Improving the Quality of Crude Palm Oil to Reduce Losses with the Lean Six Sigma Method

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Abstract

PT. XYZ is company operating in the agribusiness sector that produces crude palm oil (CPO) from palm oil. In the production process, it always prioritizes product quality in order to compete with competitors. Currently, losses occur in the production process that exceed the national standard limit, namely 1,57%. This occurs in the separation process between palm fiber and oil, resulting in the resulting losses being quite high and affecting product quality. For this reason, efforts are being made to improve product quality using the lean six-sigma method. This method focuses on mapping process activities, analyzing waste, and then analyzing the level of process capability. From the result of data processing, it was found that the DPMO value was 78,51, or a sigma level of 2,92, which means that industry is very uncompetitive, so improvements are needed to reduce losses, such as carrying out regular machine maintenance so that losses can be reduced and the machine can work optimally, improving operator performance, so that operators can work according to standard procedures and check whether the level of raw materials meet standards or not, so that the CPO produced meets company specifications.

Keywords: *Crude Palm Oil, Quality Improvement, Lean Six Sigma*

1. Pendahuluan

Indonesia as the country with the largest production of crude palm oil (CPO) in the world, this is because supported by the geographical conditions that many found palm coconut plantations in parts of Indonesia. From this condition prompted industry players to develop their ventures in the production of CPO based on palm coke thus generating competition in the palm Coconut industry. Every player in the industry must demonstrate his ability to compete with the other companies. This ability can be seen through the products produced and the production activities carried out[1]. Production activities can be performed effectively and efficiently where consideration is given to quality, cost and time. Good quality, minimal cost, and short timing can provide many benefits to the company one of which is the improvement of quality for the company

Every company is always paying attention to the quality of its products, with quality guaranteed will increase consumer confidence and can promote marketing [2]. Quality is an important parameter to be taken into account by the Company in improving the competitiveness

of the products produced [3]. Quality are a series of characteristics of a product (goods and services) that can support performance to meet needs that have met the specified specifications or anything that can provide consumer satisfaction and meet the requirements and needs of the consumer [4].

One way to improve consumer satisfaction is to observe product quality standards by performing proper quality control, have ways and purposes clearly, find solutions by doing innovation [5]to solve problems that exist at the time of production process as well as product supervision in the company. Quality control can help the company in increasing the value of product quality by paying attention to the level of product damage to the lowest level or zero, so can withstand the occurrence of waste of materials and labor in the end can improve the quality of productivity [6].

The company is moving in crude palm oil (CPO) production by producing crude Palm Oil (CPA) and kernel (palm core), CPO is a product with high demand in the market, it creates a great opportunity against the emerging competition from other companies that produce CPO, so the company must take good steps to win market competition. The company also has a quality standard of Crude Palm Oil with a threshold of free fatty acids (alb) of 3.50%, water content of 0.20%, and dirt content of 0.02% This setting aims to anticipate not to exceed the national standard of 5%, the water level of 0.5% and the dirt level of 0.5%. The situation at the company shows that the standard of losses is 1.50% (national standard) whereas what happens in 2020 is 1.57%. One waste occurs in the production process is the separation between the fiber of palm fruit and oil resulting in losses that reduce the rate of profit of the company. So there are still standard parameters of palm oil quality that deviate from the maximum limit according to the company's regulations and regulations.

So there are still standard parameters of palm oil quality that deviate from the maximum limit according to the company's regulations and regulations. To solve the problem, a study should be carried out to identify factors that influence quality control.

2. Method

In this study the object studied is the production process of CPO at PT. XYZ located in South Sumatra. With data processing using the lean six sigma method with the help of DMAIC (define, Measure, Analysis, Improve, control). Data capture techniques are done with field observations on the part of the production process, brain storming with the parties involved by conducting interviews, literature studies as well as documentation.

On data processing, describe the stages of the lean six sigma method as the Company's strategy in improving product quality and reducing the level of product defects[7] .

2.1 Define

This phase describes the production process in the company, the selection of products that will be the focus of the research, the description of production processes includes the SIPOC diagram. This stage to define the plans and actions to be taken to implement the improvement of each stage of the industrial process [2]

2.2 Measure

This phase is a performance measurement phase with the aim of evaluating a set goal [8]. At this stage, we identify the waste that most influences the production process, determine critical to quality, calculate DPMO values, and measure defective products using P-chart calculations.

2.3 Analyze

The process of analysis is the process in which an attempt is made to find the reasons that lead to the occurrence of problems in the production process [9]. At this stage an analysis is made of the causes of losses and waste that most influence the process of production by creating a fishbone diagram. The tool used to find the cause of the problem and the consequences.

