

DECLARATION

I hereby, declare this thesis entitled “A Study on the Sustainability Programs and Practices, Legislative Compliance and The Benefits of Production Losses Elimination.” is the result of my own research except as cited in references.

Signature :

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APPROVAL

This Bachelor's report submitted to the senate of UTeM and has been accepted as fulfillment of the requirement for the Degree of Bachelor of Manufacturing Engineering (Manufacturing Management) with Honours. The member of the supervisory committee is as follow:

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ABSTRACT

Production losses elimination is the process of getting rid of disruption normal operations that leads to inefficiency. This can increase costs which may be difficult to recoup unless the situation can be rapidly resolved. The goals of this project are to study and determine the significant relationship between sustainability programs and practices, legislative compliance, the benefits of production losses elimination and to verify the tangible manufacturing sustainability practices in palm oil mill. A total of 28 selected palm oil mills in Malaysia have been surveyed using a questionnaire survey where Sime Darby Plantation Sdn Bhd and Felda Palm Industries Sdn Bhd (KKS Serling) have been chosen as the case study. In the study, 20 sustainability programs and practices, 18 legislation compliances and 36 benefits of the production losses elimination have been identified. From the results, it shows that the relationship between the cradle-to-cradle manufacturing and good crushing practice for palm kernel crusher has shown the strongest correlation while in term of legislative compliance and benefits of production losses elimination, most of the elements show the moderate correlation between each other. Also, six manufacturing sustainability programs have been verified where each of them were able to increase the efficiency of the palm oil mill. In conclusion, the project was able to help to identify and eliminate the production losses as well as to increase the productivity of the palm oil mill.

ABSTRAK

Pemansuhan ketidakpatuhan pengeluaran adalah proses pengurangan halangan terhadap operasi normal yang membawa kepada ketidakcekapan. Ini boleh meningkatkan kos yang mungkin sukar untuk di atasi melainkan jika keadaan ini boleh diselesaikan dengan cepat. Matlamat projek ini adalah untuk mengkaji dan menentukan hubungan yang signifikan di antara program kemampunan dan amalan, pematuhan perundangan, manfaat daripada pemansuhan ketidakpatuhan pengeluaran, untuk mengesahkan amalan kemampunan pengeluaran yang ketara di kilang minyak sawit. Sebanyak 28 buah kilang minyak sawit yang terpilih di Malaysia telah diselidiki menggunakan borang soal selidik di mana Sime Darby Plantation Sdn Bhd dan Felda Palm Industries Sdn Bhd (KKS Serting) telah dipilih sebagai kajian kes. Dalam kajian itu, 20 program kemampunan dan amalan, pematuhan undang-undang 18 dan 36 manfaat pemansuhan ketidakpatuhan di dalam pengeluaran telah dikenal pasti. Daripada keputusan kajian, ia telah menunjukkan bahawa hubungan antara *cradle-to cradle* dengan amalan penghancur isirung sawit yang baik telah menunjukkan korelasi yang kuat manakala dari segi pematuhan perundangan dan faedah pemansuhan ketidakpatuhan dalam pengeluaran, kebanyakan elemen menunjukkan sederhana korelasi antara satu sama lain. Selain itu, enam program kemampunan di dalam pembuatan telah disahkan di mana setiap daripada mereka dapat meningkatkan kecekapan kilang minyak sawit. Kesimpulannya, projek ini dapat membantu untuk mengenal pasti dan memansuhkan ketidakpatuhan di dalam pengeluaran serta meningkatkan produktiviti kilang minyak sawit.

DEDICATION

For my beloved parents:

Mohd Norddin Bin Ripin

Mida Binti Ramli

For my PSM supervisor

Dr. Wan Hasrulnizam B. Wan Mahmood

For my cherish siblings

Syamsulhazmi Bin Mohd Norddin

Syahrul Izwan Bin Mohd Norddin

Nuraisya Maisara Binti Mohd Norddin

And my treasured friends

UTeM's students

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Bismillahirrahmanirrahim...

