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ECO-FRIENDLY PRACTICES IN OIL PALM PLANTATION IN SABAH – A SURVEY

FABIAN LIM CHIN WEN

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIRMENTS FOR THE DEGREE OF
BACHELOR OF AGRICULTURE
SCIENCE WITH HONOURS

CROP PRODUCTION PROGRAMME
SCHOOL OF SUSTAINABLE AGRICULTURE
UNIVERSITY MALAYSIA SABAH
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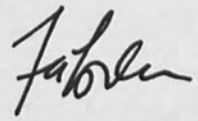

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ABSTRACT

This research was done with the objective to review the eco-friendly practices in oil palm estates located in Sabah. The study was divided into three management aspects; namely fertilizer management, pest and disease management, and land preparation and biodiversity management. A survey method using questionnaire form was used to collect the data from the respondents. The questionnaire form was developed based on the 'Guidelines to Good Agriculture Practices for Palm Oil' which was introduced by Unilever (2003). A total of 17 respondents responded to the questionnaire. Descriptive statistics and chi-square test were used to analyze the data. From the test, it was discovered that the respondents were aware of eco-friendly practices and has already deployed the methods in their respective estates. This finding was contradicting with the statements made by Western countries, various bodies and the media.

AMALAN-AMALAN MESRA ALAM DI LADANG KELAPA SAWIT DI SABAH: SATU TINJAUAN

ABSTRAK

Kajian yang telah dijalankan ini adalah bertujuan untuk meninjau amalan-amalan mesra alam yang dipraktikkan oleh ladang-ladang kelapa sawit di negeri Sabah. Kajian ini telah meninjau tiga aspek pengurusan iaitu pengurusan baja, pengurusan penyakit dan perosak serta pengurusan penyediaan tanah dan biodiversiti. Kajian ini telah menggunakan kaedah tinjauan dengan menggunakan borang soal selidik untuk mengumpulkan data kajian daripada responden. Borang soal selidik ini telah dibangunkan berdasarkan kepada buku 'Guidelines to Good Agriculture Practices for Palm Oil' yang diperkenalkan oleh Unilever (2003). Sebanyak 17 responden atau ladang kelapa sawit yang telah memberi respon kepada borang soal selidik yang diedarkan. Data yang telah dikumpul ini kemudiannya di analisis dengan menggunakan kaedah statistik deskriptif dan juga ujian khi kuasa dua. Hasil analisis menunjukkan bahawa ladang kalapa sawit di negeri Sabah telah mempraktikan amalan mesra alam dalam ladang mereka. Kajian ini adalah sebalik daripada penyataan oleh badan-badan, media dan negara-negara Barat.

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This study would not be completed nor would it go so smoothly if not for both my supervisors. Both of my supervisors were very helpful in providing aid in understanding how to complete the project.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

BSR	Basal Stem Rot
BT	*Basillus thuringiensis*
CEC	Cation Exchange Capacity
CIRP	Christmas Island Rock Phosphate
Eco-Friendly	Environmental Friendly
EFB	Empty Fruit Bunches
FFB	Fresh Fruit Bunches
GAP	Good Agriculture Practices
HCVF	High Conservation Value Forest
IPM	Integrated Pest Management
K	Possession
KIES	Kieserite
LAI	Leaf Area Index
MOP	Muriate of Potash
MPOB	Malaysian Palm Oil Board
N	Nitrogen
P	Phosphorus
POME	Palm Oil Mill Effluent
PORIM	Palm Oil Research Institute Malaysia
RSPO	Roundtable Sustainable Palm Oil
SAAB	Sustainable Agriculture Advisory Board
VAM	Vascular Arbuscular Mycorrhizal

CHAPTER 1

INTRODUCTION

Oil palm has been the backbone for Malaysian economy for a number of decades now. Approximately 11 percent of total land in Malaysia today has been used for oil palm plantation and reports shows that it would continue to increase, especially in the state of Sarawak and Sabah (MPOB, 2008). However, the environmental impact has been an issue which has been questioned over and over again.

