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GAP ANALYSIS AND PROJECTION MODEL OF INDONESIAN PALM OIL-BASED FATTY ACID AND FATTY ALCOHOL INDUSTRY

ANALISIS KESENJANGAN DAN MODEL PRAKIRAAN INDUSTRI ASAM DAN ALKOHOL LEMAK BERBASIS MINYAK KELAPA SAWIT DI INDONESIA

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ABSTRAK

Asam dan alkohol lemak berbasis minyak kelapa sawit termasuk oleokimia yang paling penting. Tujuan utama penelitian ini adalah menganalisis kesenjangan antara kinerja saat ini dengan kinerja yang diharapkan untuk industri asam lemak dan alkohol lemak berbasis minyak kelapa sawit di Indonesia, menggunakan kerangka penilaian daya saing World Economic Forum (WEF). Tujuan lain dari penelitian ini adalah melakukan prakiraan jumlah produksi, ekspor, impor, pasokan domestik, dan konsumsi industri ini. Penelitian ini menggunakan metode kajian pustaka, wawancara secara mendalam, dan kuesioner untuk mengumpulkan pendapat para pakar dan/atau praktisi industri ini, terhadap kinerja saat ini dan kinerja yang diharapkan. Tes non-parametrik Mann-Whitney digunakan untuk menilai signifikansi perbedaan antara kedua kinerja tersebut. Hasil penelitian menunjukkan bahwa faktor dengan kesenjangan terbesar antara kinerja saat ini dengan kinerja yang diharapkan untuk industri ini adalah faktor persyaratan dasar, dan kesenjangan terkecil adalah faktor pendorong efisiensi. Hasil penelitian juga menunjukkan bahwa terdapat perbedaan signifikan antara kinerja saat ini dengan kinerja yang diharapkan pada α = 5% untuk semua sub-faktor, faktor, dan total WEF. Hasil penelitian juga menunjukkan bahwa dari tiga model prakiraan yang digunakan dalam penelitian ini, tidak ada satu pun dari ketiga model prakiraan tersebut yang cocok digunakan untuk semua prakiraan yang dilakukan atas industri ini.

*Kata kunci**:** alkohol lemak, analisis kesenjangan, asam lemak, daya saing, prakiraan*

ABSTRACT

Palm oil-based fatty acids and fatty alcohols are the most important oleochemicals. The primary aim of this study was to identify the gap between current and expected performance of Indonesian palm oil-based fatty acid and fatty alcohol industry, using competitiveness framework developed by the World Economic Forum (WEF). The secondary aims of the study was to estimate production, export, import, domestic supply, and consumption of the industry. This study used in-depth interview and questionnaire methods to gather opinions from the experts and/or practitioners of the industry of current and expected performance of the industry. The non-parametric Mann-Whitney test was used to assess the differences between current and expected performance. The results of this study show that factor having the biggest gap using WEF competitiveness framework was basic requirements while factor having the smallest gap was efficiency enhancers.The results of this study also show significant differences between current and expected performances of the industry at α = 5% for all sub-factors, factors, and total WEF competitiveness. The results also show that from three projection models used in this study, there was no model best suited to projections applied of the industry.

Keywords**:** competitiveness, fatty acids, fatty alcohols, forecasting, gap analysis

INTRODUCTION

Oleochemicals are chemicals derived from natural oils or fats (from plants or animals). Basic oleochemicals consist of fatty acids, fatty alcohols, methyl esters, fatty amines, and glycerol. Example of derivative products of oleochemicals for example are solid soap, detergent, shampoo, softener, cosmetics, additives for the plastic, rubber, lubricant industries, and many others. Raw materials being used in the production of oleochemicals are tallow, stearin, and lauric oils (LMC International, 2009).

World demand on oleochemicals is increasing each year. The increasing world demand has been due to increasing application of oleochemicals in a wide variety of daily needs products, increasing number of world population, rising number of middle class population, and increasing income per capita in many countries. The increase of world demand on oleochemicals has also been caused by the advantages of oleochemicals over petrochemicals (chemicals derived from petroleum), such as lower prices, made from renewable sources, and more environmentally

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friendly (Yoyo *et al*., 2014). This study focused on the Indonesian palm oil-based fatty acids and fatty alcohols as the most important basic oleochemicals, and the fact that Indonesia is the largest crude palm oil (CPO) and crude palm kernel oil (CPKO) producer in the world.

