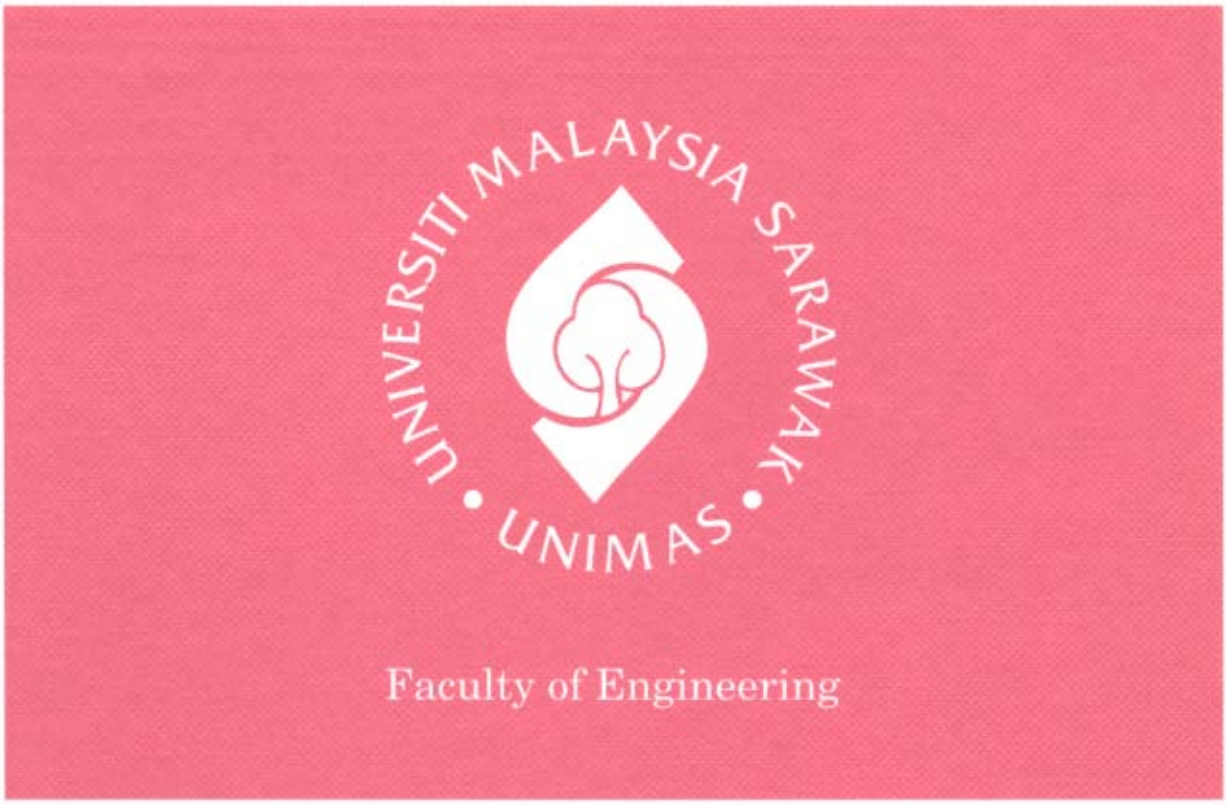

BIOMASS CONVERSIONS FROM AGRICULTURE WASTES; POTENTIAL OF BIOMASS RESOURCES IN SARAWAK

Liew Fui Fath

Bachelor of Engineering with Honours
(Mechanical Engineering and Manufacturing Systems)
2006

Universiti Malaysia Sarawak

BORANG PENGESAHAN TESIS

Judul: BIOMASS CONVERSIONS FROM AGRICULTURE WASTES; POTENTIAL OF BIOMASS RESOURCES IN SARAWAK.

SESI PENGAJIAN: 2005 - 2006

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BIOMASS CONVERSIONS FROM AGRICULTURE WASTES;

POTENTIAL OF BIOMASS RESOURCES IN SARAWAK

LIEW FUI FATH

Thesis Submitted to the Faculty of Engineering,

University Malaysia Sarawak

as a partial fulfillment of the Degree of

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(Mechanical Engineering and Manufacturing System)

2006

To my beloved parents and family members.