The reason for this paper is to review the practices in the oil palm plantation and how environmental friendly it is. If such paper was produced thirty years ago, the results might be different compare to today as new technologies and the practices in plantations have already curbed the problems faced. Thus this paper is also to give awareness of environmental problem facing today and not based of papers which are most likely no longer valid.

Perhaps one of the largest factors affecting the environment by the oil palm plantation would be the management itself (Tan *et al.*, 2007). Naturally, if the management were poor in aspect, it would bring negative impact to the environment. Waste products come in many forms in the plantation and the oil palm mill, thus proper management in necessary to ensure no or minimal damage to the environment.

It is also important that the management team in the oil palm plantation follows the criteria by the government. Malaysian government has set up several acts to protect environment which all plantations must follow. However, how many plantations do follow every part of the act set by the law, undergo Environmental Monitoring Program (EMP), and follow the Roundtable of Sustainable Palm Oil (RSPO) guidelines? Furthermore, how many plantations do take steps for the protection of the environment? These are the aspects of implementation which this paper will review.

The statement 'no man is an island' applies well in the oil palm plantation. Ensuring environmental safety is not just the responsibility of the top management, but also the entire team. Even staffs from the labour department play a role in environment protection. There are possibilities where labourers do not follow guidelines entirely such as discarding toxic waste irresponsibly. This is just an example. In reality there are other cases as well.

Some of the management systems are relatively old. These managements were passed down perhaps several decades ago, managers after managers. There are possibilities where the management steps need a review since fertiliser and crop protection chemical application and rate might defer due to advancement of technologies in the chemicals itself, new strain of oil palms, or even new findings. A review is thus needed to ensure management procedures are still applicable.

Oil palm mills in Malaysia are partly powered by using the waste from the empty fruit bunches (EFB) which is a method of managing waste. However, due to the high content of moisture (50%), a white smoke is produce which makes the area hazy. Although moisture is the reason towards the white smoke and not harmful chemical, the mills are still considered a contributor to air pollution as stated by Sumiani *et al.* (2004) and Sumiani *et al.* (2006). Management team in the oil palm plantation might take further steps to curb this by methods such as upgrade the mill if available in the market.

As for fertilisation management, do the management team practices planting leguminous cover crop to enhance fixation of nitrogen into the soil? This will reduce the fertiliser rate as well as safe cost while reducing residue in the environment. At the same time, if the management team do practises such method, do they remove the leguminous plant after it has serve the purpose or do they let it rot in the field? Removal of the dead or dying cover crop will increase soil's acidity which should be avoided (Crews and Peoples, 2003)

1.1 Problem Statement

There were claims that oil palm plantations were build on the expanse of open burning of virgin forest while others believe that it cause loss of stability of the environment (Glastra *et al.*, 2002). This further brings forth reasons that show palm plantations were not environmental friendly and cause harm to the planet in several ways. Oil palm plantations on the other hand say that they were not causing harm to the environment. Many management practices and more sustainable approach in the plantation was developed and introduced. Since the early 1990s, books had been published and guidelines ware compiled for a more sustainable oil palm plantation and many articles was produced even before that (Singh *et al,* 1999). With ever development of eco-friendly and sustainable practices, does the plantation abide with the practices been laid out? Thus, the significant of this study was to review if plantations were really practicing environmental friendly practices which have been laid out.

1.2 Objective

The objective was to review back the methods and practices of oil palm management in relation to the environment. There were three (3) specific managements targeted to be reviewed:

a. Fertilisation Management
b. Pest and Disease Management
c. Land Preparation and Biodiversity Management

1.3 Scope of Study

The scope of study will cover a representative number of oil palm plantations in Sabah. Ten companies in Sabah having oil palm plantations were selected to be reviewed. Each of the company was represented by three estates as a replicate for a more accurate result finding. There was no need to have all the estates being reviewed since the practices in most of the estate belonging to the same company would be expected to be similar, if not the same. Survey Questionnaire was used to collect data from the representative.