Geographically, there are important differences between the major oleochemicals supply and demand centers, and these have significant implications for trade flows and patterns of investment in productive capacity (LMC International, 2009). Fatty alcohol production is balanced across the three major world regions, namely North America, Europe, and South East Asia compared to fatty acid production. Fatty acid consumption is concentrated in the more developed countries of the world, with Europe and North America prominent. Demand in South East Asia is also significant as much fatty acid is converted locally into soap/soap chips and fatty alcohol, which are then exported. Fatty alcohol consumption is even more centred upon North America and Europe.

Indonesian CPO and CPKO export in 2012 (8.1 million tonnes) is higher than that of Malaysia (4.7 million tonnes). In 2012, Indonesia (12.6 million tonnes) is still less than Malaysia (16.4 million tonnes) in exporting CPO and CPKO derivative products including palm oil-based fatty acids and fatty alcohols (GIMNI, 2013; MPOB, 2013). The importing countries of Indonesian CPO and CPKO, such as India and China, are more advance in the development of palm oil-based fatty acid and fatty alcohol industries.

This study focused on the competitiveness of Indonesian palm oil-based fatty acid and fatty alcohol industry by identifying the gap between current and expected performance of the industry, using competitiveness framework being developed by WEF. Nation competitiveness is the set of factors, policies, and institutions that affect the level of productivity of a country (WEF, 2009). Competitiveness is rooted in a nation's microeconomic fundamentals, manifested in the sophistication of its companies and the quality of its microeconomic business environment (Snowdon and Stonehouse, 2006). Competitiveness represents, now more than ever, one of the most desirable attribute of an entity (country, region or firm) that is looking for on the global arena (Ogrean, 2010).

This study focused on projected of several aspects of Indonesian palm oil-based fatty acid and fatty alcohol industry, namely production, export, import, domestic supply, and consumption. Projection is a prediction of values of a variable based on historical values of the variable. Projection is based on data pattern or behavior in the past. Projection models used in this study were trend analysis and decomposition model. Selection of trend analysis and decomposition model is due to the data availability that is neither so long nor seasonal. Trend analysis models used in this study were linear and exponential models.

Previous studies on Indonesian palm oil industry and its competitiveness had been conducted by several researchers. Simanjuntak (1992) examined the factors affecting the competitiveness of the Indonesian palm oil. A similar study conducted by Vidyatmoko and Zubair (2002) analyzed the factors affecting palm oil supply and demand in Indonesia and the world. Said-Didu (2000) focused on the design of decision support system on the development of Indonesian palm agro-industry, Sugiyanto (2002) studied the effect of liberalization on Indonesian palm oil market, and Chalil (2008) for the impact of asymmetric duopoly in the Indonesian palm oil industry. Competitive advantage analysis of palm oil-based products in Indonesia has been studied by Usman (2003). Pahan (2011) conducted a study regarding the development of the Indonesian palm oil industrial cluster. On the other hand, Liwang (2011) conducted a study to analyze the dynamics of oil palm seed market in Indonesia. These studies used descriptive and analytic network process (ANP) methods.

Based on the previous studies, it can be concluded that research on palm oil industry and market were very rare on fatty acids and fatty alcohols, even on oleochemicals. On the other hand, competitiveness analysis tools being used in the previous studies were descriptive analysis, Porter Five Forces Model, Porter Diamond, Nine Factors-Model Competitiveness, ANP, or combination with other analytic tools. None of the studies used competitiveness framework developed by WEF.Therefore, this study becomes unique by focusing on Indonesian palm oil-based fatty acid and fatty alcohol industry and by examining and analyzing the gap between current and expected performance of the industry, using competitiveness framework developed by WEF.

The primary aim of this study is to identify the gap between current and expected performance of Indonesian palm oil-basedfatty acid and fatty alcohol industry, using competitiveness frame work being developed by WEF. The secondary aims of the study were to estimate production, export, import, domestic supply, and consumption of the industry.

