

**SYSTEMATIC LITERATURE REVIEW  
OF EVALUATION OF QUALITY  
MANAGEMENT PRACTICES IN  
PALM OIL SUPPLY CHAIN: THE  
CASE OF UPSTREAM**

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**ABSTRACT**

Malaysia is classified among the world's leading producer and exporter of palm oil. A statistic recorded at 2016 indicates that the total oil palm planted area in Malaysia have reached 5.74 million hectares. In previous findings, the palm oil industry are linked together from upstream to downstream and consists of four sub-sectors which are growers, millers, refiners, and oleo chemicals. However, some organization has yet develop a tool to assess quality

management practices in the upstream activity. Besides, the quality management practices implemented has not been so effective. There are various quality management practices that are currently being implemented in palm oil industry. This research attempts to identify the current quality management practices in palm oil upstream supply chain and to develop an instrument to produce quality palm oil in upstream sectors. This paper presents a systematic review on quality management practices in upstream sectors and the final selection comprehends 32 articles selected and comprehensively analyzed to assess quality management practices in upstream processes of palm oil supply chain and finally producing an oil palm quality management tool in the form of checklist.

*Keywords: Oil palm supply chain, quality management, quality assessment, management practices*

**1.0 INTRODUCTION**

Oil palm tree (*Elaeis guineensis*) is a tropical tree crop originates from West Africa that was grown mainly for its industrial production including in Malaysia. Malaysia contributed about 30% of the world's palm oil production and 37% of export market respectively. A statistic recorded at 2016

indicates that the total oil palm planted area in Malaysia have reached 5.74 million hectares (MPOB, 2016). Palm oil consumption had grown up in a good pattern to become the world's largest produced and consumed oil.

Oil palm when compared to other vegetable oil has the highest yield compared to other sources of oil and is the least expensive to produce and refine (AGEB, 2015). Its production cost is cheaper than rapeseed oil for about at least USD200 per tonne and also cheaper than soybean, groundnut and sunflower oil (Tan et al. 2009). Palm oil has been proven to be enriched with antioxidants and has beneficial effect on cholesterol level and it is a very useful product which leads to an increased demand of its commercial operation (Edem, 2006).

Even though previous research proven that palm oil is without doubt having more advantages compared to other edible oil, extensive research about the oil palm in Malaysia and also the world are still lacking especially in the SCM field (Omain. S.Z et al, 2010).

## **2.0 METHODOLOGY**

### **2.1 Method**

The method being used in this research is Systematic Literature Review

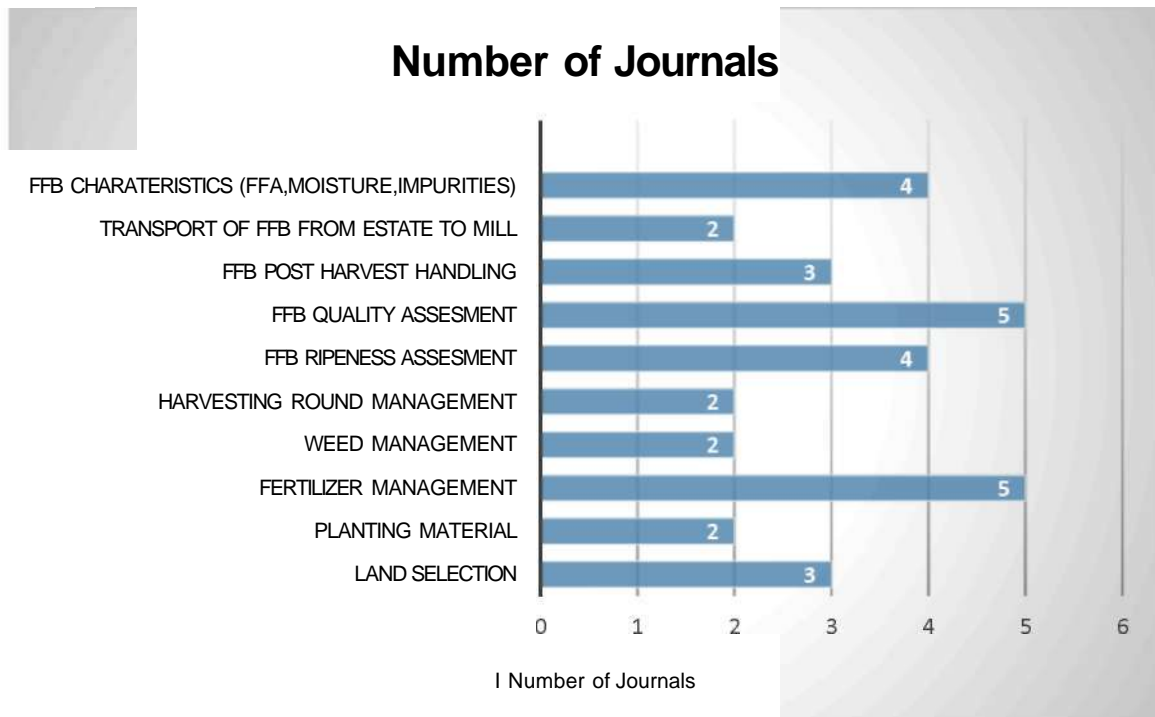
(SLR). A systematic literature review is a method involving identify, evaluate and interpret all available research which is relevant to a particular research question, topic area, or situation of interest.