1.4 Terminology

1.4.1 Eco-Friendly Practices

As stated by Anderson (2007), Eco-friendly practices involve use-efficient practices, recycling of materials and reduction in pesticides use thus leading to reduction of off-site environmental effect. It was also stated that Eco-friendly system is one that has a high use-efficiency of inputs, while having an output which is minimum or no impact to the environment.

1.4.2 Fertiliser Management

This involves the management of fertilisation of the plantation. The purpose of this management was to ensure optimum growth of the palm during immature stage and to ensure that yield was at the optimum levels. This management involve intensive study of nutrient requirement of palm oil at different stages and the necessary application if fertiliser deficiency exists. This was to ensure that no wastage occurs for economical reasons and environment reasons.

1.4.3 Pest and Disease Management

Oil palms are prone to attack by range of pest and diseases. Management of pest involves the control of several types of pest namely rodent pest, insect pest, mammalian pest and weeds. Disease on the other hand involves the management to control and to eradicate and disease and the vector which carries the disease causing agent. There are several methods to control pest and disease. The most commonly adopted practices to control pest and disease is Integrated Pest Management (IPM). IPM involves a series of different approach in pest and management and is considered as sustainable method.

1.4.4 Land Preparation Management and Biodiversity

This management involves the preparation of the land for planting of oil palms. Often, the land was prepared by converting forest land to oil palm land by means of jungle clearing. For existing plantations, old trees were felled to make way for new plantings. There were generally three types of method used in land preparation; Mechanical Clearing, Manual Felling, and combination of both. Land preparation also involves following guidelines which has been set by the government to ensure the environment was preserved. At the same time, biodiversity is maintained in when land is being prepared. Before any conversion of land to oil palm plantations, Environment Impact Assessment (EIA) must first be done. In existing plantations, biodiversity is maintain by various methods such as using selective pesticides and herbicides to control targeted pest only, maintaining riparian buffer zone along the river, and preserving wildlife by maintaining secondary forest in unproductive areas.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Researches in oil palm have been going on for years. Perhaps one of the earliest research institutes was Palm Oil Research Institute Malaysia or PORIM, which is known today as Malaysian Palm Oil Board (MPOB). This is not the only institute which conduct research in the development of Oil Palm and it's used but others from government bodies and private too played a part in the development of Oil Palm. A well known private company which contributed significantly into the oil palm industry is Golden Hope which today has merge with Sime Darby. Golden Hope's contribution to the industry was the finding and the development of Zero Burning technique in land clearing. Although originally they were ridiculed for such method, today it is one of the most important steps in land clearing of forest and replanting. Research and Development still continues today for a better oil palm industry in terms of better yield, better management, and better guidelines. (Tomich *et al.,* 2004; Khairudin *et al.,* 2007; and Tan *et al.,* 2007)

2.1 Fertiliser Management

Fertiliser is one of the most important management in the plantation as it is directly related to the yield. Improper management of fertiliser would lead to waste of fertiliser, both organic fertiliser and chemical fertilisers. (Pigott, 1990; Rankine and Fairhurst, 1998; Turner and Gillbanks, 2003; Lelong *et al.*, 2007)

2.1.1 Foliar Analysis

This is a commonly used method to detect the level of nutrient within the palm. It is relatively accurate if proper preparation of the blades was done. A set percentage from a given area is sampled. (Pigott, 1990).