RESEARCH AND METHOD

Measurement and Analysis of Competitiveness

Scientific approach in measurement and analysis of competitiveness can be done by qualitative and quantitative approaches (Zhang *et al.* 2009). The approaches are modeling approach, indicator approach (Esterhuizen, 2006; Zhang *et al.*, 2009), and weighted summation approach (Zhang *et al.*, 2009). Modeling approaches are very complex and usually created specifically to answer specific questions (Esterhuizen, 2006), such as value chain

model (Porter and Millar, 1985), portfolio matrix model, competence pyramid model (Walsh and Linton, 2001), enterprize model (Hatten and Rosenthal, 1999), and Weibull model (Weibull,1951).

Indicator approaches use indices which are designed to measure changes in a period of time or inter industries comparison, such as revealed comparative advantage (RCA; Ferto and Hubbard 2003; Arisman, 2002), real exchange rate, foreign investment (Nabi and Luthria, 2002), growth share matrix, constant market share analysis (Hadi and Mardianto, 2004; Rifin, 2010), export performance (Nabi and Luthria, 2002), labor cost (Nabi and Luthria, 2002), production cost comparison (Esterhuizen, 2006), and domestic resource costs (Kirsten *et al.*, 1998). RCA (Balassa Index) has also been applied in many researches of agribusiness product competitiveness, such as Indonesian palm oil (Arisman, 2002), Hungarian agri-foods (Ferto and Hubbard , 2003), Hawaiian agriculture products (Cai *et al*., 2007), Indian agriculture products (Shinoj and Mathur, 2008), and Thailand canned tuna (Kijboonchoo and Kalayanakupt, 2003).

Weighted summation approaches are done by developing key competitiveness indices consisting of a number of indicators using certain weighting method. Weighted summation approaches use multi-attributes as objective variables (Jansen, 1992). Measuring competitiveness index using weighted summation approach has been widely used in the global competitiveness reports of various countries in the world being developed by the World Economic Forum (WEF, 2009). In this study, the competitiveness is measured by using weighted summation approach adopted from WEF competitiveness framework.

WEF Competitiveness Framework

This new era of information and various forms of global competition flowing in all directions creating an environment that is more complex, turbulent, contradictory, inconsistent, and multi-dimensional. Development of Indonesian palm oil-based fatty acid and fatty alcohol industry must be able to adapt with external changes towards a sustainable competitive advantage. Development of the industry is influenced by economic and business environment which can be described by the WEF competitiveness pillars. The pillars cover interactions of business, government, and society to create competitive advantage at the national level towards competitiveness of a country.

WEF uses three factors (sub-indices) of competitiveness which are basic requirements, efficiency enhancers, innovation and sophistication factors. Basic requirements consist of four sub-factors which are institutions, infrastructure, macroeconomic environment, and health and primary education. Efficiency enhancers consist of six sub-factors which are higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, and market size. Innovation and sophistication factors consist of two sub-factors which are business sophistication and innovation.Therefore, there are total 12 WEF sub-factors of competitiveness (competitiveness pillars) (WEF, 2009).

Analysis Method

This study used in-depth interview and questionnaire (based on Likert scale of 1 - 9) methods to gather opinions from the experts and practitioners of current and expected performance of the industry. Questionnaire was developed using WEF competitiveness framework.This study then uses non-parametric Mann-Whitney test to assess the differences between current and expected performance of the industry. The Ho (null hypothesis) is there is no difference between current and expected performance of the industry at $\alpha = 5\%$. Mann-Whitney test is an alternative testing to the t test without any restriction. This test can also be applied for a different number of samples tested in the two groups.

Secondary data of Indonesian palm oil-based fatty acid and fatty alcohol industry, namely production, export, import, domestic supply, and consumption from 2006 to 2012 were collected from PT Capricorn Indonesia Consult (CIC) research.The secondary data were processed by Minitab 16.0 software to make projections using linear, exponential, and decomposition models; and then to select the best model in projecting production, export, import, domestic supply, and consumption of the industry.