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Muhamad Hazrul Bin Mohd Norddin

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LIST OF ABBREVIATIONS

BOE	-	Benefits of Production Losses Elimination
CDM	-	Clean Development Mechanism
Cp	-	Current Performance
FFB	-	Fresh Fruit Bunches
ISCC	-	International Sustainability & Carbon Certification
RSB	-	Roundtable on Sustainable Biomaterials
ISO	-	International Organization for Standardization
KKS	-	Kilang Kelapa Sawit
LCA	-	Life Cycle Assessment
MSPO	-	Malaysian Sustainable Palm Oil
NGOs	-	Non-Government Organizations
OSHA	-	Occupational Safety and Health Act
POME	-	Palm Oil Mill Effluent
pr	-	Priority
PSM	-	Projek Sarjana Muda
RBDPO	-	Refined Blanched Aerated Palm Oil
RSPO	-	Roundtable On Sustainable Palm Oil
SIRIM	-	Standards And Industrial Research Institute Of Malaysia
SPL	-	Sustainability Programs in Legislation
SPP	-	Sustainability Programs and Practices
SPSS	-	Statistical Package for Social Science
UNCCC	-	UN Climate Change Conference

CHAPTER 1

INTRODUCTION

This chapter provides the background of the study, objectives, scope and importance of the study.

1.1 Background of Study

Palm oil production in Malaysia is one of the most highest among the producing nations. The need of Malaysia is to fare palm oil to fulfil the developing business request worldwide for oils and fats around 58 million tons by 2020 (Ani and Mohamad, 2010). Further, it is estimated that local palm oil creation to increment to 26.6 million tons in 2035. Household interest of palm oil for nourishment utilization, mechanical non-sustenance uses and biodiesel is foreseen to increment by more than 200% to 1.4 million tons in 2035 (Ajeng *et al.* 2014). Understanding the local and overall requests of palm oil, delivering and preparing palm oil should be done in the most productive methodology. In the quest for execution magnificence in amplifying palm oil creation volume and secure future gainfulness, the Malaysian palm oil plants are depending upon the hardware to be working at high efficiency and proficiency, and keeping the issue before it may happens. Broad examination of the frameworks is obliged to keep legitimate perception for diminishing item dismissal and misfortunes, creating parts without imperfection with a specific end goal to

discover the inefficiencies of the creation framework. Speedy wastefulness recognizable proof utilizing execution measures are key as a part of creation administration to gauge genuine execution and contrast it with the hypothetical execution.

Joachim (2009) has stated that sustainability has turn into an extraordinary concern around the world, highlighting the issues of environment and social effect particularly in the assembling level. The estimation of supportability execution like financial, ecological, and social related variables are urgent to increase complete point of preference for Malaysian palm oil generation. European Union is the second biggest merchant of palm oil, the oil palm industry expected to meet the higher desire of these abroad clients on the natural execution of the business. These manageability execution desires can gradually start to change into requests in the commercial centre and may even turn into a business sector obstruction later on maintainability has been coordinated into assembling administration regions, for example, item improvement, production network administration, incline producing, and is exploration, endeavour is made to coordinate supportability into assembling execution by consolidating gear proficiency with reasonable assembling execution.

1.2 Problem Statement

Palm oil is one of the most traded agriculture commodities in the world. Global palm oil production is increasing every year, prompted largely by expanding bio fuel markets in the European Union and by food demand in India and China (Kanyarat *et al.* 2015). In Malaysia, palm oil industry has been an important agriculture sector in the economy for the past three decades. The important role of this industry to the Malaysian's economy is not only because Malaysia depends substantially on oil palm for its foreign exchange earnings, but also because palm oil is used a development tool in poverty alleviation program for the past three decades.