Systematic review is a method of literature review which adopt a series of steps to ensure the appropriate transparency is brought in the process of analysing lots of paper. It suggests that there are four phases needed to prove this research is relevant which is: planning, sampling, analysis and reporting (Tranfield, Denyer, and Smart, 2003).

### **2.2 Data collection**

The sources were identified from various databases and a number of 472 articles were retrieved. The criteria is further screened by removing duplicate articles which reduces the number of articles into 390. After title screening, the articles were further narrowed to 233 and further narrowed into 150 after the abstract were screened. This number includes articles discussing about QMP, SCM, GAP, and other main practices and management system exists in the oil palm upstream supply chain area. Other sources also being used to strengthen the findings such as primary documents from MPOB, SOP from big companies, and also conference materials from MPOC.

### 3.0 RESULT



**Figure:** Graph representation of number of articles discussed about management practices in oil palm upstream sector

Based on the results obtained, the sector with highest number of article is fertilizer management and FFB quality assessment. This might due to the importance and direct effect of such factors towards the oil palm quality itself.

### 4.0 DISCUSSION

#### 4.1 FFB post-harvest handling

According to Mat Sharif et al (2017), first process to be supervised is the post harvesting handling where harvester should handle the oil palm FFB with care after the FFB being harvested because the FFB could

easily become damaged and bruised if it is not handled properly. All FFB and LF were collected from the palm base should be delivered free from any contamination of ground debris and stones to the collection points at the road side with minimum damage, delay, contamination and being sent to the mill together with harvested bunches.

In other study by Krisdiarto, A. W., & Sutiarto, L. (2016), in order to resist quality reduction it is recommended that FFB should be handled carefully. High impact when dropping and throwing the fruit by the harvester and fruit loader should be avoided. Meanwhile, the fruit collector and transporter

should try to reduce the friction and bump among the fruit.

#### 4.2 Transport of FFB

A study by Hadi, S., Ahmad, D., & Akande, F. B. (2009) suggest that to reduce bruising during transportation of FFB to mill is by taking sterilizer cages to the field for immediate sterilisation process. For process of transport of FFB to the mill, harvested bunches should be transported by lorry, tractor-drawn trailers or rail cages.

According to Ismail et al (2014), they also states that the FFB and LF should be sent to the mill preferably within 24 hours after harvesting. Transport should be arranged in such a way that the FFB do not become contaminated with undesirable substances and quality is preserved. The general requirement is that the compartments should be dedicated to FFB, free from previous load residues, free from odour of previous loads, mineral oil and is dry. This should be checked before each consignment. The result of the cleaning actions should be checked visually and recorded.

Another aspect to be prevented during transport is the penetration of rainwater and splash water. Even if the load compartments are empty, it needs to be covered in order to prevent rain penetration and contamination from bird droppings. In case of road transport, the outside of the means of transport including the chassis

should be free from visible traces of previous cargoes (Ismail et al., 2014).