The projection models of Indonesian palm oil-based fatty acids and fatty alcohols assumed that the occurrences in the past will continue in the future. Projections will never be a 100% accurate. Efforts required to determine which models providing projection results with error (inaccuracy) as small as possible. Projection error of a model can be determined by comparing graphically the actual values in the past with the projection values. Numerically, the values commonly used to calculate the projection errors are MAPE (Mean Absolute Percentage Error), MAD (Mean Absolute Deviation), and MSD (Mean Square Deviation). The best projection model is the model that has the smallest MAPE, MAD, and MSD. Short term projections based on past data will be more accurate than long term projections.

Variables and Measurement

Measurements of research variables were conducted using expert and/or practitioner opinions (15 respondents) for current and expected performance of the industry. All respondents were

selected by using purposive sampling method from the supply chain of Indonesian palm oil-based fatty acid and fatty alcohol industry. All selected respondents were persons having knowledge, passion, and interest on the industry. They were not chosen merely from the oleochemical manufacturers in order to have broader perspectives on the performance of the industry.

Table 1 shows the complete profiles of the respondents. Most of the respondents are male, affiliated to oleochemical manufacturer, industry association, oil palm plantation, and trading company, having work experience of more than 20 years, and having educational background of under graduate and graduate. Especially for supply chain affiliation, one respondents could be affiliated to more than one affiliation.

Data Source and Gathering

The primary data of this study were the opinions (based on Likert scale of 1 - 9) of Indonesian palm oil-based fatty acid and fatty alcohol industry experts and/or practitioners for current and expected performance of the industry. The primary data are a cross sectional type. All the expert and/or practitioner opinions are arranged in a table and its arithmetic means were calculated. Then the gaps between current and expected performance of the industry for all sub factors, factors, and total factor were calculated. Finally, the non-parametric Mann-Whitney tests were used to assess medians of each sub factor for current and expected performance whether the differences between current and expected performanceof the industry were significant or not at $\alpha = 5\%$. Secondary data of this study were volume of production, export, import, domestic supply, and consumption of the industry (2006-2012). Domestic supply is fatty acids and fatty alcohols available for domestic market which are derived from production added by import and deducted by export.

RESULTS AND DISCUSSION

Gap Analysis Using WEF Competitiveness Framework

Expert and/or practitioner opinions for current and expected performance of the industry were cross sectional data. This kind of data elicited tacit knowledge into explicit knowledge. The results of expert and/or practitioner opinions for current and expected performance of the industry can be seen in Table 2 and Figure 1.

Table 2 and Figure 1 show that based on the arithmetic means of all the expert and/or practitioner opinions for current and expected performanceof the industry, the current performance of all sub-factors of WEF competitiveness framework were under the expected performance. From a total of 12 sub-factors (pillars), sub-factor with the biggest gap (51.33%) was infrastructure. This means that the availability and quality of transportation, the quantity and continuity supply of electricity, the availability and number of customers of telecommunications sector, and others infrastructure-related items have to be increased by 57.55% to reach the expected performance. The sub-factor that had the smallest gap (14.41%) was market size since markets of Indonesian palm oil-based fatty acids and fatty alcohol sboth domestic and international market shave already been widely open.

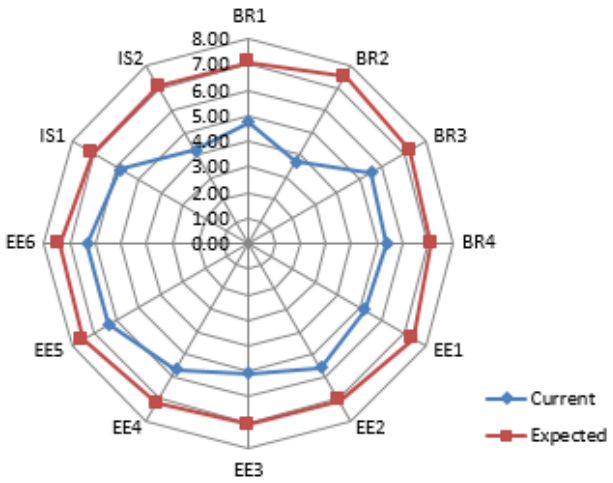
Table 1. Respondent profiles

Description	(%)	Description	(%)
Sex:		Work Experience:	
Male	93.3	< 5 years	0.0
Female	6.7	5 - < 10 years	6.7
		10 - < 15 years	6.7
Affiliated Supply Chain:		15 - < 20 years	0.0
Oil palm seed producer	7.1	>= 20 years	86.7
Oil palm plantation	17.9		
Oleochemical manufacturer	21.4	Educational Background:	
Trading company	14.3	Professor	6.7
Industry association	21.4	Ph.D	13.3
R&D institution	7.1	Graduate	40.0
University	3.6	Under Graduate	40.0
Bank	3.6	Senior High School	0.0
Government	3.6		