2.4 Improve

In the improvement phase, the FMEA method is used to identify the cause of product failure and identify major improvements that can be made based on the highest RPN values obtained from the results of severity, Occurance, and detection. An action plan to implement six sigma quality improvement, where every plan implemented must be evaluated its level of effectiveness through achieving performance targets such as lowering DPMO [2].

2.5 *Control*

This phase is the final operational phase in the effort to improve quality based on the six sigma method, at which stage the proposal proposal is implemented and evaluated [2]. The results of the improvement phase must be implemented within a certain time frame in order to see its impact on the quality of the product produced [9]. At this phase also emphasizes on documentation and dissemination of the Action taken [10]

3. Result and Discussion

The data processing in this study uses the concept of lean six sigma, from the data collection results obtained data output of production and the type of losses that occur on the product CPO namely:

Table 1. Production and losses of CPO

Bulan	Jumlah Produksi (Ton)	*Fruit Losses* (%)	*Empty Bunch* (%)	*Fiber From Fresh Cake* (%)	*Nut From Fresh Cake* (%)	*Final Effluent* (%)	*Standart* (%)
Januari	1.126,9	0,18	0,15	0,68	0,19	0,51	1,70
Februari	965,3	0,18	0,16	0,63	0,16	0,44	1,57
Maret	920,0	0,18	0,14	0,65	0,18	0,46	1,61
April	919,6	0,18	0,15	0,63	0,17	0,55	1,68
Mei	709,6	0,18	0,17	0,77	0,23	0,55	1,89
Juni	1.008,7	0,18	0,14	0,36	0,09	0,50	1,28
Juli	576,4	0,19	0,20	0,42	0,08	0,52	1,41
Agustus	725,2	-	0,26	0,56	0,09	0,51	1,42
September	993,3	-	0,33	0,59	0,09	0,52	1,53
Oktober	1.502,8	-	0,34	0,55	0,09	0,50	1,56
November	1.779,3	-	0,40	0,59	0,09	0,54	1,62
Desember	1.576,7	-	0,39	0,58	0,09	0,55	1,62
Total	12.803,8	0,18	0,24	0,58	0,13	1,51	1,57

3.1 Define

This phase describes the relationship between supplier, input, process, output, and customer (SIPOC diagram) which gives general information about the business processes carried out [11]. Input from the company is a sign of fresh fruit that will be used as a raw material in the production process. The production process consists of a weighing station, a loading station ramp, a sterilizer station, tippler station, thresher station, press and digester station, oil clarification station. The output of the production process is CPO. The customer of the CPO is storage. (storage tank))

As a company that produces CPO and kernel palm oil. The purpose of this method is to measure and reduce the losses of the CPO products that will be observed, as well as to know the cause of losses on the product and find recommendations for the best solution so that the production process of crude Palm Oil can be maximized and improve the quality of the crude palm Oil products.

3.2 Measure

Critical To Quality (CTQ) are all attributes that are very important to pay attention because they are directly related to the needs and satisfaction of consumers [12]. In the production process of Crude Palm Oil PT. Sriwijaya Palm Oil Indonesia researchers found some characteristics of quality or Critical to Quality (CTQ) that are present in the production of crude palm oil products namely, Fruit Losses, Empty Bunch, Fiber From Fresh Cake, Nut From Fresh Cake and Final Effluent.

This measurement is to determine to what extent a product can meet a specific consumer's needs, before the product reaches consumer hands [13]. In this measurement, DPMO (Defect Per Million Opportunities) measurements are used to determine the level of sigma. Before obtaining the sigma value, you must first perform calculations to determine DPMOs. The results of the calculation of DPMOS and the Sigma level of CPO production over a year can be seen in the table below:

Table 2. DPMO and Sigma values of CPO

Bulan	Jumlah Produksi	Jumlah *Losses*	CTQ	DPMO	Sigma
Januari	1.126,90	19,270	5	85500	2,87
Februari	965,3	15,155	5	78500	2,92
Maret	920	14,812	5	80500	2,90
April	919,6	15,449	5	84000	2,88
Mei	709,6	13,482	5	95000	2,81
Juni	1.008,70	12,810	5	63500	3,03
Juli	576,4	8,127	5	70500	2,97
Agustus	725,2	10,298	5	71000	2,97
September	993,3	15,197	5	76500	2,93
Oktober	1.502,80	22,241	5	74000	2,95
November	1.779,30	28,825	5	81000	2,90
Desember	1.576,70	25,385	5	80500	2,90
Total	12.803,80	201,051	65	940500	35,03
Rata-rata	1.066,98	16,754	5	78375	2,92

Based on the above DPMO value, the Sigma level value for the entire production process of CPO products in the last year is an average of 2.92 sigma..

