International Journal on Advanced Science Engineering Information Technology

Vol.9 (2019) No. 2
ISSN: 2088-5334

Value Chain Analysis and Value Added Enhancement of Indonesia Crude Palm Oil Supply Chain

Juliza Hidayati[#], Sawarni Hasibuan[*]

[#] *Industrial Engineering Department, Universitas Sumatera Utara, Medan, Indonesia*
Email: rivaijuliza@gmail.com; julizausu2307@gmail.com

[*] *Master of Industrial Engineering Program, Universitas Mercu Buana, Jakarta, Indonesia*
E-mail:sawarni02@gmail.com; sawarni@mercubuana.ac.id

Abstract*— PT. XYZ is a manufacturing company that produces Crude Palm Oil (CPO). The competition Crude Palm Oil (CPO) company do not only happen in manufacturing companies but also among supply chain components. Due to the increase of fierce competition, it is necessary to improve companies' value chain that may increase productivity and reduce costs. The purpose of this study was to analyze the supply chain and value chain of CPO in some companies. Data were analyzed using both qualitative and quantitative analysis within descriptive research. This research was started by conducting a supply chain analysis and followed by a value chain analysis and ended with an improvement of the value chain. The qualitative analysis describes supply chain and value chain while the quantitative analysis is used to find out value-added values and establishment of the value chain. Based on the analysis, the value chain of CPO in the company consists of four main participants: suppliers of raw materials (plantation), processing plant, distributor, and customer. In this research, the analysis was focused on two participants: palm oil plantation and palm oil processing plant. The oil palm plantation activities include nurseries, planting, plant maintenance, harvesting, and shipping while the processing plant consists of reception, sterilizing, threshing, pressing, and classification. The company's value-added actual condition in oil palm plantation was 72.42% and palm oil processing plant was 10.13%. A low-cost strategy had been applied, resulting in the value-added increasing of oil palm plantations by 1.08% and at processing plants by 11.73%. The increase in value-added has been able to reduce the company's costs. However, this study still has limitations because the analysis only covers plantation and processing plant value chain; the company's distribution and consumers of CPO products for maximizing the value-added of a CPO value chain have not yet been studied.

***Keywords*— crude palm oil; oil palm; supply chain; value chain; value-added.**

I. INTRODUCTION

Palm oil is one of the most favorite natural resources of foreign exchange. Palm oil commodities have a bright prospect in the world vegetable oil trade that requires the industry to be capable and has high competitiveness [1], [2]. Competitiveness between companies may produce a better quality product with a lower price for consumers. High competitiveness is needed by industry to keep ahead [3].

The industry competitiveness in achieving optimal trading performance is influenced by an effective value chain [4], a key competitive advantage that can generate value-added for industry [5], [6]. A value chain is a model used in analyzing specific activities that can create value and competitive advantage for an organization [7]. To achieve the effectiveness of the value chain strategy in improving the performance of smallholders, it was decided to assess the entire value chain and to include incorporate external activities which directly improve the livelihoods of the farmers. This creates the added-value chain which is more effective and may assist strategies and managers to develop and communicate new activities that will allow producer-owned small firms to be efficient [8].

Value chain analysis shows the organization as a continuous process of value creation activities. Value is divided into two categories: main activities and supporting activities [9]. The main activities were assessed concerning raw material procurement, processing, and marketing. Supporting activities consist of preparation of industrial supporting infrastructure, human resource development, technological development, and procurement [10]. Value chain analysis is used to identify the stages of the value chain where the industry can increase value-added for consumers and streamline costs [11]. Value chain analysis has initially been an analysis of activities that produce value both from within and outside a company [12]. The value chain concept gives the perspective about where the company lies in an industrial value chain. Value chain

analysis helps companies understand the value chain which forms a product or service [13]. Value starts from the raw materials to the end consumer receiving the product or service. Value chain analysis contains two main activities. The first activity is being conducted outside the company, and the other activity is undertaken within the company, both of which have the same purpose of creating value [14]. Companies must be able to recognize their position in the value chain and the opportunities to create value in a competitive environment [15].

The concept of a value chain has assumed a dominant position in the strategic analysis of industries [16]. The strategy formulation of a company can be seen as a decision that promises to generate economic rents that may provide generic strategies of low-cost and differentiation strategies to suggest where costs should be cut or how products should be differentiated [17]. The importance of a supply chain system in achieving a simultaneously high-level efficiency has generally focused on new performance measures and categorizing existing value chain measures to utilize the supply chain became more complete, accurate and therefore more effective [18].

From the description above, it can be seen that maximizing value-added in a value chain is one of the keys in company competition. Therefore, an analysis of the value chain in CPO companies in Indonesia is needed, which consists of supply chain analysis and value chains, as well as improving the value chain to maximize company productivity to reduce company costs. The purpose of this study was to analyze the supply chain and value chain of CPO in the company.

