DESIGN AND DEVELOPEMENT OF PNEUMATIC MINI DISC OIL PALM FRUIT STALK CUTTER

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CANDIDATE'S DECLARATION

"I hereby declare that the work in this thesis/project is my own except for quotations and summaries which have been duly acknowledged. The thesis/project has not been accepted for any degree and is not concurrently submitted in candidate of any other degree."

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"To family and friends"

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Apart from the efforts of myself, the success of Pneumatic Mini Disc Oil Palm Cutter depends largely on the encouragement and guidelines of many others. I would like to take this opportunity to express my humble gratitude to the people who have been instrumental in the successful completion of this project.

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ABSTRAK

Kekurangan tenaga buruh dalam industri sawit telah mencetuskan kebimbangan banyak pihak terutamanya dalam memastikan dapatan keuntungan melalui pengimbangan produktiviti dan kos pengeluaran. Kaedah tradisional dalam penuaian buah tandan segar yang menggunakan sabit mengambil masa yang lama dan menjejaskan kecekapan pengeluaran. Laporan ini adalah kolaborasi daripada beberapa bab yang berkisar tentang semua aspek penting dalam merekabentuk alat pemotong pneumatik. Bab pertama adalah merujuk kepada bahagian pengenalan yang meliputi penyataan masalah, objektif dan skop permasalahan. Bab kedua laporan ini memaparkan tentang teori-teori dan dapatan daripada penyelidikan terdahulu berkenaan alat pemotong tandan segar. Ciri-ciri fizikal pokok kelapa sawit dinyatakan dengan jelas sebagai garis panduan untuk memastikan produk akhir dapat digunakan dengan berkesan. Bahagian seterusnya adalah berkaitan dengan teknik atau metodologi yang terdapat dalam penyelidikan. Dapatan juga telah dinyatakan dalam selingan supaya pemilihan data yang sesuai boleh dibuat. Satu alat penuaian baru, yang direka khas untuk menuai buah tandan segar, akan direka dan dibangunkan dengan menggunakan mekanisme pneumatik. Produk ini adalah diharapkan meningkatkan lagi produktiviti dalam bidang penuaian.

ABSTRACT

Shortage of labour recently has forced all parties involved in the oil palm industry to find ways and means to at least maintain the profit through balancing the productivity and the production cost. The traditional sickle method of harvesting oil palm fresh fruit bunch takes a lot of time and reduces production efficiency. This report writing contains several chapters that will cover all important aspects related in designing a pneumatic mini disc cutter. The first chapter is an introduction to the study which includes the problem statement, objectives and scope of the relevant discipline of study and will be referred to throughout this research. The second chapter is a description of the theory and the results of previous studies ever conducted in relation to the study of fresh fruit bunch cutting tools. The physical quantity of the oil palm itself has also been clearly explained to ensure the end product can be utilize efficiently in harvesting process. The next section is related to the actual composing technique or perhaps methodology found in the research. In this section, some with the methods used are described in detail. The finding has also been stated in the process so that appropriate data selection can be made. A new harvesting tool, specifically designed for oil palm trees, is about to be designed and developed, by means of using pneumatic system, to increase productivity in the field harvesting.

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LIST OF SYMBOLS

F_P	=	Pulling Force (N)
F_R	=	Reaction Force (N)
F_C	=	Cutting Force (N)
W	=	Weight (N)
x	=	Maximum distance where the force can be apllied(mm)
Σ	=	The sum of
δx	=	Change in distance (mm)
η	=	Safety factor
s_{ut}	=	Ultimate tensile strength (Nm^2)
σ_{max}	=	Maximum stress (Nm^2)
W	=	Wide (cm)
H	=	Height (cm)
L	=	Long (cm)

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Projek Sarjana Muda (PSM) is one of the most important aspects of local university to evaluate their degree level students. Through PSM, students will be able to apply all the knowledge they had learnt in related field of engineering.