#### 4.3 FFB characteristics

A study by (Hazir et al, 2012) states that a ripe FFB should have an OER higher than 21% and the FFA content less than 5%. The OC and FFA level are determined through analysis at the chemical laboratory (Makky, M., & Soni, P., 2014). The FFA level determines the quality of palm oil, because high presence of FFA leads to production of poor quality of oil (Makky, M., & Soni, P., 2014). The temperature and moisture content influences FFB physical and mechanical properties (Morakinyo, T. A., and Bamgboye, A. I, 2015).

Previous studies also shows that the FFA content and oil quality will slowly be reduced if there was no immediate heating step taken (Sivasothy et al, 2005). A study was also found that a damaged FFB causes the lipase enzymes to be rapidly hydrolysed, contamination of FFB by microorganisms and FFA development on the FFB (Tan et al., 2009).

#### 4.4 FFB quality assessment

According to Makky, M. and Soni, P. (2014), the FFB quality can be determined by its ripeness, FFA and OC level. Balasundram et al (2006) states that to ensure quality FFB is graded physically right before it passes through process of oil extraction and current FFB quality assessment is very time

consuming and prone to errors and inconsistencies.

The storage time of damaged oil palm fruits is also a major problem that could activate the lipase enzymes and eventually reduce the oil quality where a study proves that the length of the storage periods showed significant correlation with the FFA release rate within a 2 hour storage period (Fatin et al., 2014).

#### 4.5 FFB ripeness assessment

In practice, manual ripeness assessment is carried out by visual inspection (Makky, M. and Soni, P. (2014). The FFB colour varies from very dark purple for unripe to orange for ripe bunch. To harvest, the bunch ripeness needs to be analysed first. To determine the ripeness of bunch on a tree, observing the number of loose fruits on the ground is one of the method Fadilah et al., (2012). Another way to determine the ripeness is based on observing different colour intensities of FFB by referring to the colour ripening index (Tan et al., 2010). Using this index, a ripe bunch could be differentiated from other FFB categories such as the black bunches, under ripe bunches, overripe bunches, empty bunches and rotten bunches. According to indicator used, purplish black indicates an unripe bunches, reddish black indicates an under ripe bunches, red indicates a ripe bunches, and reddish orange indicates an overripe bunches.

Another method available to determine the ripeness according to Alfatni et al., (2008) is by measuring the fruit firmness using penetrometer based on colour, shape and feature. Other than that, measuring level of chemical type and parameters are also related to ripeness such as spectral image analysis and pH value.

#### 4.6 Harvesting round management

According to study by Woittiez et al, (2017), Plantations Company usually have harvesting round of 7-day, 10-day or 14-day interval while smallholders usually having harvesting intervals of 14 or 15-day sometimes up to 30 days. Having a shorter period of harvesting interval is important as they proved that the yield increase at 5-20% when reducing length of harvesting round from 14 to 10 days.

Another study by Lee et al (2014) that were more focused on smallholders further proven the above research findings where it shows that harvesting once a month predicted the lowest yields in smallholder oil palm plantations. They find that short harvesting intervals around 7-10 days helps to improve fresh fruit bunch productivity of oil palm crops.

#### 4.7 Weed management

Based on study by Dilipkumar et al., (2017), weeds affect crop production and the importance of managing weeds is usually ignored by farmers and government officials. The effects of weeds on oil palm are difficult

to be expressed due to their long economic life up to 20-30 years. The researchers reported that because of strong competition from weeds, yield losses in oil palm plantations are up 6% to 20%. Oil palm growers normally assume that weeds can easily be controlled by herbicides or mechanically. This misinterpretation prevents effective weed management.

In overall, chemical control has been widely used as a weed management tool for oil palm sectors. There have been issues where the application of herbicide mainly affects the main crop being grown which is the oil palm itself. A findings from Wibawa et al., (2007) proved the issue to be wrong based on their research data regarding the FFB amount per plant and the number of fronds for each plant. The results shows that as long as the herbicides used in the research such as glufosinate ammonium, paraquat, and glyphosate were not sprayed directly at the plant, they had no adverse effect on the vegetative growth of the oil palm.