II. Material and Method

A value chain analysis (VCA) includes the range of activities performed within a firm or supply chain system to produce a specific output [19]. The purpose of value chain analysis is to identify the value chain stages in which companies can increase value for customers or reduce costs. Decreasing costs or increasing added-value can make a company more competitive. In this study, a value chain analysis is conducted to identify improvements in crude palm oil (CPO) supply chain that enable enterprises to gain enhanced value added to the company's CPO value chain.

The data used include primary and secondary data relevant to the value chain activities of CPO. Primary data obtained directly from observation and interview. Secondary data is obtained from the literature review. Data processing or data analysis used in this research is both qualitative analysis and quantitative analysis. The framework of this research is presented in Fig. 1. It starts with analyzing the company's supply chain, then analyzes the value chain and makes improvements to the value chain.

The qualitative analysis describes the activities of supply chain participants (including flow patterns of supply chain and production process flow of CPO supply chain) and value chain activities in palm oil processing. Quantitative analysis was used to know the value added and value chain formation in palm oil processing.

The value-added analysis was carried out in plantation part that has additional inputs, while related to the number of seeds, other additives and the amount of oil palm fruit produced. And parts of processing plants that undergo further processing in a production process or are related to the treatment of materials and additional inputs when processing FFB into CPO.

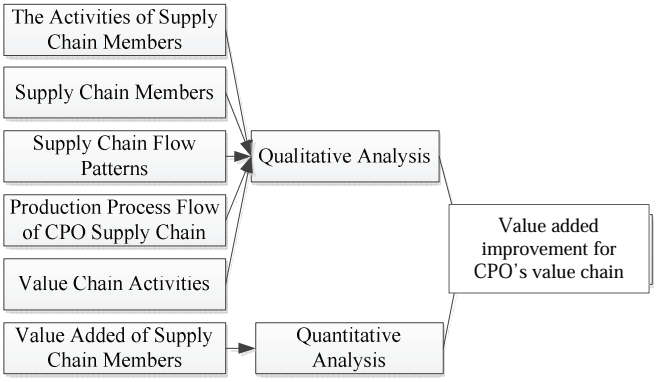

Fig. 1 Framework for operational thinking

III. Result and Discussion

A. Supply Chain Conditions of Crude Palm Oil

A Supply chain analysis of crude palm oil includes a discussion of the activities of supply chain participants, participants involved in the supply chain, supply chain flow patterns, and production process flow.

B. The Activities of Supply Chain Components

The supply chain in this company begins with plantation activities; those include nurseries, planting, plant maintenance, harvesting, and shipping. The Fresh Fruit Bunches (FFB) are sent to processing plants and then processed into CPO. CPO processing involves reception, sterilizing, threshing, pressing, and oil classification. CPO that has been produced will be stored in the storage tanks and delivered to the consumers. Supply chain activities can be seen in Fig. 2.

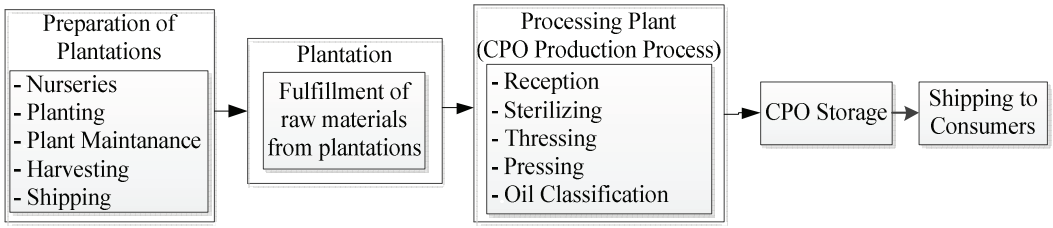

Fig. 2 Supply chain activities

C. Supply Chain Flow Patterns

Supply chain flow of CPO in the company starts from the flow of raw materials from palm oil plantations to palm oil processing factories and processed into CPO, stockpiled in tanks and storage warehouses, supplied to industrial consumers, distributed to retailers to end customers. Supply chain flow pattern can be seen in Fig. 3.