Engineering is first and foremost the application of knowledge. However, the application must be carried out with judgement, to ensure that the resultant system is effective and efficient, and that it is of benefit. The PSM is one of the primary the mechanisms used by the local university to provide students with an opportunity to gain experience in the practical, effective, efficient, and beneficial application of what you have been studying for the past several years. Naturally, student will continue to gain engineering experience after they graduate but the final year project will always be their first exposure to the full rigour of engineering practice. It is essential that the students learn from this exposure and practise all of the engineering methodologies involved. It is particularly important that they learn not just to apply what they know, but to apply it with judgement, with the ability to assess what they are doing and to be critical of it.

This chapter will cover several subtopics in project area which consist of project background, the objectives, the scopes and the problem statement.

1.1 BACKGROUND

Harvesting costs signify near 45% associated with total expenses in adult plantations. This activity is usually initiated whenever palms tend to be between 23 and 36 months. Precocity as well as early yields rely on environmental problems, the range, the quality from the nursery plantation, care throughout planting, as well as early administration. The initial bunches produced are little in size and consist no much oil, and they are normally not harvested.

In regards to a week prior to the first commercial harvesting, the palms tend to be cleaned (sanitary pruning) associated with old lifeless leaves as well as bunches. No green leaves ought to be cut, since a new palm needs them all. During earlier harvesting rounds it is suggested to “steal” the bunch by means of cutting the fresh bunch without having to cut any leaf. This practice might be done till bunches can be found to the height of 1 meter within the soil area.

Bunches might be cut utilizing a narrow chisel (5-8 cm width), having a metal handle about 1.2 m in length, or a little Malayan knife (sickle-shaped) mounted on a brief aluminium rod. The purpose is to reduce as much of green leaves as possible. As the palm grows older, the bunch weight increases, from about 2.5 kg at the beginning (2-3 years after planning), to 25 or even more kilograms within matured palms. However, the fruit bunch production decreases with its age.

A matured palm produces 8-13 bunches each year, which signifies about 140-175 kg associated with FFB (fresh fruit bunches), that will generate 30-38 kilograms. The optimum potential when it comes to FFB production is usually reached within commercial plantations once the palms tend to be between four and eight years old. During this period, yields could be between 15 as well as 40 tonnes of FFB each year, which signifies 3.3 - 8.8 tonnes of crude palm oil/ha (considering 22% extraction in the mill). The causes of such differences need to be found upon climate, earth, agronomic management, and obviously, the variety used.

Harvesting in some way is very challenging in the sense that bunches build up the majority of its oil throughout a fairly short time (a few days) of development

time. If the FFB is harvested too soon (unripe), it will contain less oil than its potential. If harvested past due, the actual oil is going to be partly deteriorated (free fatty acid accumulation). The actual ideal level of ripeness is actually evaluated through the harvester through bunch colour, texture, the change in colour, and the presence of loose fruits. Ripen fruitlets turn out to be soft, as well as change from a black coloration to shiny brown and finally to an opaque reddish-brown appearance at the tip and orange-reddish on the medium section.

The time needed to achieve maturity varies based on palm age, the variety and environmental conditions, but usually takes between 5.5 and 6 months from the time of anthesis (pollination). Typically, bunches tend to be harvested within young palms when 10 or even more loose fruit are discovered. For matured palms, the amount of loose fruit is decreased to 5. In order to gather peak proportion associated with bunches using the optimum level of ripeness; harvesting cycles need to be relatively short: every 8-15 days, depending upon palm grow older and time from the year (bunch density).

Throughout the very first 5-6 years, harvesting is performed using a metal chisel (14 cm width or less), welded to a metal hollow rod or attached to a wood pole (1-3 m long). In matured palms, cropping is performed using so-called Malaysian knifes (sickle-shaped) mounted on hollowed aluminium rods, that are light and incredibly flexible. The length of the aluminium pole is increased with palm. The employee might crop 100-300 large bunches (10-25 kg) per day on an adult planting, or 400-1, 000 small ones (3-8 kg) in a young plot. Effectiveness depends upon the power from the worker as well as bunch density.