Note : n (total respondents) = 15 persons

Table 2. WEF gap analysis per sub-factor

Factor and Sub-Factor	Current	Expected	Gap
Basic Requirements:			
Institutions	4.73	7.07	33.02%
Infrastructure	3.67	7.53	51.33%
Macroeconomic environment	5.53	7.27	23.85%
Health and primary education	5.40	7.13	24.30%
Efficiency Enhancers:			
Higher education and training	5.20	7.40	29.73%
Goods market efficiency	5.60	7.07	20.75%
Labor market efficiency	5.07	7.07	28.30%
Financial market development	5.67	7.20	21.30%
Technological readiness	6.33	7.53	15.93%
Market size	6.33	7.40	14.41%
Innovation and Sophistication Factors:			
Business sophistication	5.80	7.07	17.92%
Innovation	4.20	7.07	40.57%



Scores: 1 = extremely poor, 2 = very poor, 3 = poor, 4 = nearly poor, 5 = average, 6 = nearly good, 7 = good, 8 = very good, 9 = extremely good

Notation: BR1 = Institutions, BR2 = Infrastructure, BR3 = Macroeconomic environment, BR4 = Health and primary education, EE1 = Higher education and training, EE2 = Goods market efficiency, EE3 = Labor market efficiency, EE4 = Financial market development, EE5 = Technological readiness, EE6 = Market size, IS1 = Business sophistication, IS2 = Innovation

Figure 1. WEF gap analysis per sub-factor

Production Projection of Indonesian Palm Oil-based Fatty Acid and Fatty Alcohol Industry

Until 2012, there had been 10 manufacturers of palm oil-based fatty acids and fatty alcohols in Indonesia. Total production capacity of the 10 manufacturers reachs 2.19 million tonnes per year, which is composed of fatty acids of 1.06 million tonnesand fatty alcohols of 1.13 million tonnes (CIC, 2013). Indonesian palm oil-based fatty acid and fatty alcohol production during the years of 2006-2012 increase significantly with the average growth rate per year of 18.0% as shown in Table 5.

Table 6 shows the summary of linear, exponential, and decomposition models of production projections of the industry. Based on the values of MAPE, MAD, and MSD of the three models as shown in Table 7, the production projection of fatty acids was better using exponential model since this model has the smallest MAPE, MAD, and MSD among the three models. On the other hand, for production projection of fatty alcohols, there was no model having all smallest MAPE, MAD, and MSD. In order to determine the best model for production projection of fatty alcohols, we select model having either smallest MAPE or smallest MAD or smallest MSD. Therefore production projection of fatty alcohols can use either linear model having smallest MSD or decomposition model having smallest MAD.

Table 5. Productions of palmoil-based fatty acid and fatty alcohol industry in Indonesia (2006-2012)

Year	Fatty Acid (Tonnes)	Fatty Alcohol (Tonnes)	Total (Tonnes)	Growth (%)
2006	404,309	208,396	612,705	--
2007	412,401	273,659	686,060	11.97
2008	479,012	300,611	779,623	13.64
2009	498,952	331,943	830,895	6.58
2010	632,870	336,415	969,285	16.66
2011	830,843	358,718	1,189,561	22.73
2012	1,210,269	413,243	1,623,512	36.48
			Average Growth (%)	18.01

Source: CIC (2013).