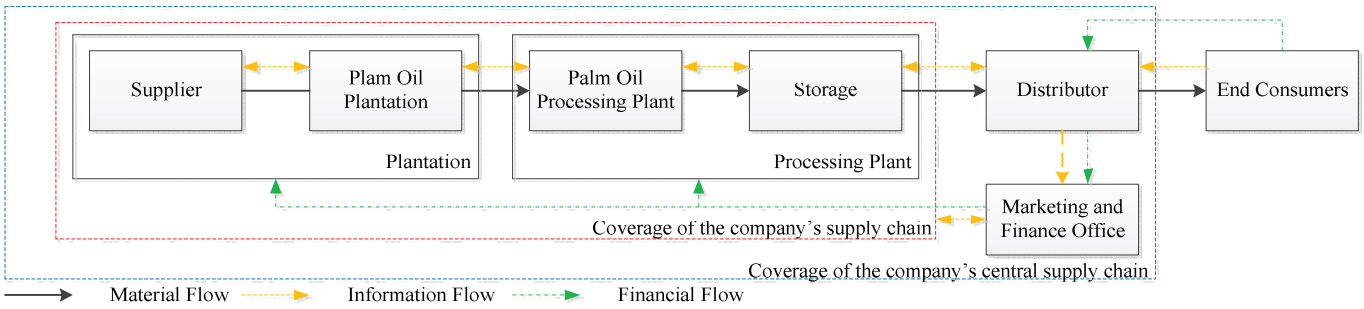

Fig. 3 Supply chain flow pattern of CPO

D. Production Process Flow of CPO Supply Chain

The production process flow of CPO in the company starts from the provision of raw materials (palm oil plantations) to the processing of FFB into CPO can be seen in Fig. 4.

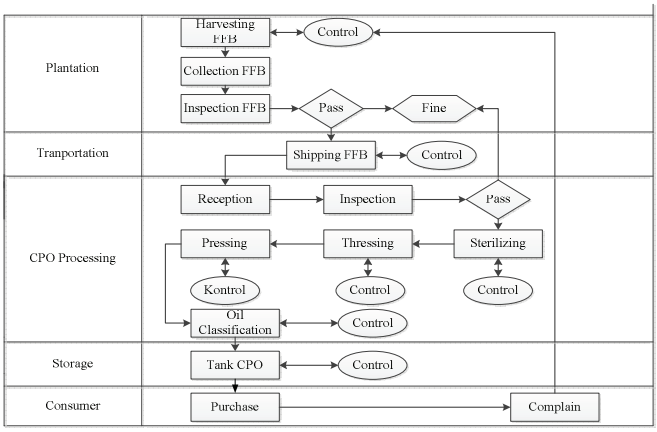

Fig. 4 Production process flow of CPO

E. Value Added Analysis

Value added is the occurrence of value increases in a commodity because the commodity experienced the addition of input or further processing in a production process [20]. The calculation of value added in this research is focused on the palm oil plantation and processing of CPO in the company. Value-added analysis of the supply chain components of CPO uses several assumptions:

- The number of seeds required as many as the number of palm oil plants that produce in the Year 2016.
- The number of plants produces each hectare of 143 plants.
- The price of FFB used is the average price of FFB in 2016.
- Costs incurred are the costs required in the process of palm oil cultivation area of the plantation that produces in the Year 2016.
- CPO price used is the average price of CPO in the Year 2016.

F. Value Added Analysis of Palm Oil Plantation

The value-added analysis on the plantation is related to the number of seeds, other additives and the amount of palm oil fruits produced in each period. Activities undertaken in palm oil plantations include nurseries, planting, and plant maintenance, harvesting, and shipping. Value-added analysis of palm oil plantations in the company is as follows:

1) Nurseries: Plantation area for plant produces in the year 2016 is 2,110 hectares with the number of palm oil plants per hectare of 143 plants. So the number of seeds needed is 2,110 hectares x 143 plants = 301,730 seeds. Breeding is done in polybags. In this process, there are fertilizing and spraying activities. The quality of the nursery will affect the growth and quality of oil palm crops [15]. In the nurseries process activities, consists of nurseries, fertilization, and spraying. There are four main components needed in the nursery process. They are seeds, polybag, urea fertilizer and fungicide with a total need per year described for each component (Table 1).

TABLE I
COMPONENTS OF NURSERY PROCESS

Components	Needs	Cycles/ Years	Total Needs	Unit
Seeds	301,730	-	301,730	seed
Polybag	301,730	-	301,730	seed
Urea Fertilizer	0.01 kg/ plant	6	18,103.8	kg
Fungicide	0.03 kg/ 250 plant	26	941.3976	kg

2) Planting: Palm oil planting begins with stands. Planting stands are done to determine the point of planting of palm oil. After planting point has been determined, the holes with size 60 cm x 60 cm x 60 cm are prepared. Selected palm seedlings are then planted to the ground that has been in the hole.

3) Plant Maintenance: Plant maintenance is divided into two, namely the maintenance of Immature Plant (IM) and Mature Plants (MP). In this process, there are weed control activities with herbicide spraying and fertilizing activity with NPK fertilizer and compost. The components of the plant maintenance process in 2016 can be seen in Table 2.