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ABSTRACT

Biomass is a naturally renewable resource from biological origin that appears naturally and repeatedly in the earth's surface is considered as a form of stored solar energy through the photosynthesis process in the growing plants. Biomass industries can revitalize rural economics, increasing energy independence, reducing pollution and created job opportunity in the rural area. Malaysian 5th Fuel Policy can be achieved, especially in Sarawak due to its abundant large amount of biomass resources mainly from agriculture waste and forestry residues. The potential biomass resources in Sarawak are wastes generate from oil palm, cocoa, paddy, coconut and residues from forestry residues such as woodchips. This project is about the biomass conversions from agriculture wastes and the potential biomass resources in Sarawak. The main concern of this project is to find out the potential biomass resources in Sarawak based on the statistic from the Department of Agriculture Sarawak. The heat value and moisture content of the selected samples is then determined by using bomb calorimeter. The result of the laboratory work could be a useful data to estimate the total potential biomass energy derived from these selected samples. These results also provide useful data as a criterion for the selection of suitable biomass conversions routes which could optimum the bioenergy conversion efficiency.

ABSTRAK

Biomass adalah sumber tenaga semula jadi yang boleh diperbaharui yang muncul di permukaan bumi. Biomass adalah sejenis simpanan sumber tenaga matahari dalam tumbuhan melalui process fotosintesis. Industri Biomass boleh merangsang economi kawasan luar bandar, mengurangkan kebergantungan kepada sumber tenaga tidak boleh diperbaharui, mengurangkan pencemaran dan menyumbang peluang perkerjaan. Polici Tenaga Kelima Malaysia boleh dicapai, terutamanya di Sarawak yang mempunyai sumber biomass yang banyak. Sumber biomass yang berpotensi di Sarawak adalah sisa-sisa daripada kelapa sawit, kelapa, koko, padi dan sepihan kayu. Projeck ini adalah tentang teknologi petukaran sumber biomass daripada sisa-sisa pertanian dan potensi sumber biomass di Sarawak. Objektif projeck ini ialah mengenal pasti sumber biomass yang berpotensi di Sarawak dengan berpandukan statistic daripada Jabatan Pertanian Sarawak. Sumber biomass yang terpilih akan dibawa untuk menentukan 'heat value' serta kandungan kelembapan di dalamnya dengan menggunakan 'bomb calorimeter'. Keputusan eksperimen ini boleh memberi informasi yang berguna untuk mejangka tenaga biomass di Sarawak. Keputusan ini juga memberi informasi berguna sebagai panduan biomass penukaran teknologi yang sesuai untuk sisa-sisa buangan pertanian, di mana pemilihan biomass penukaran teknologi yang sesuai akan mengoptimumkan tenaga biomass.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO BIOMASS

Biomass, a very broad term is defined as a form of renewable energy from the biological origin material especially the organic matter from growing plants, animal manure, municipal solid waste (MSW) and industrial and forestry residuals on the Earth's surface. According to G.N Tiwari & M.K Ghosal **[1]**, biomass is a naturally renewable resource which implies that it is the part of the flow of resources occurring naturally and repeatedly in the environment. In many ways biomass can be considered as a form of stored solar energy through the photosynthesis process in the growing plants. The term bioenergy is referring to the energy derived from biomass resources such as wood, straw and animal wastes. A fuel is any material that can be burned to release thermal energy and biofuel is the fuel that derived from the biomass resources. The concept of production of synfuel derived from biomass resources is represented in **Figure 1.1** below.