Table 6. Summary of linear, exponential, and decomposition models of production projections of Palm oil-based fatty acid and fatty alcohol industry in Indonesia

	Production	
Model	**Fatty Acid**	**Fatty Alcohol**
Linear	Y_t = 151.433 + 121. 736t	Y_t = 200.360 + 29.302t
Exponential	Y_t = 290.907 x (1.194 2)^t	Y_t = 211.495 x (1.101 5)^t
Decomposition	Y_t = 154 400 + 120.171t	Y_t = 200.019 + 29.556t

Note : = best projection model

Where: Y_t = projection in year t (tonnes), t = 1 for year 2013 and so on

Table 7. MAPE, MAD, and MSD comparison of production projections of palm oil-based fatty acid and fatty alcohol industry in Indonesia

Projection Error		Linear Model	Exponential Model	Decomposition Model
Fatty Acid				
	MAPE	1.65429×10^1	10	1.59978×10^1
	MAD	1.01518×10^5	65371	9.59055×10^4
	MSD	1.42671×10^{10}	8.401.711.607	1.26590×10^{10}
Fatty Alcohol				
	MAPE	5	5	5
	MAD	14.051	15531	13787
	MSD	214.504.701	293.603.800	220.940.681

Export, Import, and Domestic Supply Projection of Indonesian Palm Oil-based Fatty Acid and Fatty Alcohol Industry

Table 8 shows the summary of linear, exponential, and decomposition models of export, import, and domestic supply projections of Indonesian palm oil-based fatty acid industry. Based on the values of MAPE, MAD, and MSD of the three models as shown in Table 9, the export projection of fatty acids is better using exponential model since this model has the smallest MAPE, MAD, and MSD among the three models. Import projection of fatty acids was better using decomposition model since this model has the smallest MAPE and MAD among the three models. Whereas the domestic supply projection of fatty acids can use either linear model having smallest MSD or exponential model having smallest MAD

Table 10 shows the summary of linear, exponential, and decomposition models of export, import, and domestic supply projections of Indonesian palm oil-based fatty alcohol industry. Based on the values of MAPE, MAD, and MSD of the three models as shown in Table 11, the export

projection of fatty alcohols is better using linear model since this model has the smallest MAD and MSD among the three models, where as the import and domestic supply projections of fatty alcohols are better using exponential model since this model has the smallest MAPE, MAD, and MSD among the three models.

Table 8. Summary of linear, exponential, and decomposition models of export, import, and domestic supply projections of palmoil-based fatty acid industry in Indonesia

Model	Fatty Acid		
	Export	**Import**	**Domestic Supply**
Linear	Y_t = 105 257 + 124 918t	Y_t = 29 491 - 137.801t	Y_t = 75 667 - 3 318.86t
Exponential	Y_t = 256 422 x (1.211 9)^t	Y_t = 28 504.8 x (0.998 9)^t	Y_t = 74 257.1 x (0.951 5)^t
Decomposition	Y_t = 106 045 + 124 501t	Y_t = 29 942 - 116.052t	Y_t = 75 394 - 3 359.07t

Where:
Y_t = projection in year t (tonnes); t = 1 for year 2013 and so on

Note : = best projection model

Table 9. MAPE, MAD, and MSD comparisons of export, import, and domestic supply projections of palmoil-based fatty acid industry in Indonesia

Projection Error	Export	Import	Domestic Supply
Linear Model			
MAPE	1.87143×10^1	19	17
MAD	1.05702×10^5	5078	11048
MSD	1.50055×10^{10}	29670688	170116823
Exponential Model			
MAPE	11	19	17
MAD	67767	5158	10835
MSD	8342016050	30030319	173149749
Decomposition Model			
MAPE	1.85847×10^1	18	17
MAD	1.04260×10^5	4681	10928
MSD	1.45869×10^{10}	31082460	170372176

Note:

MAPE = Mean Absolute Percentage Error
MAD = Mean Absolute Deviation
MSD = Mean Square Deviation

Table 10. Summary of linear, exponential, and decomposition models of export, import, and domestic supply projections of palmoil-based fatty alcohol industry in Indonesia

Model	Fatty Alcohol		
	Export	**Import**	**Domestic Supply**
Linear	Y_t = 171 129 + 23 783t	Y_t = 23 753 + 4 176t	Y_t = 52 984 + 9 695t
Exponential	Y_t = 179 102 x (1.098 9)^t	Y_t = 26 655.4 x (1.100 2)^t	Y_t = 60 036.7 x (1.105 1)^t
Decomposition	Y_t = 170 432 + 24 326t	Y_t = 23 727 + 4 296t	Y_t = 53 035 + 9 623t