TABLE II
COMPONENTS OF PLANT MAINTENANCE

Components	Needs	Cycles/ Years	Total Needs	Unit
Maintenance (Immature Plant)				
- Compost	50 kg/ plant	1	15,086,500	kg
- NPK Fertilizer	0.5 kg/ plant	1	150,865	kg
Maintenance (Mature Plant)				
- Compost	100 kg/ plant	1	30,173,000	kg
- NPK Fertilizer	2.25 kg/ plant	1	678,892.5	kg
Herbicide	2.1 l/ hectare	12	53,172	L

4) Harvesting: Harvesting is the activity of cutting fruit bunches that meet the mature criteria for the harvesting of each plant, take the fruit bunches in the field and hauls it to the collection site:

5) Shipping: FFB that have been collected at the collection site is shipped to the palm oil mill. The transport of fruit to the plant must coincide with harvest days as ALB levels continue to increase over time which can degrade the quality of CPO. Transportation is done by using a dumb truck. The plantation value added in the planting period of Year 2016 can be seen in Table III.

TABLE III
VALUE ADDED CALCULATION OF PALM OIL PLANTATION IN 2016

No	Components	Amount	Unit	Price (IDR)	Total Price (x1000IDR)
Input					
1	Seed	301,730	Unit	28,000	8,448,440
2	Polybag	301,730	Unit	127	38,320
3	Fertilizer				
	- Urea Fertilizer	18,103.8	kg	3,900	70,605
	- Compost Company	16,765,313	kg	150	1,770,982
	- Compost Buy	28,494,187	kg	400	13,381,181
	- NPK Fertilizer	829,757.5	kg	5,450	4,522,178
4	Fungicide	941,3976	kg	75,000	70,605
5	Herbicide	53,172	l	79,000	4,200,588
Output					
6	FFB	70,270,500	kg	1,676.83	117,831,683
Reception					
7	Total Input				32,502,899
8	Total Output				117,831,683
9	Value Added				85,328,784
10	Value Added (%)				72.42

G. Value Added Analysis of Palm Oil Processing Plant

The processing is a participant of the CPO supply chain responsible for processing FFB into crude palm oil (CPO). Increasing in added value occurs due to the treatment of materials and the addition of inputs when processing. Activities undertaken in the processing plant include involves reception, sterilizing, threshing, pressing, and oil classification. Value-added analysis in the processing plant is as follows:

1) Reception: FFB delivered by the plantations will be received and weighted to determine the net weight of the FFB, knowing the yield and the FFB capacity required by the plant. The weighted FFB then goes into the loading ramp which serves as a temporary stockpiling of the FFB before it is processed, the FFB into the lorry and the sorting site.

2) Sterilizing: The sterilizing process begins with the process of separating the palm fruit to obtain the oil and the kernel (core). Boiling is done with a sterilizer vessel. The purpose of boiling is to ease the release of fruit from bunches and kernels (core), soften the flesh to facilitate the process of extortion.

3) Threshing: The threshing process serves to separate the fruit/boiled fruit by smashing boiled fruit bunches. The boiled fruit that has been separated from the bunch will fall into the under-thresher conveyer. This process also produced solid waste that is empty fruit bunches which are then taken to the empty bunch scrapper.

4) Pressing: This process aims to separate the fruit flesh by seed and the process of extracting crude oil from the fruit. The first oil was taken by pulverizing the fruit and filling it. The lubrication aims to pulverize the fruit until it is destroyed and separated from the nut (nut). While pressing aims to suppress the crushed fruit flesh to exit crude oil (crude oil). This process produce solid waste in the form of fiber.

5) Classification: The resulting crude oil will be brought to the oil classification station. This process aims to obtain palm oil in accordance with predetermined quality standards. The calculation of inputs on the supply chain component of palm oil processing plant can be seen in Table IV.

TABLE IV
INPUT CALCULATION OF PALM OIL PROCESSING PLANT IN 2016

No	Components	Amount	Unit	Price	Total Price (x1000 IDR)
Input					
1	FFB	70,839,070	kg	1,676	118,785,137
Operating Costs (IDR/Year)					
2	Water				327,689
3	Energy				898,283
	Total Input				120,011,108

Output generated is crude palm oil with production amount in Year 2016 was 17,401,798 kg. The average price of CPO in the year 2016 was IDR 7,674.03. The output price was IDR 133,541,919,906. The calculation of value added on the supply chain participants of palm oil processing plant in 2016 can be seen in Table V.

TABLE V
VALUE ADDED CALCULATION OF PALM OIL PROCESSING IN 2016

No	Components	Total Price (x1000IDR)
1	***Input***	120,011,108
	Output	
2	*Crude palm oil*	133,541,920
3	Value added	13,530,812
4	Value added (%)	10.13

Based on the above data, the value added obtained by palm oil processing plant is equal to 10.13%.

