Partial Relationships Testing (F-stat) and (t-stat)
The simultaneous influence test (Test F) is a test used to find out whether the independent variables simultaneously affect the dependent variable. The analysis results of variant analysis (Anava) in Table 2 are obtained the calculated F value of 24.404-48.551 which is greater than the F value of the table of 2.402. This means that the dependent variable, the balance of the Economy, Social, Environment and Security is influenced simultaneously by indicators which are independent variables of sustainable palm oil.

Moreover, the partial effect test (t-test) is a test used to find out whether the independent variable partially influences the dependent variable. The partial t-test value of each indicator of the independent variable in Table 2 for the Economic balance variable, Social, Environment and Safety is greater than the t value of table as many as 1.968 except for the indicator L_2. This

Table 1: The summary of variables and indicators

EqE = Economic balance		EqS=Social balance	
E1	Management and financial planning	S1	Transparency of information and data
E2	Revenue from palm oil plantation activities	S2	Compliance with laws and land ownership status
E3	The economy of the palm oil farming family	S3	Social conditions of the community
E4	Partnership / cooperation in the business of palm oil plantations with communities around the plantation	S4	The concern of plantation companies in fostering planters and the community around the plantation
E5	Regional economy	S5	Low discrimination and protection of employees, child labor, gender and labor organizations
EqL=Environmental balance		**EqK=Security balance**	
L1	Conservation practice	K1	Land conflict
L2	Maintain endangered plant and animal species and predatory animals in natural cycles	K2	The company's conflict with workers and the community around the plantation is not a land issue
L3	Do not use fire in land clearing and guard against land fires	K3	Reintegration of GAM Ex-combatants
L4	Does not damage the environment and cause critical land	K4	Regional security in carrying out development
L5	Do not use restricted land and protected areas	K5	The low theft of FFB and other crimes

Sources: RSPO (2018); Kementan (2013); Permentan No. 26, 2007

Table 2: The result of regression analysis for various proposed model

Economic balance (EqE)					Social balance (EqS)				
Model	Unstandardized B	Standardized coefficients	Model summary	Anova	Model	Unstandardized B	Standardized coefficients	Model summary	Anova
		t	Sign				t	Sign		
Cons	0.823			R=0.596	F=32.473	Cons	0.403			R=0.673	F=48.551
E_1	0.215	3.682	0.000	R^2=0.355	Sign=0.000	S_1	0.204	3.124	0.002	R^2=0.452	Sign=0.000
E_2	0.194	3.518	0.001			S_2	0.164	2.617	0.009		
E_3	0.152	2.286	0.023			S_3	0.167	2.125	0.034		
E_4	0.112	2.648	0.009	F Table $_{\alpha\,0.05}$=2.244		S_4	0.235	4.803	0.000	F Table $_{\alpha\,0.05}$=2.244	
E_5	0.126	2.822	0.005	t Table $_{\alpha\,0.05}$=1.968		S_5	0.142	2.069	0.039	t Table $_{\alpha\,0.05}$=1.968	
Environmental balance (EqL)					Security balance (EqK)				
Model	Unstandardized B	Standardized Coefficients	Model Summery	Anova	Model	Unstandardized B	Standardized Coefficients	Model Summery	Anova
		t	Sign				t	Sign		
Cons	1.347			R=0.542	F=24.408	Cons	1.085			R=0.569	F=28.141
L_1	0.101	2.071	0.039	R^2=0.293	Sign=0.000	K_1	0.121	2.307	0.022	R^2=0.324	Sign=0.000
L_2	0.021	1.561	0.120			K_2	0.138	1.977	0.049		
L_3	0.172	2.955	0.003			K_3	0.234	3.911	0.000		
L_4	0.159	2.652	0.008	F Table $_{\alpha\,0.05}$=2.244		K_4	0.151	2.214	0.028	F Table $_{\alpha\,0.05}$=2.244	
L_5	0.180	2.394	0.017	t Table $_{\alpha\,0.05}$=1.968		K_5	0.103	2.000	0.046	t Table $_{\alpha\,0.05}$=1.968	

Source: Analyzed data (2020)

condition shows that each variable indicator partially influences the dependent variable of sustainable palm oil balance in Nagan Raya District, except indicators L_2 or efforts to protect plant species, endangered animals and predators in the natural cycle do not affect the environmentally balance variable of sustainable palm oil.

3.4. Palm Oil Sustainable Model Analysis

Based on data of Undestandarized B Table 2, analysis results of research data can be arranged sustainable model of palm oil as follows:

$$EqE = 0.823+0.215E_1+0.194E_2+0.152E_3+0.112E_4+0.126E_5 \quad (13)$$

$$EqS = 0.403+0.204S_1+0.164S_2+0.167S_3+0.235S_4+0.142S_5 \quad (14)$$

$$EqL = 1.347+0.101L_1+0.021L_2+0.172L_3+0.159L_4+0.180L_5 \quad (15)$$

$$EqK = 1.085+0.121K_1+0.138K_2+0.234K_3+0.151K_4+0.103K_5 \quad (16)$$

$$SD = 0.823+0.403+1.347+1.085+0.215E_1+0.194E_2+0.152E_3+0.112E_4+0.126E_5+0.204S_1+0.164S_2+0.167S_3+0.235S_4+0.142S_5+0.101L_1+0.021L_2+0.172L_3+0.159L_4+0.180L_5+0.121K_1+0.138K_2+0.234K_3+0.151K_4+0.103K_5 \quad (17)$$

$$SD = 3.658+0.215E_1+0.194E_2+0.152E_3+0.112E_4+0.126E_5+0.204S_1+0.164S_2+0.167S_3+0.235S_4+0.142S_5+0.101L_1+0.021L_2+0.172L_3+0.159L_4+0.180L_5+0.121K_1+0.138K_2+0.234K_3+0.151K_4+0.103K_5 \quad (18)$$