3.3 Analyze

The control map is used to see whether or not corrections are required in such circumstances as indicated by the upper, lower, and also middle control boundaries. In this study, the attribute data used is the losses data of the palm oil production process, so the results are as:

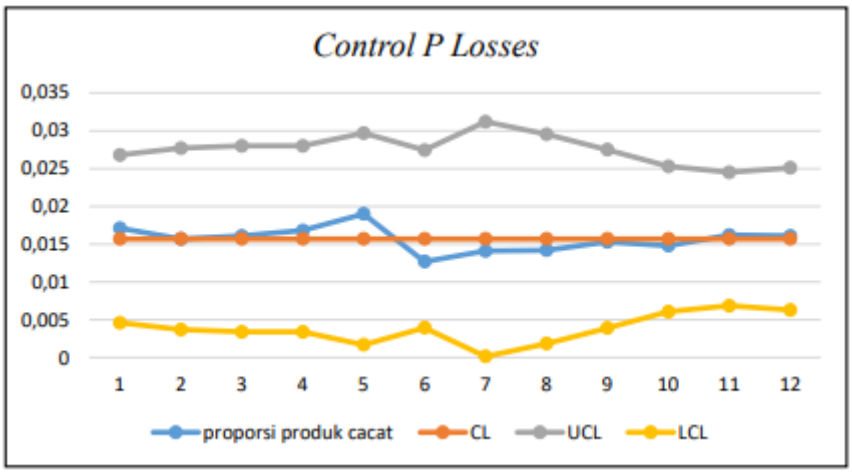

Figure 1. Control P Map Graph for Losses

Based on the control chart P of the palm oil production process in January to December above, it can be seen that the production process is stable, i.e. the value is already between UCL and LCL it means that the process is ongoing or operating with a reasonable cause (controlled) as expected. The most common types of losses are Fiber From Fresh Cake on crude palm oil with 37 percent, Final Effluent with 33 percent, Empty Bunch with 17 percent, Nut From Fresh Cake with 8 percent, and Fruit Losses with 6 percent.

After finding out the type of losses that are presented the greatest then then analyze to find out the cause of the losses by using fishbone. In the fishbone diagram above, the occurrence of Fiber From Fresh Cake at press and digester stations is due to a number of factors, including engine factors such as lack of maintenance schedules, decline in production machinery, human factor in rush, lack of care, and lack of supervision, material factor caused by poor raw materials or not meeting company standards, and a lot of broken fruit. The next method factor is the lack of temperature against the dilution of palm oil and the last environmental factor is poor environment.

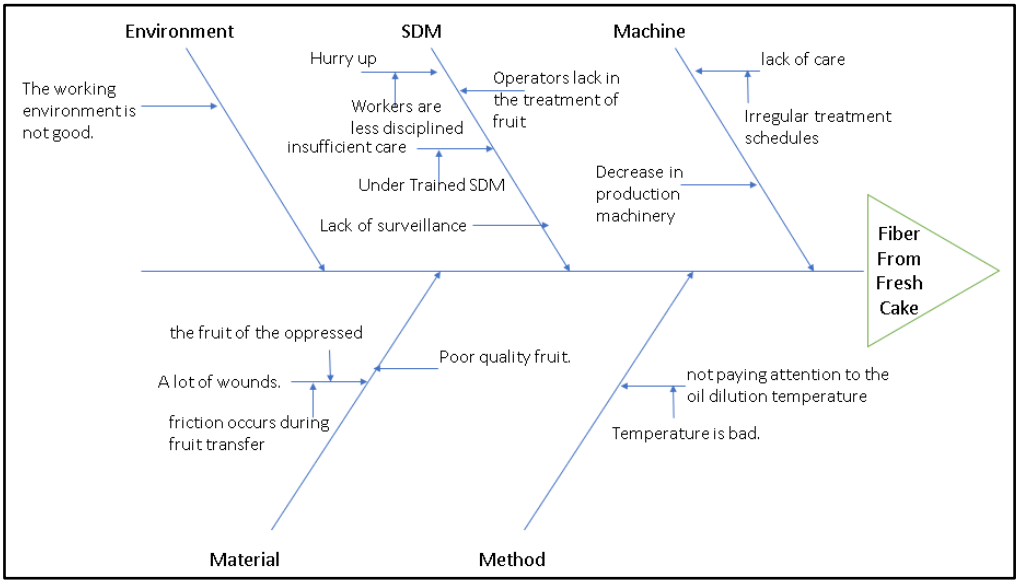

Figure 2. Diagram Fishbone causes fiber from fresh cake*Improve*

At the improvement stage, the factors and causes of losses in palm oil products are identified using the FMEA (Failure Mode and Effect Analysis) method. FMEA is a structured procedure to identify and prevent as many failure modes as possible[14]. By using the FMEA method, it is expected to know what kinds of losses often occur in CPO products. In the method FMEA there are three things that are assessed: Severity, Occurance and Detection. After assessing each of the assessment indicators, the Risk Priority Number (RPN) value is obtained from the multiplication of the Severity, Occurance and Detection values [15]. The RPN value is then sorted according to the highest value. The type of product loss that has the highest RPN value is defined as the dominant product loss occurring on crude palm oil products and requiring repairs. The improvement phase is carried out after finding out the cause of the loss of the product, then the next step will be the analysis of the problem using the FMEA method as in table 3 below.