H. Value Added Improvement from CPO's Value Chain

The value chain is a model used to analyse specific activities that can create value and competitive advantage for an organization. Value is divided into two categories: main activities and supporting activities. The main activities were assessed in terms of raw material procurement, processing, and marketing. Supporting activities consist of the preparation of industrial supporting infrastructure, human resource development, technological development, and procurement. The value chain stages of palm oil processing can be seen in Fig. 5.

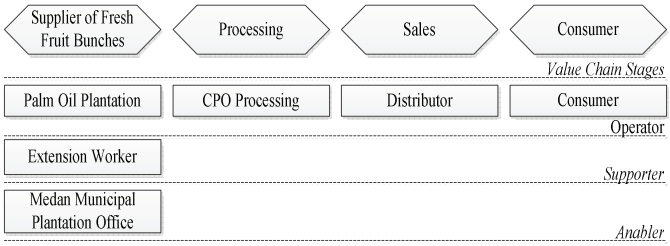

Fig. 5 General value chain of CPO production process

Value chain of CPO production process shown in Figure 5 shows the stages of the value chain, the participants in the stages, as well as the supporter and the indirect supporter (enabler) at various stages. Value chain analysis is used to identify the stages of the value chain where the industry can increase value added for customers and streamline costs. Value chain analysis is carried out on the critical process steps in Crude Palm Oil production business. The analysis can be seen in Fig. 6.

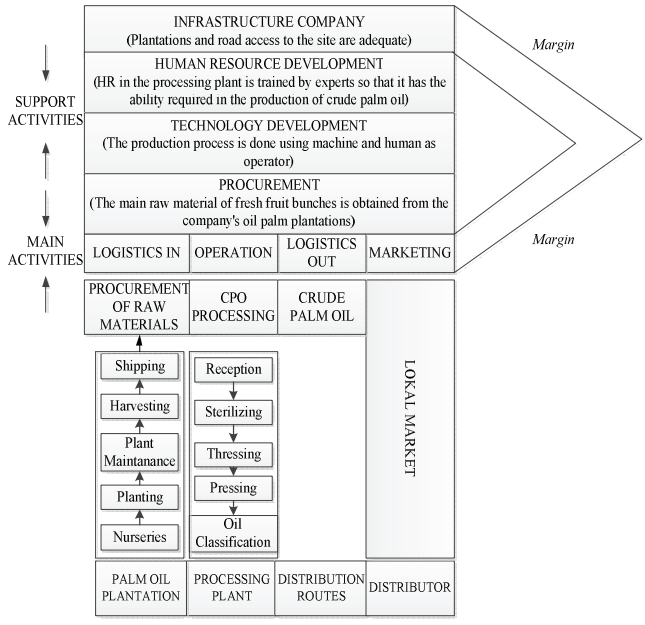

Fig. 6 Value chain of CPO

Generally, the value chain of CPO production process could be developed into several value chain functions as follow:

- Oil palm plantations as raw material providers.
- Processing plant, processing raw materials into CPO.
- Distributor, marketing CPO processed products to consumers.
- Supporter (extension field), provide socialization on plant care and fertilization.
- Enabler as an indirect supporter in studying oil palm cultivation

I. Value Chain Activities

The activity of the CPO value chain consists of main activities and supporting activities. Main activities include logistics in, operations, logistics out and marketing, sales and service. For logistics includes the provision of the raw material of FFB fruit bunches and transportation of raw materials to the processing factory. The operation includes the activity of processing FFB fruit bunches into crude palm oil. Logistics out includes the distribution of crude palm oil. For marketing, sales and service, crude palm oil are marketed through corporate centers to distributors who have worked with the company.

Supporting activities include infrastructure, human resources, technological developments, and procurement. Infrastructure includes road access, plantation area, tools and machinery used, means of transportation and communication and information technology used. Human resources include sellers and suppliers of materials and labor. Technology development includes technology used in the production process, transportation, communication equipment, and data storage technology used. Procurement includes the procurement of raw materials, machinery and equipment, and transportation needs. The description of the process is analyzed to see how important the resources, technologies, and capabilities are in shaping the company's competitive ability. Analysis of the CPO value chain based on activities can be divided into:

1) Procurement of FFB:

- Resource: The need for FFB is fulfilled from oil palm plantations and the price of FFB is IDR 1,676.83 per kg.
- Technology: FFB that have been harvested directly sent to the processing plant to be processed directly because the longer the FFB in though will increase free fatty acids that can reduce the quality of CPO.
- Capability/Skill: Qualified harvesting ability and the ability to select quality raw materials.
- Analysis: The raw material of FFB for the production of crude palm oil can be met from oil palm plantations and fresh raw material quality of FFB.