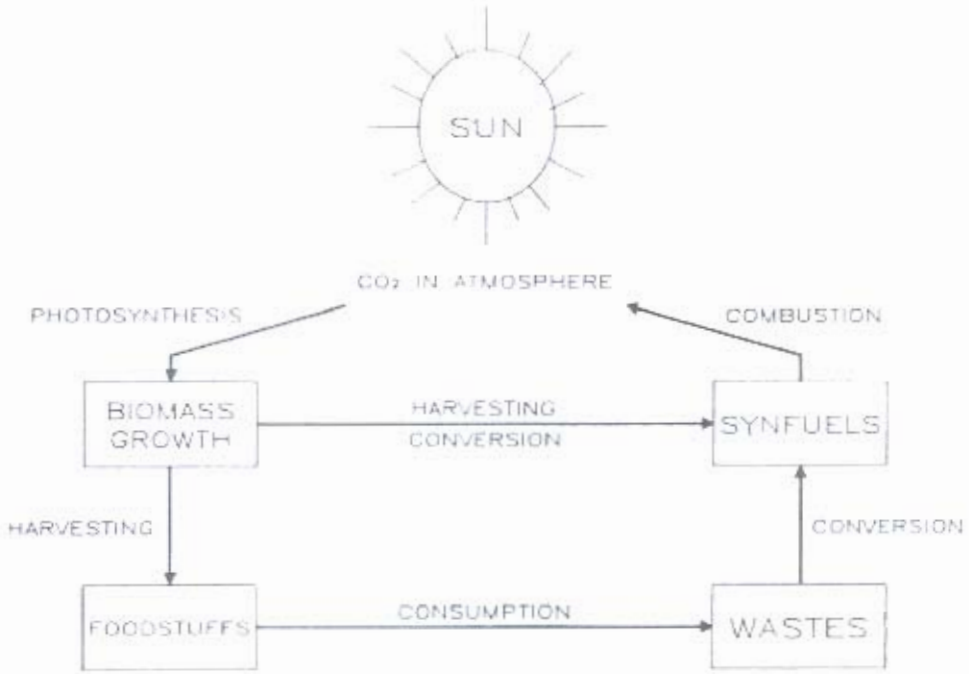

Figure 1.1: Schematic Representation of Synfuel Production From Biomass. [2]

As fossil fuels prices increase and global warming due to excessive emission of greenhouse gas from coal power plant, finding new energy sources became increasingly important. Moreover these fossil fuels will be exhausted very soon. Therefore, technologies on renewable energy such as bioenergy, wind energy, solar energy, geothermal and hydro energy have to develop.

Biomass can be converted to useful energy through various biomass conversion technologies, such as direct combustion, fermentation, gasification and pyrolysis. Biomass can be burned to produce steam for making electricity, or to provide heat to industries and homes. Biomass also can be converted to other usable forms of energy

called biofuel like methane gas or transportation fuels like ethanol and biodiesel through various biomass conversions technologies such as gasification and fermentation.

Biomass is an important source of energy in developing countries. In ASEAN (Association of South East Asian Nations), energy from biomass such as wood and agricultural residues represents about 40% of its total energy consumption. According to Food and Agriculture Organization of United Nations (FAO) **[3]**, for the five ASEAN countries (Indonesia, Malaysia, Philippines, Thailand and Vietnam) biomass consumption increased on average 2% per year between 1985 and 1994, due mainly to population growth. Despite this growth, the share of biomass energy in total energy consumption in ASEAN nations has been decreasing due to the great depends on fossil fuel.

In the Eighth Malaysian Plan, Malaysian Government has commended formulating a new energy policy to include utilizing renewable energy (excluding hydroenergy) as a fifth energy resource**[4]**. Biomass energy has the potential to supply a significant portion of Malaysia's energy consumption since Malaysia produce million tones of wastes annually, mainly from the agriculture wastes and forestry residues. Moreover, with proper management, biomass industries can revitalize rural economics, increasing energy independence, reducing pollution and created job opportunity in the rural area.

1.2 AGRICULTURE AND FORESTRY ACTIVITIES IN MALAYSIA AND SARAWAK

Malaysia is well known for its agriculture activities and agro-industrial business. Malaysia is the largest palm oil producer in 1994, produced about 51% of the of world production of palm oil. Sarawak as the largest state in Malaysia, have the largest agriculture land use. Major agriculture commodities in Sarawak are oil palm, rubber, coconut, cocoa, paddy and pepper. The major export of principal agriculture products from Sarawak and the planted area of main crops in Sarawak are shown in the **Table 1.1** and **Table 1.2**.

Table 1.1: Export of Principal Agriculture Products in Sarawak (Tonne), 1998-2003.