Table 3. Recapitulation results with FMEA

No.	Factor	S	Cause of Losses	O	Control Recommendations	D	RPN
1.	SDM	7	Hurried because of the lack of discipline of the officers.	5	Create production schedules and operational standards procedure	3	105
		7	The SDMs are less careful because they're less trained.	6	The operator gives orders to the officer before the process production begins	3	126
		7	Operators lack in the treatment of fruit	7	Inspect raw materials very carefully.	3	147
		6	Lack of surveillance	5	Monitoring intensive	2	60
2.	Machine	8	An irregular schedule of treatments is only done when The machine is damaged.	5	Permanent maintenance of machinery	6	240
		8	Permanent maintenance of machinery	6	Permanent maintenance of machinery	5	240
3.	Material	8	Poor quality fruit.	6	Inspection of raw materials with very careful.	4	192
		7	Many of them were wounded by the tyres of the cars, and the friction that occurred at the time of the movement of the fruit.	5	Gives the distance between the car and the mark of fresh fruit	5	175
4.	Method	9	Lack of attention to the dilution temperature where the temperature is not good	2	Periodic temperature checks	3	54
5.	Environment	9	Less working environment Good	2	Installing a sound suppressant	2	36

After making the calculations using the calculation of FMEA on crude palm oil products to solve the problem that caused the defect dominantly by giving the advice and value assumed by the researchers, on the FMEA table, Treatment on the machine is only done when the machine suffers damage (unregulated) gets the largest RPN (Risk Priority Number) (240) with the recommendation performed maintenance of the machine periodically, then error on the raw material many of the fruits are wounded and the fruit is less qualified get the 2nd greatest RPN value (192) with recommendation to inspect the raw materials very carefully, Operators are less disciplined, less careful, and lack of supervision when the oil is separated from the fiber gets the biggest RPN (105) with a recommendation.

Analysis of DMAI methods obtained to measure and reduce losses crude palm oil knowing the causes of losses so made SIPOC diagrams, can be seen from the production process there are 5 types of loss from critical to quality namely Fruit Losses, Empty Bunch, Fiber From Fresh Cake, Nut From Fresh Cake and Final Effluent., and obtain the average value of DPMO 78.375 and sigma 2.92 which is good but still a long way to chase the world class industry with a value of 3.4.

Of the five types of losses, the largest percentage occurred in fibers from fresh cakes of 37%, where the control chart was at the normal point, of the largest percent made a fishbone diagram to find out the cause is human resources still in a hurry at work and less trained, machinery used less maintenance and decrease in production machines, material used less quality and a lot of fruit broken, methods used are less attentive to the temperature resulting in losses.

The condition of the company indicates that with the standard losses is 1.50 % whereas that occurred during 2020 is 1.57%, the highest losses occurred on fiber from fresh cake of 37 %, the solution was made using FMEA obtained the cause of the loss is the lack of maintenance of the machine so that the machine suffered a decrease in the production machinery that made losses at the time of production of crude palm oil occurred, so the recommendation of the repair performed the maintenance of machine periodically because when the production of coconut oil palm machine has been reduced due to continuous use and rarely carried out the maintenance machine then the solution performed periodically the machine will reduce the existing losses and to add added value by reducing the output of material using lean six sigma i.e. empty pledge used as fertilizer in the growth of palm tree, fiber used as fuel in producing crude Palm oil, the initial waste can be used as added value or replacement of other materials so that it can reduce the cost of the production process.

4. Conclusion

From the results of the analysis and discussion of the observation results can be drawn the conclusion of quality control with lean six sigma which is carried out maintenance of the machine periodically so that the existing losses can be reduced and to add value added empty promises as fertilizer in the growth of palm trees, fiber as fuel in the production of crude palm oil, which initially became waste can be added value or replacement of other materials so that it can reduce the cost of the production process.

There are five factors that cause losses on crude palm oil products: human resources that are still in a hurry to work, less trained, machinery used less care and reduction of production machines, material used less quality, a lot of fruit is damaged, methods used less attention to the dilution temperature where the temperature is not good leading to losses, and a poor working environment (shit) which affects workers at the time of work that affects the output of crude Palm Oil production.

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