2) Processing of FFB into CPO:

- Resource: The ability of labor in processing FFB into crude palm oil is good.
- Technology: Tools and machines used are semi-modern because it still requires operator power in operation; Knowledge gained from experts as well as head of the production.
- Capability/Skill: In addition to producing crude palm oil, also produces palm kernel. Workers have the skill of producing crude palm oil.

- Analysis: The production process of crude palm oil is acceptable, can be seen from the yield yielded 24.57% above company standard that is equal to 22percent and high quality crude palm oil products.

3) Transportation:

- Resource: The means of transportation to support the production process and the distribution of products is adequate.
- Technology: The means of transporting FFB to a processing plant is a dump truck, the means of transporting crude palm oil to consumers is a tank truck.
- Capability/Skill: The distribution of products is done directly by the company by means of transportation that has been available.
- Analysis: Support of transportation facilities and infrastructure has met the needs of the processing plant industry in distributing its products.

4) Technology development:

- Resource: Availability of equipment and machinery technology required in the production of crude palm oil.
- Technology: Using old tools and machines that can still operate.
- Capability: Manpower capable of running tools and production machinery.
- Analysis: Tools and machines used in the production process of crude palm oil are still old tools, and machines with the capacity of the machine are 30 tons/hour and still can operate well.

5) Human resource development and marketing of CPO:

- Resource: Working people are people who are experts in their field. Market access is done with companies that have cooperated.
- Technology: HR gets training conducted by the company itself.
- Capability: The company produces high-quality crude palm oil. The standards applied are: FFA max of 2.5%, iodine value>55, RBD >76.92%, β carotene 550 ppm, ISO 9001-2008, ISO 14001-2007 and OHSAS 18001: 2007.

The formation of the CPO value chain can be seen in Fig. 7.

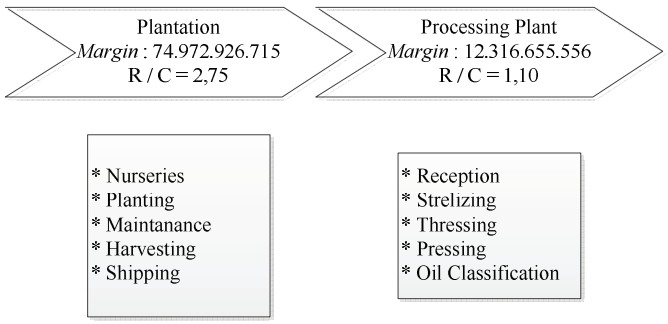

Fig. 7 The Formation of the CPO Value Chain

The value chain shows the overall value and consists of value and margin activity. Value is the amount of money that consumers are willing to pay for what the company provides. A margin is a difference between the total cost incurred by the company and the sales revenue earned by the company. There are at least two parties involved in the CPO value chain, namely oil palm plantations and palm oil processing plants. The CPO value chain forming activities can be seen in Table VI.

TABLE VI
FORMATION OF THE CPO VALUE CHAIN IN 2016

No	Activities	Plantation (x1000IDR)	Processing Plant (x1000IDR)
1	Palm Oil Plantation		
	salary of labor		
	- Nurseries	8,627,969	-
	- Planting	-	-
	- Plantation Maintenance	23,87,93	-
	- Harvesting	-	-
	- Shipping	-	-
	- Salary of daily labor	4,200,588	-
2	Palm Oil Processing Plant		
	- Raw material	-	118,785,137
	- Reception	-	513,897
	- Sterilizing	-	284,972
	- Threshing	-	138,485
	- Pressing	-	68,379
	- Oil Classification	-	208,423
	Total Cost	42,858,756	121,225,264
3	Sales	117,831,683	133,541,920
4	Margin	74,972,927	12,316,656
5	R/C	2.75	1.10

Two strategies that can be applied by the company that is a low-cost strategy and differentiation strategy. The low-cost strategy emphasizes the selling price that is cheaper than competitors to attract consumers. Consequently, the company must exercise strict cost control. Differentiation strategy emphasizes the uniqueness of the product. The resulting product has more value in the consumers' side. This strategy is done by stressing on superior quality.

1) Low-cost strategy:

- Palm oil plantation
- Analysis of palm oil plantation activities can be seen in Table VII. Based on the description, the activities of the plantation value chain have been good, but the utilization of liquid waste and empty fruit bunches (EFB) as compost fertilizer has not been done maximally. So that the value chain increase can be done on the cost of fertilization. Based on research, the processing of liquid waste and EFB into compost fertilizer will reduce the cost of purchasing compost [9].
- Palm oil processing plant

Analysis of palm oil processing plant activities can be seen in Table VII.