Year	Rubber	Pepper	Cocoa	Crude Palm Oil	Palm Kernel Oil
1998	4688	18888	4467	313469	17767
1999	2731	22131	3583	433768	14591
2000	1808	24033	3176	487640	13001
2001	2704	25897	1518	613410	12369
2002	5247	23225	2496	694144	9787
2003	15049	19023	2583	847818	10417

Table 1.2: Planted Area of Main Crops in Sarawak (Ha), 1997-2002

Main Crops	1997	1998	1999	2000	2001	2002
Rubber	173567	174993	170172	168523	169542	149729
Pepper	10178	11373	12196	13327	13555	13644
Paddy	126500	127614	131608	130881	124644	127634
Sago	59467	58041	60550	60709	61523	
Coconut	25590	25683	26334	25578	25186	24847
Oil Palm	147007	248430	320476	330387	374828	414260
Cocoa	16031	13283	10895	6832	5731	4688
Fruits	34944	36714	36538	36997	35455	
Vegetables	4639	4627	4456	3045	2827	

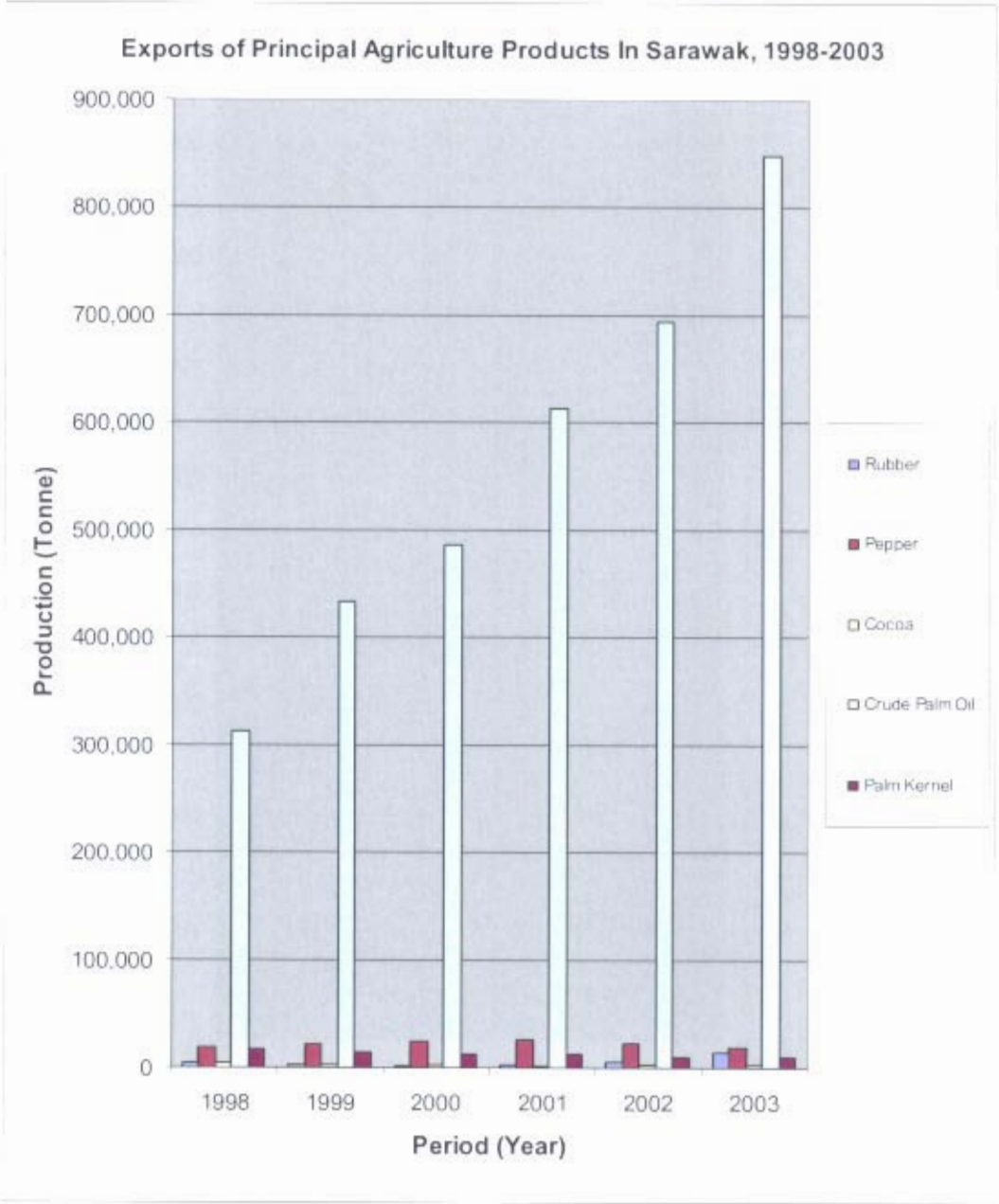

Figure 1.2: Exports of Principal Products in Sarawak (Tonne), 1998-2003

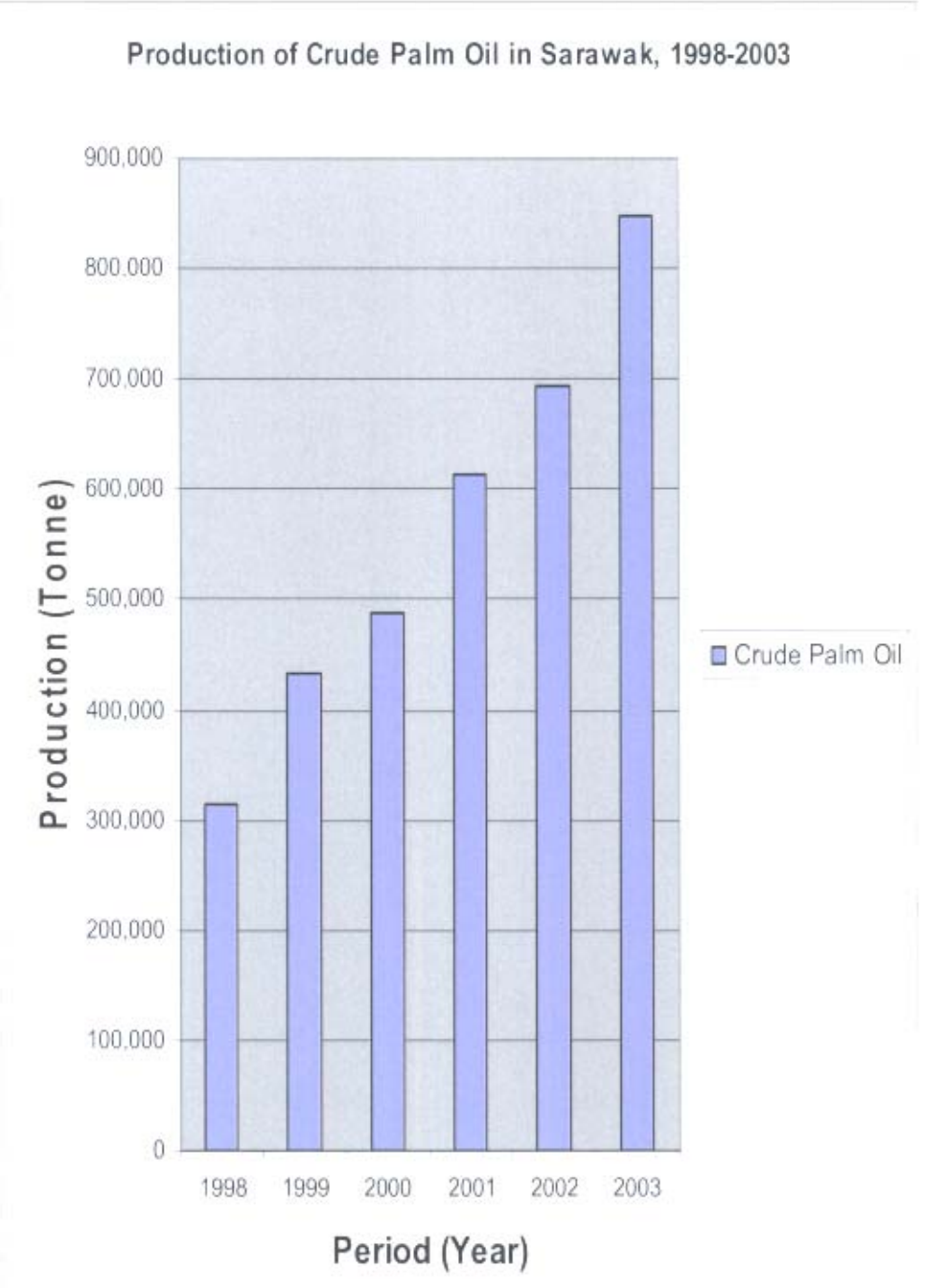

Figure 1.3: Production of Crude Palm Oil in Sarawak (Tonne), 1998-2003.