Note : = best projection model

Where: Y_t = projection in year t (tonnes), t = 1 for year 2013and so on

Table 11. MAPE, MAD, and MSD comparisons of export, import, domestic supply projections of palm oil-based fatty alcohol industry in Indonesia

Projection Error	Export	Import	Domestic Supply
Linear Model			
MAPE	5	16	8
MAD	12,897	5,939	7,436
MSD	250,307,550	5,297,2405	86,074,594
Exponential Model			
MAPE	6	14	7
MAD	14903	5,359	6,038
MSD	327,722,189	466,00,229	63,753,493
Decomposition Model			
MAPE	5	18	8
MAD	12938	6,993	7,274
MSD	263,752,280	63,507,398	76,772,658

Note:

MAPE = Mean Absolute Percentage Error
MAD = Mean Absolute Deviation
MSD = Mean Square Deviation

Consumption Projection of Indonesian Palm Oil-based Fatty Acid and Fatty Alcohol Industry

Industrial users of palm oil-based fatty acids and fatty alcohols in Indonesia are widely spread and keep growing. Total consumption of Indonesian palm oil-based fatty acids and fatty alcohols of each industrial user can be seen in Table 12. Average consumption growth rate per year during the years of 2006-2012 is 4.3% for fatty acids and 12.0% for fatty alcohols.

The development of industrial users of palm oil-based fatty acids and fatty alcohols in Indonesia is very promising which has high growth projection in line with economic and population growth in Indonesia. Evenmore taking into account the potential international market for Indonesian palm oil-based fatty acids and fatty alcohols that are also expected to continuously grow.

Table 13 shows the summary of linear, exponential, and decomposition models of consumption projections of the industry. Based on the values of MAPE, MAD, and MSD of the three models as shown in Table 14, the consumption projection of fatty acids can use either exponential model having smallest MAD or decomposition model having smallest MSD, whereas consumption projection of fatty alcohols is better using exponential model since this model has the smallest MAPE, MAD, and MSD among the three models.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The results of this study showed that factor having the biggest gap between current and expected performance of Indonesian palm oil-based fatty acid and fatty alcohol industry, using WEF competitiveness framework was basic requirements while factor having the smallest gap is efficiency enhancers. Moreover, sub-factor having the biggest gap is infrastructure while sub-factor having the smallest gap is market size.

The results of this study also showed that the gap for total factors using WEF competitiveness framework is about 28%. The non-parametric Mann-Whitney test results show that there were significant differences between current and expected performance of the industry at $\alpha = 5\%$ for all sub-factors, factors, and total WEF competitiveness framework.

The other results of this study showed that the projections of Indonesian palm oil-based fatty acids:production and export were better using exponential model, import was better using decomposition model, domestic supply can use either linear or exponential model, whereas consumption can use either exponential or decomposition model. On the other hand, the results of this study showed that the projections of Indonesian palm oil-based fatty alcohols: production can use either linear or decomposition model, export is better using linear model, whereas import, domestic supply, and consumptionare better using exponential model. It can be concluded that from three projection models used in this study, there is no projection model best suited to projections applied for the industry.

Recommendations

Basic requirement factor and infrastructure sub-factor having the biggest gaps have to be resolved in systemic and systematic approaches by involving all stakeholders of the industry. Government is also recommended to re-identify and

re-evaluate all related regulations to the Indonesian palm oil-based fatty acid and fatty alcohol industry. Government then has to ensure the synchronization and consistent implementation of all related regulations.

Since the projection models of Indonesian palm oil-based fatty acids and fatty alcohols assumed that the occurrences in the past will continue in the future, it is recommended to use the best models for short term instead of long term projections considering the rapid change of the environment and or underlying assumptions.

Further research is required to identify specific problems in each sub-factor and conduct prioritization analysis to rank its for solutions. Further research is also required to include more alternative projection models to do a more comprehensive projections of Indonesian palm oil-based fatty acids and fatty alcohols.