Based on the model formulation (18), sustainable palm oil in Nagan Raya District will occur at 3,657 units on a scale of 1-5 if the indicator as an independent variable is absent or ignored, and this value is high. This is consistent with the results of the correlation analysis (R) which shows that indicators of economic, environmental and security variables have moderate strength or are between 0.400-0.599, only social indicator has strong strength

or is between 0.600-0.799. Furthermore, based on the analysis of determination (R^2), the indicator of sustainable palm oil balance is only able to result in 29.30-45.20% of palm oil sustainability balance variable in Nagan Raya District, where the excess of the condition of palm oil sustainability is caused by other factors outside research.

In addition, based on its strength in influencing sustainable palm oil, the indicators for sustainability variables can be sorted from strong to weak in the following order: (1) (S4) Concern of plantation companies in fostering planters and communities around the plantation; (2) (K3) Reintegration of GAM ex-Combatants; (3) (E1) Management and financial planning; (4) (S1) Transparency of information and data; (5) (E2) Revenue from palm oil plantation activities; (6) (L5) Do not use restricted land and protected areas; (7) (L3) Do not use fire in land clearing and guard against land fires; (8) (S3) Social conditions of the community; (9) (S2) Compliance with laws and land ownership status; (10) (L4) Does not damage the environment and cause critical land; (11) (E3) The economy of the palm oil farmer family; (12) (K4) Regional security in carrying out development; (13) (S5) Low discrimination and protection to employees, child labor, gender and labor organizations; (14) (K2) Conflict between the company and workers and the community around the plantation against non-land issues; (15) (E5) Regional economy; (16) (K1) Land conflicts; (17) (E4) Business partnership of palm oil plantations with communities around the plantation; (18) (K5) Low theft of FFB and other crimes; (19) (L1) Conservation practices; (20) (L2) Maintain endangered plant and animal species and predatory animals in natural cycles.

Basically, the factors forming sustainability will be different from one region to another, in which each variable and factor will affect sustainability in accordance with the goals, needs and conditions of the local community (Munasinghe, 1993). The position or sequence of indicators for palm oil sustainability variables in

Nagan Raya District as the model of research results shows the strength of each indicator in influencing the sustainability. In the dynamic environment of changes that continuously occur, knowing and understanding the sustainability variable are very important to prepare for the certainty of sustainable palm oil in Nagan Raya District.

The concern of plantation companies in fostering planters and the community around the plantation is the most powerful factor in influencing the sustainability of palm oil. This shows that plantation companies play a very important role in the sustainability of palm oil in Nagan Raya District. Palm oil plantation companies in Nagan Raya District are basically as natural teachers for palm oil farmers, farmers will emulate or imitate what companies do in the cultivation of palm oil. This is because copying or imitating behavior is a strong and dominant nature for humans compared to other living things (Farmer et al., 2018). Actions to imitate the cultivation of palm oil by farmers will be even better if the company provides guidance to the community and smallholders. Community and farmer coaching by companies can be done through compensation of CSR programs that are mandatory for each plantation company (Syahza, 2007), and the company is also obliged to facilitate the development of plasma plantations as many as 20% of the company's plantation area Law of the Republic of Indonesia, (2014).

However, maintaining endangered plant and animal species and predatory animals in the natural cycle is the weakest indicator of influencing the development of sustainable palm oil. This relates to the condition of the Nagan Raya District area which has known and developed palm oil plants. Plantation company, Belgian Sociate Des Cautthautc Medan SA which is now called PT. Socfin Indonesia during the Dutch Colonial period of 1926 or the 1st time established palm oil plantations in Nagan Raya District (Gustina, 2011; Suprianto et al., 2015) Fauzi and Oxtavianus, (2014). As a result, endangered plant and animal species and predatory animals in the natural cycle have long been no longer a concern in palm oil sustainability. Endangered plant and animal species have long been lost due to hunting and land conversion to settlements and land for cultivation (Inubushi et al., 2003; Saputri, 2018). This is because the development of urban areas almost no one has the goal of conserving natural resources or preserving the balance between the initial ecosystem components in which cities are developed (Nita et al, 2015). Therefore, if the preservation of endangered plant and animal species and predatory animals in the natural cycle is a sustainable goal in the area of development, so these conservation efforts must be the responsibility of the regional and central governments as well as communities to implement an optimal approach in regulating aspects related with regional planning.

4. CONCLUSION

In conclusion, the palm oil in Nagan Raya district needs more attention because it is the central of Aceh's palm oil, which provides direct employment and income as many as IDR 4.10 million/month for 51.88% head of family in Nagan Raya. Furthermore, the social variable indicator shows strong power to sustainable palm oil, but the economic, environmental and security variable indicators only highlight moderate strength. If the variable indicators are ignored, the sustainable palm oil in Nagan Raya District will occur 3.657 units on a scale of 1-5, and this value is high.

Based on the sustainable palm oil model built from the 20 indicators tested, it shows that indicators of the concern of plantation companies in fostering farmers and communities around the plantation are the strongest indicators. Whereas the indicators to protect endangered plant and animal species and predatory animals in the natural cycle are the weakest variable indicators to influence sustainable palm oil in Nagan Raya District.

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