TABLE VII
ANALYSIS OF PALM OIL PLANTATION ACTIVITIES

Activity	Analysis
Nurseries Planting Plant Maintenance	Based on research [3] stated that: - Nursery activities, plant maintenance that includes fertilization activities already meet the exact criteria of type. - In the fertilization accuracy of fertilizer, doses have been by the standard plantation.
Harvesting Shipping	Based on the research of [4] stated that: - Harvesting and transportation activities (delivery) of FFB to the processing plant has been done well. - Harvesting is done by the applicable Company Operating Standard (COS). The harvested FFB is by the standard of the mature palm fruit. - The fruit transport to the processing plant is done simultaneously with the harvest day and not more than 24 hours. Because the free fatty acids FFB will increase over time and can reduce the quality of CPO produced.
Reception Sterilizing Threshing Pressing Oil Classification	Based on research in the CPO production process found that: - The production process is done by the COS set by the company. - The average yield of CPO produced in the year 2016 is 24.56 percent above the standard set by the company that is 22 percent.

Based on the analysis, the increasing added-value can be done by processing of palm kernel produced in the production of CPO into palm kernel and utilization of waste generated maximally. Solid waste of empty bunches and liquid waste can be used as compost fertilizer. Fiber and palm shells can be utilized as boiler fuel. Utilization of fiber and palm shell as boiler fuel can reduce the cost of purchasing diesel fuel as boiler fuel [7].

2) Differentiation Strategy:

- Palm oil plantation. The quality of FFB produced by oil palm plantation is good. The harvested fruit matches the standard of a mature fruit. Delivery of the fruit is also direct to the processing plants. Direct delivery will maintain the quality of the fruit because the longer fruit delivery will increase free fatty acids (FFA) that can reduce the quality of CPO [11], [15].
- Palm oil processing plant. Crude palm oil (CPO) which is produced by the company meets standard quality. The standard applied by PT. XYZ is as follows: FFA max. of 2.5%, Iodine value > 55, RBD olein > 76.92%, β-Carotene > 500 ppm, ISO 9001-2008, ISO 14001-2007 and OHSAS 18001:2007. With this high quality, the company can compete with similar companies.

The strategy used in increasing the value added activities is the low-cost strategy.

K. Recommendation for Company to Improve Value Added Activities

Increasing the added value that can be done based on the improvement of the CPO value chain can be seen in Table VIII.

TABLE VIII
ANALYSIS OF VALUE CHAIN IMPROVEMENT

Current Condition	Design of Improvement
In the CPO supply chain, the product analyzed only crude palm oil.	Increase in value added can be done with the addition of palm kernel product.
Utilization of liquid waste as compost is still 50%t.	Utilize maximally liquid waste as compost (100%).
Utilization of EFB as compost is still 97%.	Maximize the EFB as compost (100%).
The utilization of fiber as boiler fuel has been 100%.	The utilization of fiber as a boiler fuel remains 100%.
Utilization of oil palm shell as a boiler fuel is still 88percent.	Utilizing palm shells as boiler fuel to the maximum (100%).
Utilizing all compost produced by the company.	Utilizing all compost produced by the company.

The implementation of these strategies can increase the added value. The added value gained by oil palm plantations after the improvement was 73.50% with an increase of 1.08% added value from the previous (72.42%). While the added value obtained by the processing plant after the improvement of 21.86% with an increase of added value of 11.73% from the previous 10.13%.

IV. CONCLUSIONS

Based on the research, it can be concluded that a supply chain of CPO involves four main participants, namely plantations as raw material providers, factories as part of processing, distributors, and consumers. The flow of CPO supply chain starts from the flow of raw materials of palm fruit from plantation to processing plant then processed into CPO, stockpiled in tanks and storage warehouse, supplied to industrial consumers, distributed to retailers to the final consumer. Parties involved in the value chain of CPO consists of two parties, namely plantation and palm oil processing plant.

Activity in the value chain of CPO consists of two main categories of activities and supporting activities. The main activities were assessed in terms of raw material procurement, production and marketing. Supporting activities are reviewed from infrastructure preparation, industrial support, human resource development, technology development and procurement.

Stages of the CPO value chain that provide value-added are the provision of FFB by raw material supplier and processing in both palm oil plantation and palm oil processing plant by increasing maximizing the utilization of liquid waste, utilizing empty bunches as compost, and utilizing fiber and shells as boiler fuel.

A low-cost strategy had been applied, resulted in the value added increasing of oil palm plantations by 1.08% and at processing plants by 11.73%. The increase in value added has been able to reduce company's costs, but this study is still limited to analysis on plantation and processing plant, not including company's distribution and consumers of CPO products for maximizing the value added of a CPO value chain.