Table 12. Consumptions of palm oil-based fatty acid and fatty alcohol industry in Indonesia (2006-2012)

No	Industrial Users	Type	Consumption (Tonnes)							Growth
			2006	2007	2008	2009	2010	2011	2012	(%)
1	Tyre Industry	Fatty acid	2,676	3,069	3,445	3,328	3,916	4,289	4,129	7.83
2	Rubber Goods Industry	Fatty acid	2,622	2,903	3,103	2,960	3,141	3,291	3,406	4.56
3	Stearic Acid Industry	Fatty acid	11,436	12,571	13,652	13,180	14,004	14,676	15,477	5.26
4	PVC Pipe Industry	Fatty acid	874	1012	1138	1051	1191	1274	1365	8.00
5	Flavor and Fragrance Industry	Fatty acid	2,656	2,794	2,924	2,996	3,150	3,278	3,511	4.77
6	Cable Industry	Sub total	1,921	2,103	2,397	2,125	2,736	3,041	3,635	11.92
		Fatty acid	880	964	1,098	974	1,254	1,394	1,666	11.93
		Fatty alcohol	1,041	1,139	1,299	1,151	1,482	1,647	1,968	11.91
7	Paint Industry	Fatty acid	3,127	3,297	3,401	3,442	3,519	3,620	3,961	4.05
8	Cosmetics Industry	Sub total	2,858	3,294	3,630	3,909	4,356	4,737	5,330	10.97
		Fatty acid	1,369	1,578	1,739	1,873	2,087	2,270	2,554	10.98
		Fatty alcohol	1,489	1,716	1,891	2,036	2,269	2,467	2,776	10.97
9	Surfactant Industry	Fatty alcohol	18,271	20,555	22,016	23,337	24,915	46,591	67,837	27.50
10	Textile Auxiliary Industry	Sub total	12,130	12,481	11,898	12,476	13,296	13,777	12,693	0.90
		Fatty acid	4,852	4,992	4,759	4,991	5,318	5,511	5,078	0.90
		Fatty alcohol	7,278	7,489	7,139	7,485	7,978	8,266	7,616	0.90
11	DOP Industry	Fatty alcohol	21,971	23,180	23,793	23,241	24,346	26,172	28,724	4.64
12	Other Industries	Sub total	27,691	26,650	28,172	23,601	33,198	30,410	31,038	3.34
		Fatty acid	11,544	11,312	11,623	11,397	12,116	12,724	13,067	2.14
		Fatty alcohol	16,147	15,338	16,549	12,204	21,082	17,686	17,971	5.81
TOTAL			108,233	113,909	119,569	115,646	131,768	155,156	181,105	9.22
		Fatty acid	42,036	44,492	46,882	46,192	49,696	52,327	54,214	4.37
		Fatty alcohol	66,197	69,417	72,687	69,454	82,072	102,829	126,891	12.00

Source: CIC (2013)

Table 13. Summary of linear, exponential, and decomposition models of consumption projection of palm oil-based fatty acid and fatty alcohol industry in Indonesia

Model	Consumption	
	Fatty Acid	**Fatty Alcohol**
Linear	Y_t = 40 117 + 1 965t	Y_t = 47 322 + 9 225t
Exponential	Y_t = 40 590.3 x (1.041 78)^t	Y_t = 54 475 x (1.107 5)^t
Decomposition	Y_t = 40 099 + 1 961t	Y_t = 47 333 + 9 208t

Note : = best projection model

Where: Y_t = projection in year t (tonnes), t = 1 for year 2013and so on

Table 14. MAPE, MAD, and MSD comparison of consumption projection of palm oil-based fatty acid and fatty alcohol industry in Indonesia

Projection Error	Linear Model	Exponential Model	Decomposition Model
Fatty Acid			
MAPE	1	1	1
MAD	594	572	630
MSD	642510	583229	572680
Fatty Alcohol			
MAPE	10	8	10
MAD	8129	6976	8181
MSD	97726017	74581727	95751951

Note: MAPE = Mean Absolute Percentage Error, MAD = Mean Absolute Deviation,MSD = Mean Square Deviation

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