#### 4.8 Fertilizer management

A study by Comte et al., (2013) states that the fertilizer input on oil palm is very much needed to sustain high yields and usually contributes to 40-65% of total upkeep costs of the field. For a duration of 25 years, fertilizer management within a plantation requires an annual plan for 25-30 hectare of each block. A specific fertilizer sequence is received by each block and each

were different from the others. On a multiannual period, blocks may receive only mineral fertilizers, only organic fertilizers or they receive both mineral and organic fertilizer but alternately or known as mixed fertilizer sequence.

Based on study by Mohidin et al, (2015), N, P and K nutrient elements is one of the main factor that affect in oil palm seedlings and also mature palm growth and development that resulted from better nutrient management. Fertilizer application practice were conducted to ensure the growing plant get all the required nutrients for optimum growth.

The most important nutrient element in terms of plant growth, carbohydrate content and physiology is Nitrogen (Almodares et al., 2008). Phosphorus is the second most important nutrient for plants that are needed for energy transfer and storage and low availability of phosphorus is a limiting factor to plant growth (Fita et al., 2011). Potassium is the third important nutrient that needed for maintaining osmotic balance, phloem transport, and photosynthesis (Tripler et al., 2006).

#### 4.9 Planting material

Current issue arising is the yields of oil palm reached a stagnant level due to unimproved planting materials being used in the field (Okoye et al., 2009). They suggest that to improve productivity, generation of superior populations is much needed. This is

vital to develop an elite planting material to be used for breeding purposes and as potential genetic resource.

However, we need to estimate heritability among the fresh fruit bunch yield traits of different breeding populations because high heritability estimates resulting high genetic advance for FFB yield. At the end of the process of choosing a right planting material, the number of bunches (BN) and average bunch weight (ABW), is a major outcome that will be gained (Okwuagwu et al., 2008).

#### 4.10 Land selection

To start an oil palm plantations it is good to begin with the selection of appropriate land or soil, to determine the land potential that can be developed to obtain the proper management of oil palm fruit productivity (Idayu et al., 2014).

Oil palm can grow, develop and produce as expected when the available soil water is even and sufficient with areas of rainfall 2000-2500 mm / year and dry months less than one month per year (Henson, I. E., and Harun, M. H, 2007). The temperature should be around 22°C to 33 °C with relative humidity more than 85% (Carr, M. K. V., 2011).

## 5.0 CONCLUSION

The result obtained from this paper would be very beneficial as it is the first paper

discussing about QMP in the oil palm sector. QMP is very much needed to establish a link between the entire processes and distribution channels of products to gain customer satisfaction. Thus, the checklist produced will help the oil palm growers to produce more quality palm oil which ultimately increases profit as the norm in the marketplace, a product with high quality are categorized as more valuable and were priced differently than middle quality products. Such gains will also benefits the national income as palm oil is seen as one of the major source of GDP in Malaysia.

Based on SLR method conducted, it can be seen that there are very limited amount of resources that can be referred to produce a good QMP. Other industries such as automotive and medicals publishes journals more frequent compared to plantation industry. Even if there is journals published, the journals itself were outdated and not reliable to be referred in current situation as the industry keeps on growing and improving in line with technology development especially with the introduction of Industrial Revolution 4.0. This makes it hard for researches to have a reliable source of reference to conduct a study.

Apart from that, other edible oil have their own published papers to be referred with its own checklist so it is easier for growers to monitor their QMP to ensure the final product that they were producing and it

does not happen in the case of oil palm. Other than that, future concern is that this checklist might be unaccepted by growers because this recommendation is new and might need time to be accepted and implemented. Besides, the awareness of some sections of oil palm growers such as smallholders about GAP might limit the success of this checklist.

For further improvement of this research, a more extensive analysis of each process involved might be conducted to be more detailed, with complete explanations and effects QMP implementation towards the palm oil quality. Improvement of the checklist also are much needed as this is the first checklist that were being published for public uses and it might still lack of certain information due to limited amount of resources. A case study can be conducted in the oil palm plantations at different companies so the exact process involved can be analysed. By doing such, the QMP would benefit as the data become more accurate to current industry scenario. Oil palm industry would gain a lot as quality is often being linked with profitability and initiatives to improve quality management would mean a higher profit generated towards the national income.

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