Nitty and Mohd (2011) state that the rapid growing of global demand of palm oil in the past decade reflects the total cultivation of oil palm in the producing countries, particularly in Malaysia and Indonesia. In order to meet the overwhelming demand, oil palm area needs expansion thus more lands are required for plantation. In some producing countries, expansion of oil palm leads to new areas is opened up for plantation and in most cases it involves deforestation. Conversion of primary forest to oil palm plantation accounted for more than 10 per cent of deforestation in Indonesia and Malaysia between 1990 and 2010 (Nwaigwe *et al.* 2013). It is reported that tropical land occupied by palm oil plantation increased from 1.55 million hectares in 1980 to about 12.2 million hectares in 2009. During the UN Climate Change Conference (UNCCC) in Copenhagen, it had been mounted that conversion of forest land to other uses by developing countries including oil palm plantation is considered as deforestation. Deforestation is a major source for greenhouse gasses emissions and this activity should be curbed. This scenario attracted the attention from the world particularly international non-government organizations (NGOs) on the issue of sustainable development in the palm oil industry.

Mohamad *et al.* (2015) has stated that the palm oil industry particularly in the Southeast Asia region suffered various criticisms and negative reports from the global NGOs to discredit palm oil. The whole industry has to face the growing accusations made by NGOs about the potential impact of palm oil plantation on environment and people. Some of them also launched anti palm oil campaign to harness support against palm oil. These issues could escalate to cause significant damage in the eyes of a consuming public that consider it as socially conscious. This intensive campaign is attacking companies' reputations and public trust over the production. Large international companies and owners of top-level brands are particularly vulnerable to criticism and often become target group in palm oil campaigning program. Some of the global environment organizations accused this industry is not being conducted within the boundary of sustainable development and contributing to a loss of biodiversity, uncontrolled green gas emissions, conduct unsustainable farming practices, soil, air and water pollutions, chemical contamination as well as land disputes and social problems.

Contrary, palm oil producers accused western NGOs are unfairly targeting Southeast Asia's oil palm industry while ignoring agricultural activities in other regions that also harm biodiversity, such as soy bean cultivation in South America. They also argued that oil palm cultivation is not a threat to biodiversity and deforestation because it is only cultivated in the designated allowable agriculture zoning area thus less disturbance to original habitats and permanent forests. Some analysts also stressed that cultivation of palm oil is able to maintain the biodiversity and preserve the flora and fauna. Intense media debates between environmental NGOs and industry player will be continued if the appropriate solution to overcome this issue is not giving attention by the world. It will affect the future development of palm oil industry as this issue is concerned about the trade-off between economic development and environmental protection, in which, at the end will reflect the social development of local communities. While at the same time, the earth must be protected from further deterioration elements, to ensure the safety of future generations (Fatin *et al.* 2014).

1.3 Objective

- a) To study the sustainability programs and practices, legislative compliance and the benefits of production losses elimination for palm oil mills.
- b) To determine the significant relationship between sustainability programs and practices, legislative compliance and the benefits of production losses elimination in selected Malaysian palm oil mills.
- c) To verify the tangible manufacturing sustainability practices in palm oil mill.

1.4 Scope

This study is conducted in selected Malaysia palm oil mills. The period of this study is started on December 2014 and ended on April 2015. The report covers several scopes:

- a) Make an analysis the significant of the sustainability programs and practices, legislative compliance and the benefits of production losses elimination in selected Malaysian palm oil mills.
- b) Identify the wastes produced in the palm oil mills.
- c) Make observation on how the process of crude palm oil is produced.

1.5 Significance of Study

The importance of this study is as follows:

- a) For a better understanding on how crude palm oil is produced.
- b) A comprehensive study on determining the significant of the sustainability programs and practices, legislative compliance and the benefits of production losses elimination.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the literature review of the palm fruits, the process of making palm oil, sustainability programs and practices, legislative compliances and the benefits of production losses elimination.