1.2 PROBLEM STATEMENTS

Shortage of labour recently has forced all parties involved in the industry to find ways and means to at least maintain the profit through balancing the productivity and the production cost. The traditional sickle method of harvesting oil palm fresh fruit bunch takes a lot of time and reduces production efficiency. So, it is clearly there is an immediate need to formulate and develop a technology that can cut fruit bunches easily and efficiently.

Because of the urgent need, most tools have been developed without considering the necessary technical information for cutting frond and fruit bunches. The physical properties of the material, reaction of the material against the cutting edge, method of cutting, cutting angle and speed of cutting have not really been considered.

Product that can really satisfy engineering needs comes with really great cost and unaffordable. CANTAS™ is the latest technology developed by Malaysian Palm Oil Board (MPOB) and can really increase productivity in FFB harvesting. This technology, however, is a bit pricy especially for smallholders.

1.3 OBJECTIVES

The objectives of this project are:

a) To create a power tool that is
    a. Cost saving
    b. Environmental friendly
    c. Safe
    d. User friendly
    e. Able to be commercialized
    f. To run analysis on the best design that can reduce energy consumption

b) To design a cutting tool that is reliable, efficient and easy to handle
c) To reduce production cost, reduce labour requirement, increase productivity and improve efficiency of field operations

1.4 SCOPES

The scopes that need to be covered throughout this project are:

a) To design and develop a pneumatic oil palm fruit stalk cutter using multiple mini disc cutter
b) The design is developed to replace the traditional sickle cutter
c) To formulate and develop a technology that can cut fruit bunches easily and efficiently.
d) The design is only focusing on the cutter mechanism itself excluding design of the pole and the air compressor
e) To design a cutting tool that enhances cutting force with minimal energy consumption

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The literature review is really a description from the literature that is highly relevant to a specific field or even topic. It gives the general idea of what has been said, who the key writers are, what are the prevailing theories and hypotheses, what questions are being asked, and what methods and methodologies are appropriate and useful. As such, it is not in itself primary research, but rather it reports on other findings.

The literature review might be purely detailed, as within an annotated bibliography, or it might provide a vital assessment from the literature inside a particular area, stating in which the weaknesses as well as gaps tend to be, contrasting the actual views associated with particular writers, or increasing questions. This type of review will not just be considered as summary but will even evaluate as well as show associations between various materials, to ensure that key styles emerge. A descriptive evaluation however should not just checklist and paraphrase, but ought to add remark and enhance themes as well as trends.

This literature review will generally give an overview or the ‘big picture’ of what will be conducted throughout this project. These include

i) The information on palm oil tree
ii) Previous research on the technologies regarding to palm oil industry

2.1 BACKGROUND

The oil palm is the most productive species among oleaginous plants. Malaysia is currently the world's biggest producer of this particular plant. However, the Malaysian palm oil is now facing competition not only from other oil and fat industries but also from other palm oil producing countries. Rising competition in the world market, declining in price, and shortage of labour are some of the factors influencing the well being and future of oil palm industry.

2.1.1 Palm Oil Industry in Malaysia

In 1960, Malaysia plays only a minor part in producing oil palm with a total cultivated area of 55 000 hectares and production of 92 700 tonnes per annum. In 1995, however, the total area planted with oil palm increased to about 2.358 million hectares producing about 7.6 million tonnes of crude palm oil, which was about 64% of the total world's production. It is estimated that by the year 2005, Malaysia may produce 10 million tonnes of crude palm oil and 2.5 million tonnes of palm kernel (Dato' Khalid, 1996).