ACKNOWLEDGMENT

We would like to thank Putri Handayani Pane for data collection and the CPO Company for facilitating us in conducting this research.

REFERENCES

[1] Hasibuan, S. Thaheer, H., and Juliza, H. (2018). Life cycle impact assessment of palm biodiesel production towards the sustainability of downstream. *IOP Conf. Ser.: Mater. Sci. Eng.*. 453: 1-8.

[2] Hidayati, J., Mumtaz, G., and Hasibuan, S. (2018). Developing strategic planning of green supply chain in refinery CPO company. *IOP Conf. Ser.: Mater. Sci. Eng.* 309: 1-8.

[3] Hamdani, A. (2015). Manajemen pemupukan tanaman kelapa sawit (*Elaeis guineensis* Jacq.) di Perkebunan Bangun Bandar PT. Socfin Indonesia, Medan, Sumatera Utara. Bogor: Institut Pertanian Bogor.

[4] Anugrah, P. (2017). *Pengelolaan Pemanenan dan Transportasi Tandan Buah Segar Kelapa Sawit (Sawit (Elaeis giuneensis Jacq.) di Bangun Bandar Estate, PT. Socfin Indonesia, Serdang Bedagai, Sumatera Utara.* Bogor: Institut Pertanian Bogor.

[5] Gibbon, P., Bair, J., and Ponte, S. (2008). Governing global value chains: An introduction, *Economy and Society* 37(3): 315-338.

[6] Lie, C.C. and Yang, J. (2000). Knowledge value chain. *Journal of Management Deployment*, 19(9): 783-793.

[7] Budiarto, R. (2016). Potensi energi limbah pabrik kelapa sawit. Yogyakarta: Universitas Gadjah Mada.

[8] Giuliani, E., Pietrobelli, C., and Rabellotti, R. (2005) Upgrading in global value chains: lessons from Latin America clusters. *World Development*, 33(4): 549-73.

[9] Hidayanto. (2010). Limbah kelapa sawit sebagai sumber pupuk organik dan pakan ternak. Samarinda: Balai Pengkajian Teknologi Pertanian Kalimantan Timur.

[10] Hidayati, J., Sukardi, Suryani, A., Sugiharto, and Fauzi, A.M. (2016). Identifikasi faktor-faktor peningkatan produktivitas untuk revitalisasi perkebunan kelapa sawit di Sumatera Utara. *Jurnal Teknologi Industri Pertanian*, 26(3) : 255-265.

[11] Hidayati, J., Sukardi, Suryani, A., Sugiharto, and Fauzi, A.M. (2015). Optimization of palm oil plantation revitalization in North Sumatera Indonesia. *International Journal on Advanced Science, Engineering and Information Technology*, 5(6): 450-468.

[12] Salman, F., Najib, M., and Djohar, S. (2017). Cost and benefit analysis of RSPO certification: a Case study in PT BCA Oil Palm Plantation in Papua. *Indonesian Journal of Business and Entrepreneurship* 3(3): 219-228.

[13] Simatupang, T., Piboonrungroj, P., and Williams, S. (2017). The emergence of value chain thinking. *International Journal of Value Chain Management* 8(1): 40-57.

[14] Bolo, A.W., Lorika, J., and Obonyo, P.K. (2011). Effectiveness of the value chain strategy in the selected producer-owned dairy groups in Kenya. *Business Administration and Management (BAM)*, 1(3): 93-100.

[15] Hidayati, J., Sukardi, Suryani, A., Sugiharto, and Fauzi, A.M. (2014). Analysis of productivity improvement in the palm oil plantation revitalization of North Sumatera using Analytic Network Process. *International Journal on Advanced Science, Engineering and Information Technology*. 4(3): 38-44.

[16] Peppartd, J. and Rylander, A. (2006). From value chain to value network: insights for mobile operators. *European Management Journal*, 24(2-3): 128-141

[17] Kogut, B. (1986) *Designing Global Strategies: Comparative and Competitive Value-Added Chains. Sloan Management Review Summer*, 26(4): 15-28.

[18] Beamon, B. M. (1999). Measuring supply chain performance. *International Journal of Operations and Production Management*, 19(3): 275-292.

[19] Rosales, R.M., Pomeroy, R., Calabio, I.J., Batong, M., Cedo, K., Escara, N., Sobrevega, M.A. (2017). Value chain analysis and small-scale fisheries management. *Marine Policy*, 83: 11–21.

[20] Cucagna, M. E., and Goldsmith, P.D. (2018). Value is adding in the agri-food value chain. *International Food and Agribusiness Management Review*, 21(3): 293–316.