2.1 Palm Fruits

Palm oil and palm kernel oil are gotten from the product of the oil palm, principally the African oil palm *Elaeisguineensis*, and to a lesser degree from the American oil palm *Elaeisoleifera* and the Maripa palm *Attaleamaripa*. The Oil palm bears vast (up to 20-75 kg), gathered clusters of a huge number of organic products. The *Elaeisguineensis* begins to deliver natural products four to five years in the wake of planting. The fruit is 5 cm in distance across, lengthened, nutlike, gleaming splendid red to dark when ready. It takes around 6 months for natural products to mature. The palm organic product is drupe, oval fit as a fiddle, and contains a nut. Based on Mohammed *et al.* (2011), the nut is encompassed by stringy natural product mash or oil-bearing tissue (*mesocarp*) and the skin. The nut comprises of a hard shell and a part. Palm oil is a consumable vegetable oil got from the *mesocarp* (rosy mash) of the product of the oil palm. It is commonly rosy in shading due to high beta-carotene content. Palm portion oil is gotten from the piece of the same fruits. The distinctions are in shading (crude palm part oil needs *carotenoids* and is not red), and in

immersed fat substance. Palm *mesocarp* oil is 41% immersed, while palm bit oil is 81% soaked. Figure 2.1 shows the ripen palm fruits.



Figure 2.1: Ripen Palm Fruit

Musediq (2012) has reported that palm oil is a typical cooking fixing in the tropical cinch of Africa, Southeast Asia and parts of Brazil. Its use in the business nourishment industry is floated by its lower expense and by the high oxidative solidness (immersion) of the refined item when utilized for searing. Since the mid-1990s, red palm oil has been frosty squeezed and packaged for utilization as cooking oil, and mixed into mayonnaise and greens oil. Red palm oil cell reinforcements like *tocotrienols* and *carotenes* are added to sustenance and makeup due to their guaranteed medical advantages. In the wake of processing, different palm oil items are made utilizing refining courses of action to deliver “refined blanched aerated palm oil”, or RBDPO, and free sheer unsaturated fats, which are utilized as a part of the production of cleansers, washing powder and different items. RBDPO is the fundamental oil item sold on the world’s product market; albeit numerous organizations fractionate it further to deliver palm olein for cooking oil, or procedure it into different items. Palm oil, in the same way as other vegetable oils, can be utilized to make biodiesel, as either an essentially prepared palm oil blended with petro diesel, or transformed through trans-esterification to make a palm oil methyl ester mix, which meets the global particular. Glycerin is a side effect of trans-esterification. Figure 2.2 shows the cross-section of a palm fruit.