This method has its limitation as well. Currently, it is still impossible to obtain precise fertiliser recommendation due to analytical error. Further complication occurs when human error are involves. However, what is known in analytical data is it has about 5% nitrogen, 5% phosphorus, 19% potassium, 19% magnesium, and 3% chlorine of confidence level. Turner and Gilbanks (2003) also stated that there are times where there is no correlation between nutrient levels and optimal yield. It is also stated that it is not fully reliable as nutrient levels do not show until critical levels of depletion has occurred. This is particularly true for potassium. Apart from that, foliar analysis does not detect environmental factors such as soil conditions. This would also limit the nutrient uptake, especially when pH levels are low where nutrients are tie up within the soils. Therefore, precise fertiliser recommendation rates are impossible until several application and analysis. This method is time consuming and cost (Lelong, 2007).

2.1.2 Organic Fertiliser

Organic fertilisers are fertilisers made from organic compounds, normally from animal and plant source. Commonly used organic fertilisers are goat manure, chicken manure, and fish meal which could be obtained from the market. Green manures are also used and can be obtained from most agriculture shops. Green manures also come in various forms such as composts and palm kernel cakes. (Sharma, 2003)

Today, organic fertiliser is making a comeback in the agriculture. Organic fertiliser comes in many forms, either processed form or those obtain *in situ*. In the oil palm plantation, organic matter can be obtained the form of Empty Fruit Bunch (EFB), pruned fronds, palm trunks, or even droppings from integrated animals. (Turner and Gillbanks, 2003).

POME or Palm Oil Mill Effluent is a by product from the mill. It is a mixture of water, oil, fibres and soluble by products. This is obtained after filtration of oil from the

mill where the rest of the materials are discarded. Research has been done where this by product actually contains a relatively high nutrient content. Turner and Gillbanks (2003) reported that POME is produced by processing by-products of the mill in anaerobic pond followed by aerobic pond as a means of treatment to reduce any toxic materials and to reduce the BOD. The POME is obtain at the bed of the pond while the water can be discharge into running water bodies if the BOD is lower than 1000ppm, or in accordance to the law of the area.

Singh *et al.* (1999) also reported that POME is a good source of nutrient and would be a good practice to recycle nutrient. Others had also showed benefits of using POME (Turner and Gillbanks, 2003).

The rate of application of POME is directly related to the soil type (Singh, 1999). Turner and Gillbanks (2003) has also reported that coastal clay soils in Malaysia would improve in soil properties such as pH level, organic carbon, total nitrogen, total and available phosphorus, exchangeable calcium, magnesium and organic matter, as well as an insignificant increase in exchangeable potassium. Like all fertiliser, balance input of POME is needed to ensure optimum yield.

Table 2.1: Comparative Mean Nutrient Values and Equivalent Fertiliser Amounts of POME Applied at 5cm rey

Nutrient	**POME ppm**	**Fertiliser type**	**Equivalent fertiliser (kg/palm)**
Nitrogen	183	Ammonium Phosphate	3.0
Phosphorus	34	Rock Phosphate	0.8
Potassium	1101	Potassium chloride	7.5
Magnesium	252	Magnesium Sulphate	5.5
Calcium	180	Limestone dust	1.7

Note:*Data varies according to aspects of the milling process
Source: Oil Palm Cultivation and Management (Turner and Gillbanks, 2003)

Application of POME in excessive amounts has shown to have low impact towards the environment. Tested area where excessive POME was applied and groundwater contamination was found to be nil even after thirteen years of continues application. As for changes in soil, usually there is a significant changes at the 80cm of

the soil surface. After application of five years, there is only an extended laterally about 100cm, thus suggesting it is unlikely that application of POME would have adverse effect towards the environment. It is also found that liquid POME has higher effect towards improvement than dried cake POME. It is also found that palms have little respond towards chemical fertiliser application when POME is applied. Finally, POME must be processed before being used. Although raw POME has nutrient level and can be used directly, it is found that processed POME has higher nutrient and beneficial levels. There is also a fear of microbial outbreak in water bodies when applying raw POME, although up to date, there is no proof where harmful microbes manage to enter any water bodies from the raw POME. All in all, application of digested POME at rates suitable for the palms is a safe and effective method of utilising the effluent.