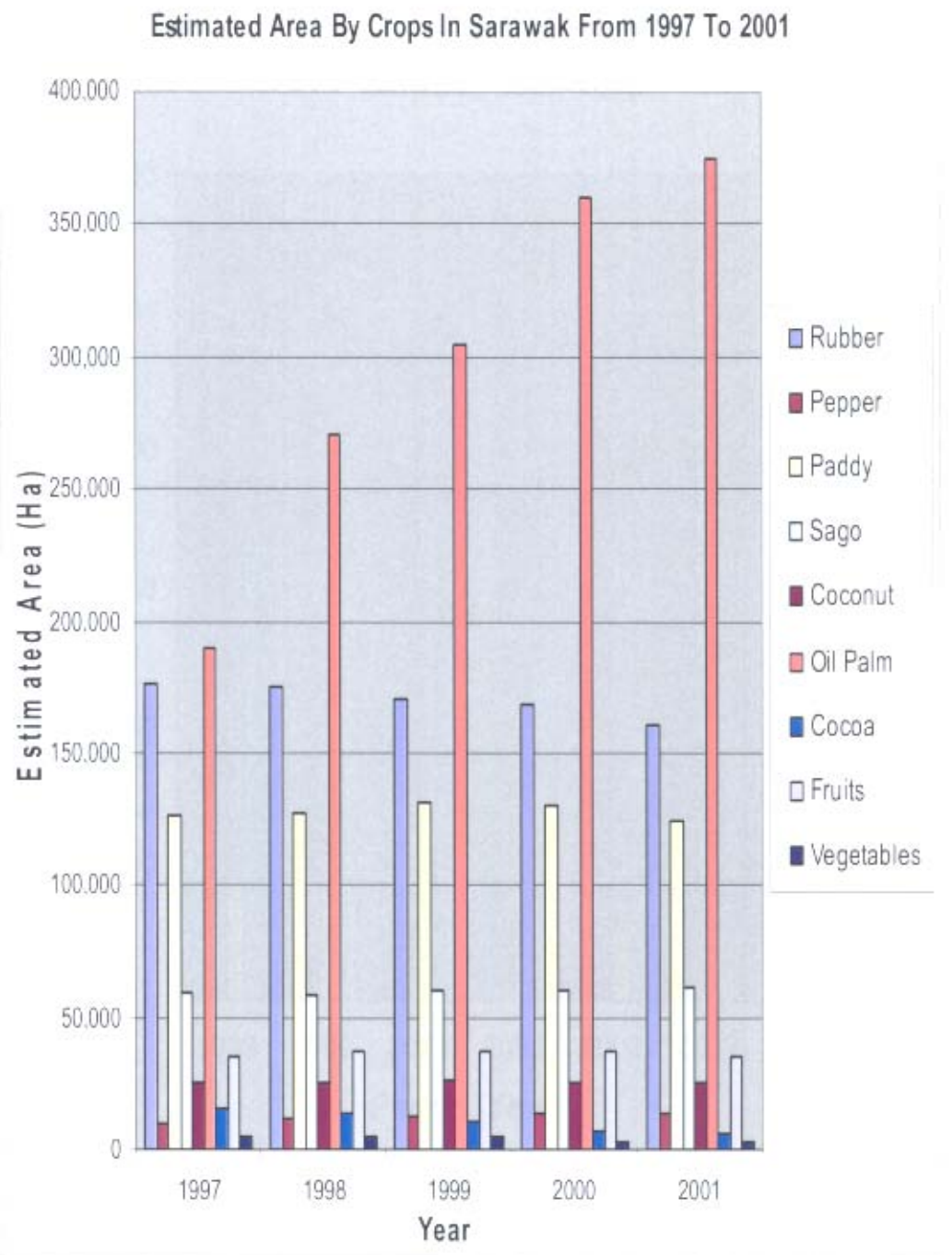

Figure 1.4: Estimated Area By Crops in Sarawak (Ha), 1997-2001

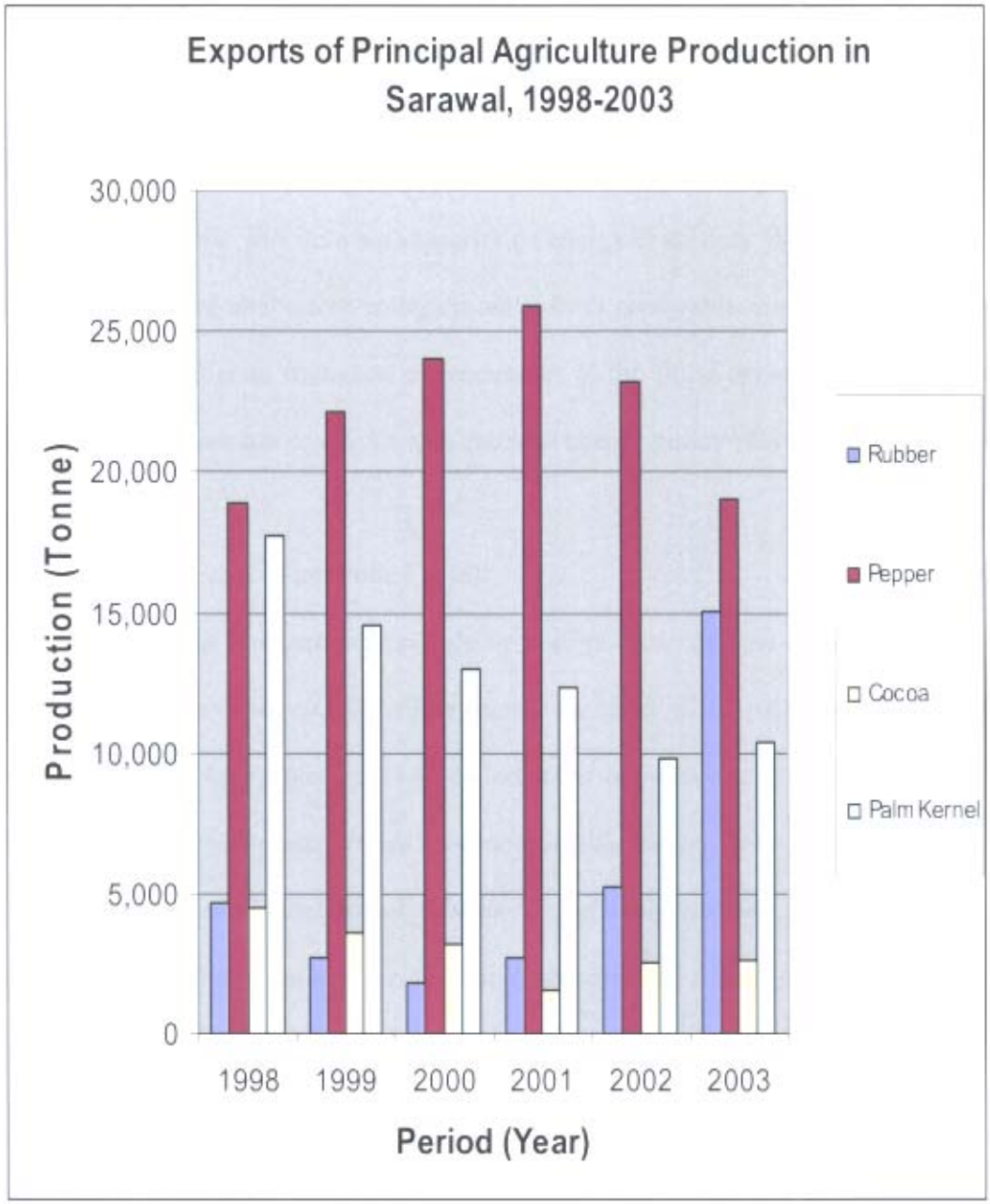

Figure 1.5: Exports of Rubber, Pepper, Cocoa and Palm Kernel, 1998-2003.

Sources: Statistical Year Book, Department Of Agriculture Sarawak, 2003