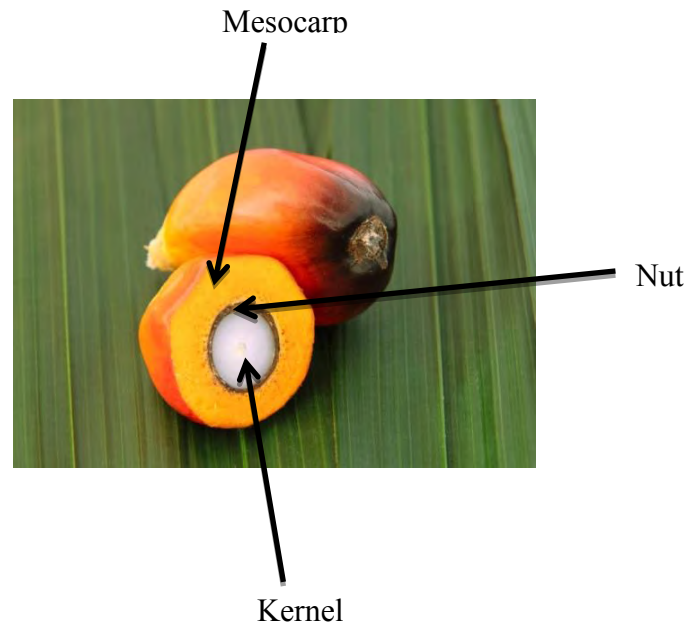


Figure 2.2: Cross-Section of a Palm Fruit

2.2 The Process of Making Palm Oil

Fresh fruits come from the field as bundles or detached fruits. The fresh fruit is typically purged into wooden boxes suitable for weighing on a scale so that amounts of fresh fruit touching base at the handling site may be checked. Huge establishments use weighbridges to measure materials in trucks. The quality standard accomplished is at first reliant on the nature of packs touching base at the factory. Vijaya *et al* (2009) has said that the plant can't enhance this quality however can anticipate or minimize further decay. The field calculates that influence the organization and last nature of palm oil are hereditary, age of the tree, agronomic, natural, collecting strategy, taking care of and transport. Huge numbers of these elements are outside the ability to control of a little scale processor. Maybe some control may be practiced over reaping strategy and in addition post-harvest transport and taking care of.

The fresh fruit group comprises of fruits implanted in spikelets developing on a primary stem. Manual sifting is attained to by cutting the fruits loaded spikelets from the pack stem with a hatchet or cleaver and afterward dividing the fresh fruits from

the spikelets by hand. Youngsters and the elderly in the town gain pay as easygoing workers performing this action at the production line site. In a motorized framework a turning drum or altered drum outfitted with rotating whipper bars confine the organic product from the pack, leaving the spikelets on the stem. Most little scale processors don't have the ability to create steam for cleansing. In this manner, the sifted fruits are cooked in water. Samson *et al.* (2011) has reported that entire packs which incorporate spikelets ingest a ton of water in the cooking procedure. High-weight steam is more viable in warming groups without losing much water. In this manner, most little scale operations sift groups before the organic products are cooked, while high-weight cleansing frameworks sift bundles in the wake of warming to release the fresh fruits. Little scale administrators utilize the cluster waste (vacant clusters) as cooking fuel. In bigger factories the pack waste is burned and the cinder, a rich wellspring of potassium, is come back to the estate as compost. Sterilization or cooking is defined as the utilization of high-temperature wet-heat treatment of detached fruits. Cooking regularly uses boiling hot water; sanitization uses pressurized steam. The cooking activity fills a few needs:-

- a) Heat treatment obliterates oil-part proteins and captures hydrolysis and autoxidation.
- b) For expansive scale establishments, where groups are entirely cooked, the wet warmth debilitates the fruits stem and makes it simple to expel the fruits from bundles on shaking or tumbling in the sifting machine.
- c) Heat helps to harden proteins in which the oil-bearing cells are minutely scattered. The protein hardening (coagulation) permits the oil-bearing cells to meet up and stream all the more effortlessly on pressure.
- d) Fruits cooking debilitate the pulp structure, softening it and making it simpler to confine the stringy material and its substance during the processing procedure. The high heat is sufficient to in part upset the oil-containing cells in the mesocarp and licenses oil to be discharged all the more promptly.
- e) The moisture presented by the steam demonstrations artificially to separate gums and resins. The gums and resins cause the oil to froth during frying. Some of the gums and resins are solvent in water. Others can be made

dissolved in water, when separated by wet steam (hydrolysis), with the goal that they can be evacuated during oil clarification. Starches show in the fruits are hydrolyzed and evacuated along these lines.

According to Ahmad *et al.* (2010) digestion is the procedure of discharging the palm oil in the fruits through the crack or separating of the oil-bearing cells. The digester normally utilized comprises of a steam-warmed tube shaped vessel fitted with a focal turning shaft conveying various blender (mixing) arms. Through the activity of the turning whipper arms the organic product is beat. Beating, or processing the natural product at high temperature, serves to decrease the consistency of the oil, annihilates the organic products' external covering (*exocarp*), and finishes the interruption of the oil cells as of now started in the cleansing stage. Sadly, for reasons identified with expense and support, most little scale digesters don't have the warmth protection and steam infusions that assistance to keep up their substance at hoisted temperatures during this operation.