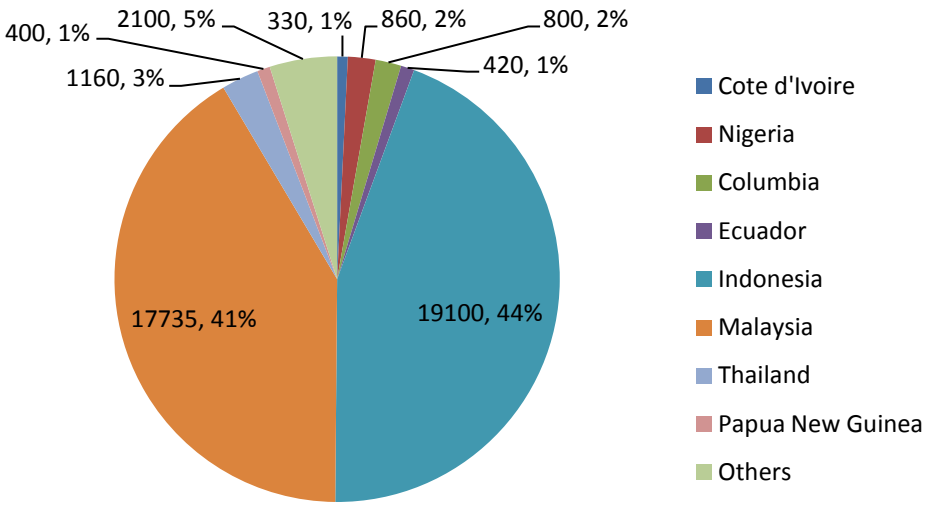

Figure 2. 1: Malaysia had produced 41.3% of world palm oil production in 2008

As the world's biggest exporter of palm oil, Malaysia accounted for 15.14 million tonnes (26.2%) of the global oils and fats trade in 2007. Its oil palm sector is

also seen as a beacon for sustainable development in agriculture (Yusof, 2007; Chan, 2003).

Although the industry is facing competitions from other edible oils produced by other countries, and the campaigns by soybeans society not to buy palm oil, it is expected that the prospect of this industry will be boosted further in the 90's, through the opening of several new markets especially Myanmar and Vietnam in Asia, Tunisia, Morocco and a few countries in Africa and South America Demand will also grow in many developing countries such as India, China and other European Union countries due to the tight supply condition of other fats and oils in the world market. In Malaysia, however, the high production cost of palm oil is mainly due to the high labour cost. Presently, labour cost in the plantation is about 30 to 35% of the total production cost (Turner and Gillbank, 1982).

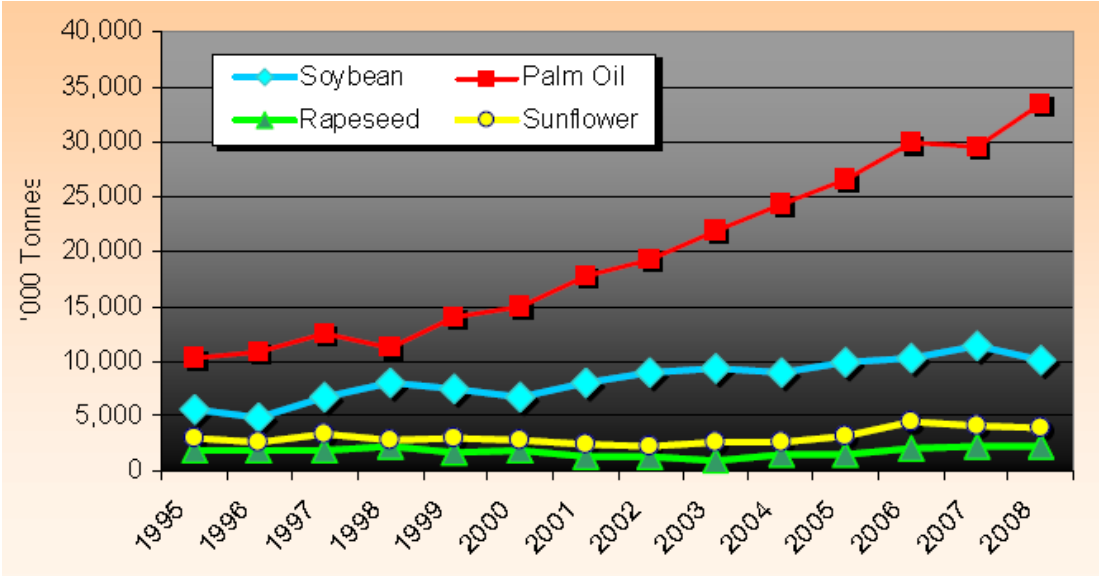

Figure 2. 2: Export trend of major oil until 2008 (MPOB, 2008)