EFB is another good source of nutrient to the plantation. EFB is obtained when all the fruitlets are collected and what is left would be the fruitless bunch or also known as Empty Fruit Bunches. Previously, EFB is used to power the boiler by burning in the furnace. Due to environment concern, this practice has been reduced. Thus, to rid of the EFB without burning, new products has been produce from it such as fibre-wood and roof tiles while the shells are made into charcoal and eco-friendly or green bricks (Singh *et al.,* 1999).

EFB is purely organic. Thus, addition of EFB into soils would increase the organic matter on that area. This would increase soil fertility by increasing the Cation Exchange Capacity (CEC), providing more available nutrients to the palm. Increase in organic matter would also improve the soil structure of that area. Thus, applying EFB on low quality soils such as hard pan soils, sandy soils, or unfertile soils would improve in the structure of the soils and fertility. It would also release soil conditional organic chemicals which would aid in binding the pegs of the soil together, particularly important to improve sandy soils (Turner and Gillbanks, 2003). Turner and Gillbanks (2003) also stated that reduction of evapotranspiration and improvement in soil water holding capacity can be enhanced through use of the oil palm by products of EFB after processing, palm oil mill effluent and trunk chipping when replanting, especially if applied in advance of periods of heavy rainfall.

Anderson (2007) also stated that a good way to replace nutrient in the most natural way possible would be the used of Empty Fruit Bunch (EFB). By doing so, it

would also consider a good practice as efficient management of nutrient cycling and adding external nutrient when needed. There was also estimation where 23% of the standard application of 3.5kg KCl per palm was in excess of demand (Tarmizi and Mohd Tayeb, 2006). This shows that standard application might need to be review back to ensure no wastage of fertiliser occurs nor does it pollute the environment. His paper which was on eco-friendly approach in oil palm plantation specifically mention of use-efficient in the plantation to ensure reduce input which would ultimately reduce runoff, if not completely no runoff. He also stated that some of these steps would also increase the economical value of oil palm. One fine example would be the used of EFB as a means of mulching, biological control agent, nutrient recovery by deep-rooted plants, growth medium, and erosion control. The list did not just ended at the plantation level but also outside of the plantation. The used of fibres from the EFB could be converted into scrubbing material, and fibre chopping board. All of these innovations are intended to increase the economical value of oil palm plantations by reducing harm towards the environment. Khairudin *et al.* (2007) of Golden Hope Research Centre also reported similarly of the use of EFB, so does Singh *et al.* (1999).

Table 2.2 Composition of Empty Fruit Bunches

Parameter	**Dry matter basis**		**Fresh w.t. basis**
	Range	Mean	**(Mean)**
Ash (%)	4.8 – 8.7	6.3	2.52
Oil (%)	8.1 – 9.4	8.9	3.56
C (%)	42.0 – 43.0	42.8	17.12
N (%)	0.64 – 0.94	0.80	0.32
P_2O_5 (%)	0.18 – 0.27	0.22	Continue...
K_2O (%)	2.0 – 3.9	2.90	
MgO (%)	0.25 – 0.40	0.30	0.12
CaO (%)	0.15 – 0.48	0.25	0.10
B (mg/l)	9 – 14	10	4
Cu (mg/l)	22 – 25	23	9
Zn (mg/l)	49 – 55	51	20
Fe (mg/l)	310 – 595	472	189
Mn (mg/l)	26 – 71	48	19
C/N Ratio	45 – 64	54	54

Source: Oil Palm and The Environment – A Malaysian Perspective (Singh *et al.,* 1999)

Singh *et al.* (1999) reported that EFB as mulch is a good method to provide nutrient, just as most journals. However, Singh *et al.* (1999) also provided a table, which is shown below, containing the complete composition of EFB in percentage. According to the table, it would have an equivalent of 7 kg urea, 2.8 kg rock phosphate, 19.3 kg muriate of potash, and 4.4 kg of kieserite.