There are two different methods for extricating oil from the processed material. One framework utilizes mechanical presses and is known as the "dry" method. The other called the "wet" method uses heated water to drain out the oil. In the "dry" method the target of the extraction stage is to crush the oil out of a mixture of oil, moisture, fiber and nuts by applying mechanical weight on the processed squash. Nursulihatimarsyila *et al.* (2010) has stated that there are an extensive number of distinctive sorts of presses yet the standard of operation is comparable for each. The presses may be intended for cluster (little measures of material worked upon for a period) or persistent operations. The principle contrasts in group press plans are as per the following:

- a) the system used to move the plunger and apply the weight.
- b) the measure of weight in the press.
- c) the extent of the cage.

Norul *et al.* (2012) has stated that the plunger can be moved physically or by an engine. The mechanized system is speedier however more costly. Distinctive plans utilize either a screw string (axle press) or a water driven framework (pressure driven press) to move the plunger. Higher weights may be achieved utilizing the water powered framework yet care ought to be taken to guarantee that noxious pressure driven liquid does not contact the oil or crude material. Water powered liquid can ingest dampness from the air and lose its viability and the plungers destroy and need incessant substitution. Shaft press screw strings are made from hard steel and held by milder steel nuts so that the nuts destroy quicker than the screw. These are simpler and less expensive to supplant than the screw. The measure of the enclosure shifts from 5 kg to 30 kg with a normal size of 15 kg. The weight ought to be expanded steadily to permit time for the oil to get away. On the off chance that the profundity of material is excessively extraordinary, oil will be caught in the focal point. In keeping this, substantial plates can be embedded into the crude material. The generation rate of group presses relies on upon the measure of the enclosure and the time expected to fill, press and discharge every cluster. Water powered presses are quicker than shaft screw sorts and fueled presses are speedier than manual sorts. A few sorts of manual press require impressive push to work and don't ease drudgery.

The early axes and hydraulic presses have now offered approach to extraordinarily composed screw-presses like those utilized for different oilseeds. These comprise of a barrel shaped punctured enclosure through which runs a nearly fitting screw. Processed organic product is constantly passed on through the enclosure towards an outlet limited by a cone, which makes the weight to remove the oil through the confine apertures (penetrated gaps). Mahidin *et al.* (2012) said that oil-bearing cells that are not cracked in the digester will stay unopened if a pressure driven or diffusive extraction framework is utilized. Screw squeezes, because of the turbulence and massaging activity applied on the natural product mass in the press enclosure can viably tear open the unopened oil cells and discharge more oil. These presses go about as an extra digester and are productive in oil extraction. Moderate metal wear happens amid the squeezing operation, making a wellspring of iron pollution. The rate of wear relies on upon the kind of press, technique for squeezing, nut-to-fiber proportion, and so forth. High squeezing weights are accounted for to have an

unfriendly impact on the detergent capacity and oxidative protection of the removed oil.

The principle purpose of clarification is to discrete the oil from its entrained contaminations. The liquid leaving the press is a mixture of palm oil, water, cell garbage, sinewy material and „non-oily solids“. Due to the non-oily solids the mixture is thick (viscous). High temperature water is in this manner added to the press yield mixture to thin it. The weakening (addition of water) gives a hindrance bringing about the overwhelming solids to tumble to the base of the holder while the lighter oil droplets move through the watery mixture to the top when warmth is connected to break the emulsion (oil suspended in water with the help of gums and resins). Water is included a degree of 3:1. The diluted mixture is gone through a screen to uproot coarse fiber. The screened mixture is bubbled from maybe a couple hours and after that permitted to settle by gravity in the substantial tank so that the palm oil, being lighter than water, will separate and ascend to the top. The acceptable oil is tapped into a gathering tank. This clarified oil still contains hints of water and earth. Emiliana *et al.* (2012) has stated that to avoid expanding FFA through autocatalytic hydrolysis of the oil, the dampness substance of the oil must be decreased to 0.15 to 0.25 percent. Re-warming the emptied oil in a cooking pot and deliberately skimming off the dried oil from any engrained soil uproots any leftover dampness. Figure 2.3 shows the process flow of making palm oil.