Fronds are a common by-product from the plantations. Fronds are pruned to ensure correct Leaf Area Index (LAI) for optimum yield of the plant. Fronds are also pruned for the ease of scouting, observation, and harvesting. However, the frond which has been taken down contains nutrients as well. This could be used as a means of nutrient recycling (Singh *et al.,* 1999; Pegott, 1990; Turner and Gillbanks, 2003).

Turner and Gillbanks (2003) reported that fronds could be recycled in the stacking path to incorporate the nutrient into the soils. It is reported that most of the feeder roots (tertiary and quaternary roots) would accumulate at that area due to the high organic content. This proves that the fronds are decomposed in that area, releasing the nutrient into the area. Feeder roots of the palm tend to grow towards nutrient rich area of the soil.

Fronds are also used as soil erosion preventer, or mulch. Fronds are also stack on terraces on hilly areas to reduce soil surface runoff. This usually works by reducing the velocity of the flow of rainwater during rainy days, ultimately reducing the amount of soil it carries. It also reduces chemical runoff from that area, such as fertiliser and herbicide chemicals. This would lead to little or no chemical wastage and pollution (Pigott, 1990; Rankine and Fairhurst, 1998; Turner and Gillbanks, 2003; Anderson, 2007). Turner and Gillbanks (2003) also mention stacking pruned fronds along contours would reduce erosion and improving overall soil fertility

Integration of livestock animals is also an area of management to increase fertilisation *in situ.* Livestock, like any other animals, would produce manure and this manure are a source of organic fertiliser. Livestock integration has not been well accepted in Malaysia due to lack of information and skill. However, Suboh Ismail *et al.* in PIPOC 2007 have presented a paper on Oil Palm integration with Yellow Cattle with interesting results and recommendation. Ismail *et al.,* stated that there was no significant difference in soil compaction between integrated area and non integrated

area. There was also on significant difference of yield between areas with the cattle and areas without the cattle. From the cattle evaluation point of view, there was an increase of calve by 28% in the first year, 74% in second year, and 70% in third. The reduction of calve production was due to the culling of infertile cattle while no replacement was made for those been culled. As for the sex ratio, the male:female was 51:49. However, when oil palm leaf nutrient was tested, it was found that boron was significant higher in the grazed area compare to un-grazed area. It is possible that the additional boron comes from the droppings of the cattle. As for other nutrients, there was no significant difference. This indicates that cattle integration has no negative impact towards oil palm yield and nutrient, and soil compaction. As for the soil, there was no significant difference in pH level but the nutrient content in the soil such as carbon, nitrogen, phosphorus, calcium, and magnesium were significant higher in grazed area. This further shows that the manure of cattle provides additional nutrient to the oil palm while reduce competition with weeds. As concluded by the authors, yellow cattle integration shows no detrimental impact towards the oil palm plantations nor the soil while being economically viable. It is also concluded that using systemic rotational grazing system is most appropriate for integration of cattle in oil palm.

2.2 Pest and Disease Management

Pest and disease is found in every agriculture activity, whether in the field or in the nursery up to the laboratory. To ensure good yield from the field, most pest and disease should be kept at bay. However, it is not as simple as said, keeping disease and pest at a distance is easy but to be environmentally sound at the same is difficult. This is one of the few challenges which the plantation faces and many techniques and technologies have been developed for this department.

2.2.1 Integrated Pest Management (IPM)

Integrated Pest Management is a technique comprising of a cocktail of methods from varies aspect. There are several concept/formula towards IPM which varies according to suitability and while there are a few, there are no 'right' or 'wrong' formulas since it is tailor to suit the particular situation. In general, there are a cocktail of six approach, namely a combination of chemical, biological, cultural, host plant resistant, physical control, and regulatory control. As for Golden Hope Plantation, Khairudin *et al.* (2007)

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